ONLINE PROFESSIONAL DEVELOPMENT FOR MATHEMATICS TEACHERS:

A STRATEGIC ANALYSIS

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EXECUTIVE SUMMARY

OVERVIEW

This study presents a strategic review of the current quality and effectiveness of more than 40 online professional development (OPD) sites for teachers of mathematics. We compared the evidence gathered about this relatively new form of professional development with evidence on the quality and effectiveness of traditional face-to-face professional development.

Individual sites incorporate features of OPD that collectively demonstrate the potential advantages of this new form of professional training. These features include OPD's convenience and accessibility; its capacity to tailor instruction to the individual learner; its video-based multimedia repository of best practices; and its ability to provide uniform, sustained, and mathematically rich, content-based training that is often missing from traditional teacher workshops.

However, this review did not find a single OPD site that provided independent evidence of its effectiveness. Moreover, existing OPD sites are still evolving and lack the capacity to demonstrate user progress that can be attributed to these tools. For example, they lack rigorous independent assessments of what teachers learned and how well teachers are able to apply their new knowledge in classroom settings.

This review of OPD is especially timely, as online training provides one way to meet the ambitious goals set by the *No Child Left Behind Act of 2001* to have a "highly qualified" teacher in every classroom by the 2005-2006 school year. OPD potentially can expose large numbers of teachers to high-quality, individually tailored training in mathematical content and pedagogy. Because it is part of the new and fast-growing field of e-learning, OPD may be more amenable to improvements than traditional teacher training programs. For example, in 2003, more than half of all two- and four-year postsecondary institutions already offered Web-based distance learning, representing three million enrollments in these courses (Waits and Lewis, 2003).

Analytic Approach

But how well does existing OPD for mathematics teachers incorporate its advantageous features? Is there evidence that OPD is currently more effective than traditional professional development workshops? Can promising features of OPD be identified that, if expanded, would enable this medium to better take advantage of its potential strengths?

This review provides new empirical evidence to address these questions of the quality and effectiveness of OPD compared with traditional training. To address issues of

quality, we applied an innovative framework drawn from learning theory. According to learning theory, good professional development is:

- *Learner-centered:* It addresses the learner's (teacher's) perspective with respect to their pedagogical and content needs as well as their extremely limited time for professional training.
- *Knowledge-centered:* It imparts research-based professional knowledge.
- *Community-centered:* It provides teachers with community learning opportunities.
- *Assessment-centered:* It assesses and provides feedback on teacher performance.

To assess the effectiveness of traditional face-to-face and online professional development, we looked for evidence of changes in teacher practices and improvements in student outcomes following participation in professional training.

This study examined OPD sites that are among the best known and that offer different types of professional training resources. These include:

- Certificated programs, which may be only online or combine online with face-to-face instruction, and which may be delivered synchronously or asynchronously (Part B, Exhibit B-1).
- Resource sites that provide teaching ideas, online courses, videos of master teachers, lesson plans, and other support materials for teachers (Part B, Exhibit B-2).

The study also examined different types of OPD providers, including state and local agencies (Part B, Exhibit B-3), higher education institutions, businesses, and foundations (Part B, Exhibit B-4).

Findings

The literature on traditional professional development for teachers of mathematics consistently finds that much of the training that teachers receive is of poor quality. The most common form of training is the one- or two-day workshop, which is heavily loaded with generalities about the teaching process and light on mathematical content. Most teachers do not change their instructional practices after workshops, and the training has little or no impact on students' mathematics outcomes (Porter, Garet, Desimone, Suk, and Birman, 2000).

This strategic review identified several serious limitations of current OPD sites, but also observed promising features that illustrate the potential for providing high-quality OPD on a large scale. Our review of OPD sites found that (Table I):

Table I. Summary of Findings on the Most Important Strengths and Weaknesses of Current OPD Sites for Teachers of Mathematics		
Area of OPD	**Current Weaknesses and Limitations**	**Current Strengths**
Overall Effectiveness	-No scientifically based evidence of changes in teacher practices or student outcomes.	-Some sites offer customer survey information or other anecdotal information as an indicator of satisfaction and OPD outcomes.
Learner-Centered Environments	- Without a single electronic access point, teachers must devote substantial time to discover sites with substantive and appropriate mathematics content. - Standards for design of OPD training are often unclear. -Few sites offer individualized initial assessments of teachers' mathematical content and pedagogical needs to guide selection of instruction.	-Allows teachers to access courses on their schedule and outside school, enabling teachers to enroll in mathematically rich coursework. -Expands range of professional development courses. -Allows for greater individualization in relation to teacher needs.
Knowledge-Centered Environments	-Little training is available in advanced mathematical content, such as for middle-school algebra or geometry teachers. -Few sites take advantage of online simulation capabilities.	- Some sites offer extensive introductory mathematics content. - Several sites offer extensive video-based multimedia material to illustrate good practice.
Community-Centered Environments	- Most discussion sites are not moderated, and amount to little more than chat rooms.	-Extends network from school community to national or even international peers. -Some sites offer problem-based discussions that focus discussions.
Assessment-Centered Environments	- Teacher participants may not be assessed at all and, when tested, they evaluate teachers' content knowledge but not their ability to apply what they have learned.	-Some sites offer individualized formative assessments to adapt instruction to learning.

- OPD currently lacks evidence of its *overall effectiveness*. None of the more than 40 reviewed sites provided any independently collected data on teacher or student outcomes. Most presented no evidence, although a few included information from customer-satisfaction surveys. As a result, OPD sites cannot reasonably claim that they are more effective than traditional professional development in improving teacher quality.

- OPD currently has clear strengths in providing training that is tailored and accessible to the needs of the individual teacher of mathematics (i.e., *learner-centered*). OPD is accessible anywhere, at anytime, and does not have to fit within a few professional development days. The expanded access to nationally available courses has meant that teachers more readily can obtain training that *fits their particular educational needs.* For example, the uncertified middle school math teacher can benefit from an in-depth algebra course provided by the Southern Regional Education Board (Part B, Exhibit B-2). The under-certified elementary school teacher can find Connected University's overview course on teaching K-2 mathematical topics (Part B, Exhibit B-3). In addition, teachers with varied mathematical backgrounds can

benefit by utilizing online mathematics *resources*, including lesson plans, teaching strategies, and student problems, such as those presented by the Math Forum or PBS Teacher Line (Part B, Exhibit B-2).

However, searching the Web and identifying quality OPD sites is a time-consuming process. In addition, many sites fail to specify standards for the selection and development of their content and pedagogy – essential information to aid teachers in judging course quality and usefulness.

- Despite OPD's potential strengths in providing rich, research-based (i.e., *knowledge-centered*) instructional content, most current sites could take better advantage of OPD's distinctive instructional features. On the positive side, courses typically extend over several months, compared with several-day workshops, and provide opportunities to learn significant amounts of mathematics. A number of sites, such as those of the George Lucas Educational Foundation, LessonLab, and Mathline (Part B, Exhibit B-2) have successfully used videos of outstanding teachers and others to demonstrate classroom practices from around the United States and the world.

  On the other hand, most instruction is quite traditional, and fails to take advantage of OPD's potential to illustrate mathematical concepts and immerse teachers in simulated classroom situations. Two notable exceptions are the National Council of Teachers of Mathematics' Illuminations applets and ExploreLearning's graphical simulations (Part B, Exhibit B-2). None of the reviewed sites offered simulated environments for teachers to learn and demonstrate instructional approaches.

- Existing OPD is weak in providing teachers with opportunities to network with their peers (i.e., *community-centered*). Although most evidence is anecdotal, one study of teacher networks in a major OPD reading program found that teachers rated online networking among the least useful of all program components (Haslam, 2003). In many cases, OPD networks amount to little more than an opportunity for chat. However, a few sites offer innovative, moderated discussions. An example is the Math Forum, which offers moderated discussions focused on concrete instructional problems; some begin with video examples of classrooms that show how different teachers approach the problem.

- OPD currently has clear weaknesses in assessing and providing feedback on the learner's performance (i.e., *assessment-centered*). Participants do not have a formal opportunity to practice what they learn and receive feedback to improve their practice. Some programs have no formal course assessment, and only require written homework, completion of a project, and regular participation. Research shows that teachers are more likely to use their training if it includes practice, observation, and feedback (Corcoran, 1995).

Suggested Action Steps

If OPD is to reach its full potential, it must be evaluated for effectiveness, and it must be used in ways that incorporate its strengths and potentials while correcting its current weaknesses and limitations (Table I). **Based on our review, we recommend that the following action steps be considered by the federal government, states, universities, and the private sector:**

- **Professional organizations develop voluntary *OPD standards* of quality for teacher learning in mathematics and other subjects.** The standards would provide guidelines for developing OPD courses that are learner-centered, knowledge-centered, community-centered, and assessment-centered, along with meeting more technical requirements associated with online learning. This effort could build on existing voluntary national standards, such as the National Education Technology Standards for Teachers (NETS-T) developed by the International Society for Technology in Education; these standards guide teacher preparation in using technology and have been adopted by many states.
- **Professional organizations with federal or state support create an OPD *portal*.** The portal would provide independent, objective information on the quality of online programming in math and science, using a standard format that shows key program features. This would provide a single place to find out about and compare similar programs as well as obtain available evaluation information.
- **The federal government *evaluates the impacts* of OPD, using objective and independently collected data.** The federal government has a responsibility to support evaluations of OPD sites since they provide training and resources that are available in all states. A number of OPD sites in mathematics also receive federal support through No Child Left Behind (NCLB)-funded programs. The federal government should determine whether it is feasible to evaluate the results of current grantees, and it should build rigorous evaluation requirements into all new grants for OPD.
- **The federal government conducts *research* to systematically determine what are effective and ineffective methods of delivering OPD.** The federal government could establish a strong research and development effort to learn how to build on OPD's convenience, breadth and reach, simulations, and ability to offer individually tailored instruction. Researchers could investigate how to initially assess teacher knowledge and learning styles to guide course content and pedagogy. Intelligent agents that learn from experience could be studied for their capacity to automatically adjust instruction to address the teachers' learning progress. Research could test the value of simulating both classroom settings and various student educational needs, which is not feasible in conventional workshops. Cost-effectiveness research—at the stages of development, delivery, and sustainability--would shed light on the relative advantages of OPD versus face-to-face professional development.

- **Federal and state governments collect *current statistics* on OPD.** The federal government should collect comparable and current national statistics on the universe of available OPD, participation, and reasons for using OPD in mathematics and other core subjects. States in which significant OPD is already widely used should collect basic evaluative information, including participant characteristics, the nature of online course work, completion rates, and user satisfaction.
- **OPD providers address clear *weaknesses of current OPD*.** OPD providers need to do a better job of assessing participants' progress in applying what they have learned. Having participants videotape their teaching is one way that authentic online assessments might be carried out. Another way is to develop simulated online teaching situations. Alternatively, teachers might agree to a review of their classroom practice by an expert teacher or principal, or OPD providers could adopt a blended approach that combines online instruction with face-to-face workshops. OPD providers also should take better advantage of the potential of online communities of practice through facilitated discussions, problem-focused discussions, and joint project work such as judging the quality of student work.
- **Providers with federal or state support develop more *mathematically advanced OPD programs.*** A focus on uncertified or under-certified math teachers would directly help teachers who have the greatest need for in-depth math support. This effort should seek to involve colleges and universities because, as providers of pre-service training, they can offer teachers rich, in-depth, in-service coursework online. These courses could take advantage of an already strong online course presence among many colleges and universities. The publishers of mathematics textbooks and curriculum materials also logically would have a comparative advantage in being able to link the professional training they offer online to the teaching of specific mathematical content. Through online training, textbook publishers could reach and train their customers in a way other than through the current, highly decentralized, face-to-face delivery system.

In conclusion, a multi-level, coordinated initiative to strengthen OPD in mathematics could spearhead reform of teacher professional development in general. The online investment is already considerable, and the field, although still young, is well-positioned to incorporate the best from research and practice. However, it must be willing to invest in quality, assess its effectiveness, and consider how this powerful learning tool might be combined with face-to-face workshops to offer the maximum potential to improve teacher quality and student outcomes.

PART A: STRATEGIC ANALYSIS

I. INTRODUCTION

Inadequate teacher knowledge and teacher preparation in mathematics is a major barrier to improving U.S. students' poor mathematics results. NCLB recognizes the need for "highly qualified" teachers in math and other subjects. The law requires each state to develop a plan to ensure that all teachers are "highly qualified" no later than the end of the 2005-06 school year. One way to help meet this goal would be to embark on a coordinated effort – among governments at different levels, higher education, and the private sector – to harness the benefits of online professional development (OPD), a comparatively new form of teacher professional development.

OPD is a promising vehicle for delivering training to teachers to strengthen their subject-matter knowledge and pedagogical skills. Teacher coursework online can be tailored more easily to individual needs than traditional, large workshops. Unlike face-to-face courses, teachers can conveniently participate at the time and place of their choosing, making it easier for them to enroll in long-term courses that provide them with the fundamental math and pedagogical content they need. Teachers also can see modeled practices from some of the best teachers around the country and throughout the world.

Mathematics is an area where realizing the potential benefits of online professional development is particularly urgent. There are approximately 1.5 million K-12 teachers responsible for mathematics instruction (Snyder, 2003). Most of these elementary school teachers, two-thirds of middle school teachers of math, and about one-third of secondary math teachers did not major in mathematics and are not certified to teach in mathematics. Many also lack necessary pedagogical skills to effectively teach math (McMillen, Henke, McGrath, and Cohen, 2002). Teachers who do not know math are not able to effectively teach it to others.

OPD could represent a model of excellence for delivering research-based professional development that would stand in sharp contrast with much of today's professional development in mathematics. Evaluations of the federal government's major program of professional development support for mathematics and science found poor-quality services that often consisted of "one-shot" workshops unrelated to classroom content (Garet, et al., 2001).

This strategic review of the rapidly changing field of OPD in mathematics provides a basis for gauging the scope, quality, and effectiveness of current OPD resources in mathematics and how it may be used to improve upon traditional professional development. An innovative evaluation framework, drawn from the science of how people learn, is used to examine the quality of professional development opportunities from four perspectives:

- How it addresses the teacher's *(learner's*) perspective with respect to their pedagogical and content needs and limited time for professional training;

- How it imparts research-based professional *knowledge*;
- How it provides teachers with *community* learning opportunities; and
- How it *assesses and provides feedback* on teacher performance.

This framework is innovative in explicitly linking professional development to what the learner brings to the training; what the training imparts to the learner; how the OPD learning process is connected to the larger education community; and what the learner learns from OPD. Using this framework, we examined approximately 40 OPD sites (See Part B) to assess how OPD in mathematics currently addresses these criteria.

Overall, although we find that OPD faces many challenges in providing high-quality professional development, particular sites already have some features that begin to meet the characteristics of high-quality OPD training. On the basis of these findings, strategies are suggested to build on demonstrated successes and bring greater coherence and effectiveness to the emerging field of online training for mathematics teachers.

Part A develops the strategic analysis leading to potential action steps to strengthen OPD, as follows:

- Section II develops a research-based framework of the characteristics of good professional development based on the science of learning.
- Section III describes the scope of the reviewed OPD sites that provide training programs and resources for teachers of mathematics.
- Section IV applies the research framework describing what constitutes good professional training to identify the current challenges and potential advantages of OPD compared to traditional face-to-face professional development in mathematics.
- Section V suggests strategic directions that would strengthen the fast-growing area of OPD to move it closer to achieving its potential for high-quality professional training.

Part B provides an extensive compilation of OPD sites by type of training and by sector offering the training.

II. DESIGNING PROFESSIONAL DEVELOPMENT AROUND THE SCIENCE OF LEARNING

Professional development should be designed to take into account the conditions in which teacher learning takes place. Teachers enter training to build up their mathematical and pedagogical skills. But teachers are often professionally isolated and do not have much time or adequate opportunities to expand their content or pedagogical knowledge, individually and collectively, informally and formally. As professionals, they also may be reluctant to acknowledge their shortcomings in math, although such personal assessment is critical to improvement. Improving teaching through training does not happen all at once, but develops with awareness, practice, feedback, and ongoing study.

Meeting these conditions requires innovative professional development. Developments in cognitive science about how people learn have produced powerful insights about learning environments that can be used to design new, more effective professional development strategies. Professional learning takes place within four different teacher-centered learning environments (Figure 1): learner-centered, knowledge-centered, assessment-centered, and community-centered (Bransford, J.D., Brown, A.L., Cocking, R.R.,2000; Merrill, M.D., 2003). Each of the four is described below.

This study applies this four-part framework to assess the evidence about the effectiveness and potential of OPD in comparison to traditional teacher training workshops.

Learner-Centered Environments

Teacher learning should be tailored to reflect teachers' needs. Among the most important teacher characteristics influencing student achievement are the teacher's content knowledge, pedagogical knowledge, and experience (Whitehurst, 2002; Rand 2003; Garet, et al., 2001).

The empirical evidence suggests that many U.S. teachers lack the necessary content knowledge in the areas of math that they teach (Gitomer, Latham, and Ziomek, 1999; Hiebert, et al., 2003). Under NCLB, a "highly qualified" elementary school teacher must demonstrate attainment of core knowledge. For example, relevant college course-taking could be a reasonable indicator of core knowledge. At the elementary school level, most teachers who teach math are education majors who take fewer math courses than the typical college graduate. On average, education majors take 6.3 credit hours of mathematics compared with the typical college graduate, who takes 8.3 credit hours (NCES, 2002). At many universities, these six credits are often earned in math classes that are not particularly rigorous because they are targeted to education majors.

At the middle and secondary school level, a "highly qualified" math teacher must hold or demonstrate the equivalent of a major in mathematics. Far fewer U.S. eighth-grade teachers are math majors compared with teachers in most higher-performing

countries. For example, 61 percent of U.S. eighth-grade math teachers had mathematics as their major field of study for their college or education degree, compared with 84 percent in top-scoring Singapore on the TIMSS (Mullis et al., 2000). Overall, only 32 percent of U.S. middle school math teachers and 69 percent of U.S. secondary school math teachers majored in, and were certificated in, math (McMillen, 2002).

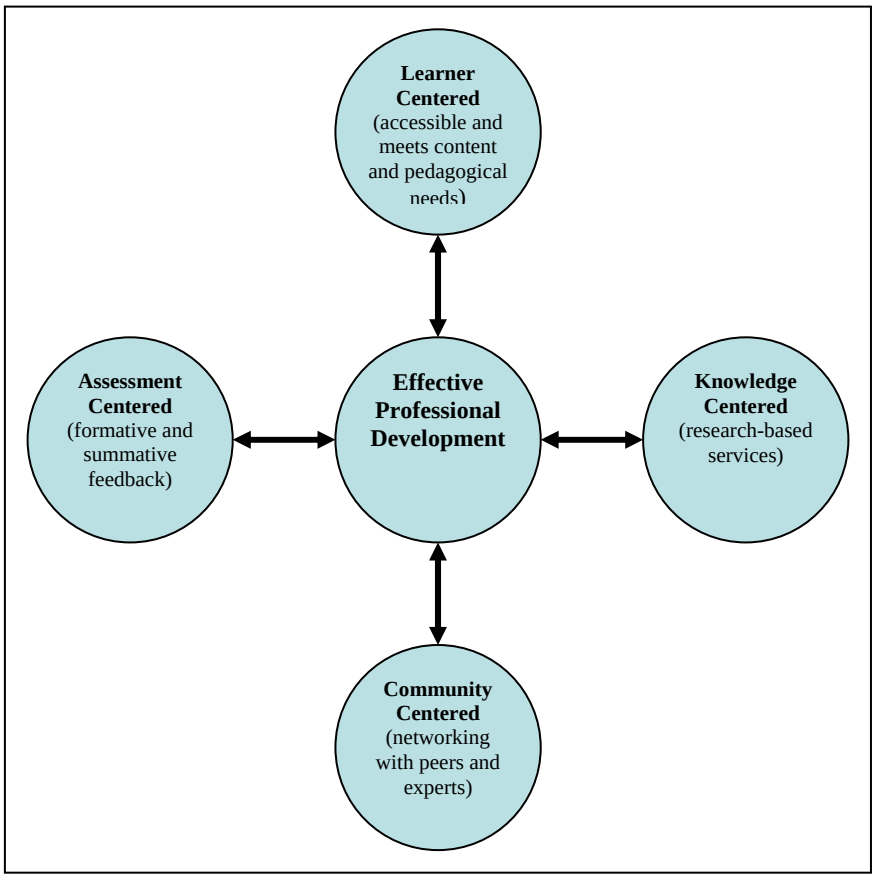

Figure 1. Perspectives on Effective Professional Development

Knowing math is not enough, as teachers also must possess the pedagogical skills to effectively teach students mathematical content. International comparisons of classroom data show that U.S. teachers emphasize the mechanics of learning math rather than building a solid conceptual foundation of mathematical understanding, which is more common among teachers in countries that perform well on comparative international assessments (Mullis et al., 2000). The TIMSS international video study of eighth-grade classrooms observed in U.S. classrooms that a smaller percentage of problems were solved in ways that made the connections among mathematical facts, procedures, and concepts than in any of the six other countries participating in the study (Hiebert et al., 2003). Although the precise effects of these pedagogical practices on differences in international achievement cannot be determined, a large body of research supports the need for sequential, in-depth teaching of mathematical topics, while making

connections with past learning (NRC, 2001; Bransford, Brown, and Cocking, 2000; Schmidt, 2002).

Similar conclusions were reached by Liping Ma's (Ma, 1999; Askey, 1999) comparison of approaches in Chinese and U.S. classrooms to four standard elementary school math problems. Chinese teachers developed rich story problems illustrating the application of mathematical principles and described the translation of story problems into mathematical expressions. Chinese teachers also connected mathematical ideas, building upon previously taught knowledge. In contrast, Ma found that U.S. teachers merely presented the formulas to solve problems and taught simple problem-solving skills.

Because so many U.S. teachers are poorly prepared to teach math, they need learner-centered training in mathematical content. Learner-centered professional development also should respond to the preconceptions that teachers bring to the classroom. In an effort to realize the ambitious goals of NCLB and strengthen the teaching of math, "teachers will have to unlearn much of what they believe, know, and know how to do, while also forming new beliefs, developing new knowledge, and mastering new skills" (Thompson and Zeuli, 1999).

It is important that learner-centered professional development address teachers' educational needs while adapting to the severe constraints on teachers' time. U.S. teachers do not have the luxury of teachers in many high-performing Asian countries where mathematics and other teachers may spend up to 30-40 percent of their time out of the classroom to prepare lessons, meet with students, or engage in training (NECTL, 1994). In the United States, time spent away from the classroom for teacher development is often considered wasted time (Cambone, 1995).

Knowledge-Centered Environments

Knowledge-centered professional development employs research-based training approaches to help teachers better understand the math content they teach, and learn effective ways to teach it. Research evidence generally suggests that sustained professional development focused on the content to be taught and aligned with state academic standards is likely to raise student achievement (Whitehurst, 2002; Garet, 2001). Summarizing the research, the National Research Council (2001) concludes:

> Professional development programs focusing on helping teachers understand both the mathematics of specific content domains and students' mathematical thinking in that domain have consistently been found to contribute to major changes in teachers' instructional practices that have resulted in significant gains in student achievement.

Several rigorous studies comparing content-based professional training with training intended to improve general teaching skills confirm these findings:

> Programs whose content focused mainly on teachers' behaviors demonstrated smaller influences on student learning than did programs whose content focused on teachers' knowledge of the subject, on the curriculum, or on how students learn the subject (Kennedy, 1998).

> When education improvement is focused on learning and teaching educational content, and when curriculum for teaching overlaps with curriculum and assessment for students, teaching practice and student performance are likely to improve. (Cohen and Hill, 1998).

Studies also show that professional development focusing on how students learn mathematical content is beneficial:

> These more successful programs tended not to be purely about the subject matter—i.e., they were not courses in mathematics but were about how students learn that subject matter (Kennedy, 1998).

Research also suggests that knowledge-centered professional development should immerse teachers in learning situations that help teachers understand how to apply what is being learned (Bransford, J.D., Brown, A.L., and Cocking, R.R., eds., 2000; Merrill, M.D.,2003). This includes:

- Focusing on problems or tasks that show how information can be used.
- Modeling practices that show how to apply information rather than only lecturing about mathematical concepts.
- Practicing using information in real or simulated contexts so that teachers learn how to teach content and overcome student problems.
- Applying the practices in their classrooms under supervised conditions with opportunities for feedback.

Elementary and middle school teachers need a firm grounding in mathematics, but they do not have to be mathematicians. Research suggests a threshold of necessary knowledge for teaching mathematics (NRC, 2001). The Longitudinal Study of American Youth estimated that student achievement typically increased with each additional college math course that their teachers had taken, but only up through five courses (Monk, 1994). In fact, large-scale studies using teacher self-reports of changes in practice conclude that changes in teacher practice are more likely to occur from exposure to content-based professional training (Garet, 2001). These studies suggest that these changes can bring about improved student outcomes (LeBlanc and Turnbull, 2001).

Community-Centered Environments

The community-centered perspective on the teacher learning process uses teacher interactions with other educators to provide teachers with additional sources of learning experiences and joint problem-solving opportunities, which are not usually experienced during formal workshop instruction. Teachers already depend heavily on their colleagues as a source of advice and instructional guidance -- more than on formal professional development courses (Feistritzer, 1999). But their current opportunities for interaction among their peers remain quite limited in time and limited to other teachers in their own school.

Teacher collaboration is often informal, as teachers discuss their experiences and reflect upon the transferability of others' experiences. An example is the co-teaching model in which a special education and regular teacher cooperatively teach, supported by common planning time and training (Arguelles, Hughes, and Schumm; 2000). Another example is the Houston Critical Friends Group (2003), which uses trained coaches to guide group members over a two-year period as they meet at least monthly to develop collaboration skills, reflect on their practices, and examine student work in order to improve student achievement.

Assessment-Centered Environments

This perspective uses different types of assessments to gauge whether teachers have learned and are able to use course content and pedagogy. Opportunities for teachers to practice and apply what they learn and to have their practice assessed and corrected are an essential part of good professional development. This is illustrated by one study of researchers who attempted to transfer model teaching practices from other researchers to teachers. Despite their theoretical understanding of the practices, feedback from other researchers and the participating teachers was essential to identify and correct serious implementation problems (Cognition and Technology Group at Vanderbilt, 1997).

Formative assessments should be employed throughout the training process to gauge teacher progress, and identify where reinforcement is needed. Summative assessments should be used to evaluate overall improvement in teacher practice and student academic outcomes.

Different forms of evidence on teacher performance used by the National Board for Professional Teacher Standards (NBPTS) to certify teachers include:

- Written tests to evaluate teachers' mathematical content knowledge.
- Videotapes or direct observations of teachers applying teaching practices in the classroom.
- Student work samples in areas related to professional development training.
- Student test scores evaluated in ways to show student improvements in the content areas that are the focus of training (NBPTS, 2003).

Teachers who participated in the National Board review process believe that going through the assessment process was beneficial, helping them develop stronger curricula, improving their ability to evaluate student learning, and helping them to use state content standards to improve teaching (NBPTS, 2001).

III: SCOPE OF CURRENT ONLINE PROFESSIONAL DEVELOPMENT (OPD) FOR MATHEMATICS

This section describes the scope of OPD and the sites that are reviewed to assess the strengths and weaknesses of OPD in relation to traditional face-to-face professional development in mathematics. E-learning opportunities are rapidly expanding in education, the workplace, the military, and other settings in the United States and abroad. These range from individual courses to fully accredited degree programs that utilize new and emerging information and communication technologies. It is estimated that individuals, employers, and other organizations have invested between $7 billion and $25 billion in online education and training activities by the end of 2003 (Grimes, 2000; Bassi and Van Buren, 1998).

Within the formal postsecondary education sector, the growth in distance learning has been remarkable (Waits and Lewis, 2003). Fifty-six percent of two- and four-year postsecondary institutions collectively offered approximately 118,000 different learning courses to more than three million students in 2001. Among these institutions, 34 percent had degree or certificate programs designed to be completed entirely through distance education.

Although there are no data on the total numbers of teachers using OPD, 1999 data on teachers' use of computers and the Internet for professional support suggest an enormous potential market. Among public school teachers, 59 percent used computers or the Internet to gather information for lesson plans; 50 percent to network with colleagues; and 37 percent to access research and best practice examples. Current figures are surely much higher (U.S. Department of Education, 1999).

Major OPD providers take advantage of its convenience and accessibility by offering courses that expose teachers to extended mathematical content, especially in introductory mathematical topics. Through video, some OPD sites show practices from some of the nation's and the world's best teachers. A few sites also can link teachers with other teachers around the country through facilitated discussions.

Our scan of professional development efforts for teachers of mathematics reveals that, while online training is still a new approach, efforts to expand these offerings are well under way. This review organizes online professional development activities by type (i.e., program and resources) and sector (i.e., whether the online provider is associated with state or local education agencies or nongovernmental entities in academia or the business sector).

The selected OPD programs are not intended to represent the complete universe of each type of site but rather include many of the major sites that illustrate the range of offerings currently available. Part B of this paper includes detailed descriptions of OPD by type and sector. The following overview and the site details in Part B portray an expanding field, with an enormous array of sites with differing purposes and content. While they offer many choices, they remain a patchwork of individual courses that lack

easy accessibility, full coverage of K-12 math topics, pre-course assessments, and full acceptance by school administrators.

OPD by Program and Resource Types

Programs for OPD in Mathematics (See Part B-I for site details). Professional development efforts that are classified for the purpose of this review as "programs" offer comprehensive training materials and modules, supplemented by some combination of teacher(s) or facilitator(s), print materials, video(s), and online communities. OPD programs are a major source of sustained, in-depth training for teachers who need to substantially upgrade their mathematical skills for a particular grade level or topic. Importantly, all of these programs offer course credit toward a graduate degree or re-certification.

Within the general scope of providing substantial OPD content, the selected sites are strikingly diverse in their offerings, differing in:

- Size, with some sites tailored to a broad audience of 80,000 participants and others to only a few thousand.
- Classroom settings, which may be only virtual or combine virtual with real instruction, delivered synchronously or asynchronously.
- Interactivity, with some individualized courses offering little interaction, and others incorporating extensive student discussion groups.
- Instructional methods, including best-practice approaches, examinations of case studies, lesson plans, and video clips.
- The scope and nature of course offerings, with some focusing heavily on how to integrate technology into mathematics instruction, others presenting broad overview courses for math teachers, and still others focusing on specialized subjects such as algebra.
- Their alignment with specific state, local, or national standards.

In part, this diversity is a reflection of differences among the array of site providers, which include textbook publishers, public broadcasting stations, and state cooperatives that often are associated with universities. Several sites receive federal funds that do not set content priorities.

Resources for OPD in Mathematics (See Part B-II for site details). For the purpose of this review, "resources" provide ideas, teaching strategies and learning activities rather than intensive professional development. They include online learning courses, videos of master teachers, lesson plans, and other support materials for teachers faced with the question of "what to do Monday morning." As opposed to OPD programs, resources do not offer course credit toward a graduate degree or re-certification. A scan of the online resources for teachers of mathematics reveals some interesting approaches:

- Videos of exemplary teaching practices are taking center stage on some sites, as OPD takes advantage of the visual nature of the Web as a medium of instruction. LessonLab, a pioneer in developing video lessons, has an extensive international library of teaching practices that enables U.S. teachers to compare mathematics practices with teachers from higher-performing nations.
- Online communities (both moderated and un-moderated discussion forums) are proliferating, as chat rooms are easy to set up. As noted, research identifies other teachers as one of teachers' major sources for advice.
- Lesson plans submitted by teachers and other educators have also multiplied, typically providing discrete, structured, short- or long-term projects organized around grade bands and mathematical standards.
- Several resource sites offer more in-depth treatment of mathematics topics by using examples of student work, student and teacher self-assessments, or studies and evaluations of intervention strategies.

Major providers of OPD programs frequently support separate resource sites. Foundations with an information-technology focus, such as the George Lucas Educational Foundation, also offer videos of best practices that include mathematics instruction. In addition, partnerships are starting to form among the major providers of online program and resource materials -- e.g., LessonLab and Connected Math – to bring together the advantages of each within a single site.

OPD by Sector

Selected SEA- and LEA-Level Online Professional Development for Mathematics Teachers - (See Part B-III for site details). Most professional development is still provided in traditional face-to-face settings (NSCD, 2001). Many states and districts may be reluctant to use other delivery methods without further evidence of their effectiveness. This initial scan of selected state education agencies (SEAs) and local education agencies (LEAs) indicates a slow but steady rise in the use of online professional development for teachers of mathematics.

Many online offerings enable participants to exchange ideas with leading experts in their content areas, observe classrooms of exemplary teachers via videos, receive coaching from mentors, and access virtual libraries of instructional resources and information. Yet, these initiatives remain at an early stage of development.

- A few states, such as Arizona and Louisiana, are leaders in the use of e-learning for professional development. In Arizona, teachers have been able to use online instruction to support a portion of their recertification requirements, and teachers are now able to use online instruction to attain math certification.
- Several urban school systems with low student mathematics scores are partnering with online sites to tailor instruction to support system reforms.

- State and local agencies that are leading in the use of e-learning for professional development most frequently partner with non-public online providers rather than fund their own courses. An exception is Michigan, which is creating a partnership with its virtual university.

Higher Education, Corporate and Business Training, and Foundations (See Part B-IV for site details). The potential for online professional development can be seen in the education and training developed by leading-edge online providers in higher education, the business sector, and information-technology related foundations.

Higher education is being revolutionized by e-learning. According to a 1999 report by the International Data Corporation, more than 85 percent of two- and four-year colleges were expected to include online course options by 2002. These consist of both credit and non-credit courses, including full degree programs. This review focuses on institutions that offer online certificate and/or degree programs rather than just selected courses.

A report by the American Federation of Teachers identified three main types of institutions:

- *Established higher education institutions*, which have broadened their offerings to include professional development and corporate executive education programs. Higher education training courses are able to build on a large base of undergraduate and graduate courses, suggesting the potential for widespread higher education-based OPD for teachers.
- *Corporate-university joint ventures*, which have developed course-management systems, or platforms, that enable colleges and universities to offer their online courses.
- *Full virtual universities*, which operate without the traditional brick-and-mortar campus, often specifically targeting the training needs of working adults.

The *business sector* has moved toward technology-enriched, just-in-time training, while decreasing reliance on face-to-face settings (Berge, 2001). More than 2,000 corporate universities offer training throughout the world, and a recent survey of businesses found that 78 percent of respondents identified e-learning as an essential part of their companies' blended learning strategy.

Foundations affiliated with technology corporations often provide training to students and teachers on state-of-the-art uses of technology. These programs generally combine online components, written materials, and face-to-face interaction to help teachers integrate technology in the classroom in applied subjects, including mathematics.

IV. ASSESSING THE QUALITY AND EFFECTIVENESS OF FACE-TO-FACE AND ONLINE PROFESSIONAL DEVELOPMENT

This section explores what we know about the *current challenges* and *potential advantages of OPD* compared with face-to-face professional development in achieving the four characteristics of good professional training identified above (See Figure 1). The analyses of OPD are empirically derived based on the approximately 40 OPD sites reviewed for this study (See Part B). The evidence about the current quality and effectiveness of OPD in mathematics should be judged against what we know about similar evidence for traditional face-to-face professional development. Because this report is focused primarily on assessing OPD, the discussion of face-to-face professional development in mathematics only highlights the extensive literature on the quality of face-to-face professional training.

Traditional Face-to-Face Professional Development Workshops

Unfortunately, a broad body of evidence suggests that current professional development to improve the teaching of mathematics does not meet even minimal standards established by research for teacher professional development. For the most part, the evidence suggests that current professional development experiences result in minor improvements in teacher practice and student learning. Typical face-to-face training consists of a one- or two-day workshop that is woefully inadequate in effectively training teachers and improving instruction.

Unlike their peers in high-performing Asian countries, U.S. teachers do not have several hours each day to prepare lessons or devote to personal improvement. Short-term workshops are well-suited to requirements to find substitute teachers and school calendars with a few allotted professional development days. This form of training is *learner-centered* only in the sense of meeting a teacher's time constraints. It is not learner-centered when considering math teachers' need for exposure to rich mathematical content and pedagogy.

A typical professional development scenario consists of:

> Several times a year, school administrators release students for a half or full day and hold an "in-service" program that may or may not be relevant to teachers' professional development needs. . . Teachers typically . . . leave with some practical tips or useful materials. There is seldom any follow-up to the experience and subsequent in-services may address entirely different sets of topics. (Corcoran, 1995).

Even in a reform-minded state such as California, Cohen and Hill (1998) found that less than half of California teachers in grades 2-5 were exposed to professional development in mathematics during the school year. This was particularly disappointing because California recently had introduced new mathematics reforms and might be

expected to expose teachers to more content-driven training than other states. Moreover, the training that California teachers received lacked the intensity and duration of solid *knowledge-based* training. Half of all California teachers spent a day or less in a workshop, and another 35 percent between two and six days. Among all teachers, less than 5 percent attended a workshop that was a week or more in duration. Cohen and Hill also found few *community-centered learning opportunities* in which teachers can participate in networks supporting reforms.

The disappointing California findings were echoed in a national evaluation of the federal government's half-billion-dollar Eisenhower Professional Development program to support teacher training in mathematics and science:

> The average time span of a professional development activity was less than a week; the average number of contact hours was 25, and half of the teachers were in activities that lasted 15 hours or less; most activities did not have collective participation or a major emphasis on content; and most activities had limited coherence and a small number of active learning opportunities. . . Nationwide, the typical professional development experience was not of high quality (Porter, Garet, Desimone, Yoon, Birman, 2000).

Only about half of the Eisenhower-participant teachers even changed their classroom practices as a result of their professional development, and these changes were generally too small to affect student outcomes. A direct relationship was observed between changes in teachers' mathematical practices and the duration, intensity, and frequency of exposure to content-focused mathematics training (Porter, Garet, Desimone, Yoon, Birman, 2000).

The poor quality of much current professional development for math teachers is one reason why it is so important to realize the potential of OPD. The following sections examine the current challenges and potential for OPD to better meet our four criteria for good professional development.

Learner-Centered Environments in OPD

OPD offers some clear advantages in tailoring training to each teacher's educational needs and schedules, although traditional training requires less self-discipline, and some learners would benefit from classroom interactions (See Table 1). Unlike face-to-face professional development, which draws primarily from local resources, teachers potentially can draw from OPD providers nationwide to find training most aligned to their education needs and that is accessible 24/7. But the site reviews demonstrate that the current practice of selecting OPD from the patchwork system of existing OPD providers is far from ideal in a number of ways.

Information on site content is hard to come by. Teachers have to search the Web to identify potential training programs and dig deep into sites to find course descriptions, which differ in their specificity and usefulness. Typically, university courses for credit

provide more highly detailed course syllabi than shorter-term "tune-up" courses, whose description may include little more than course titles.

OPD courses generally *do not require or offer formal pre-course assessments* that could help diagnose teachers' mathematical or pedagogical knowledge and guide course selection. Current OPD courses also *have incomplete coverage of K-12 mathematics topics*. For example, some rely on secondarily produced course materials, often funded by federal government grants, and topic coverage depends upon what grantees funded rather than a systematic assessment of course content needs.

Control over funds and *course approval remains largely in the hands of central district and school staff*, who are not likely to allow teachers to take advantage of the extended learning opportunities offered by OPD. Two-thirds of teachers indicate that they currently have little discretion over the content or form of professional development they take (U.S. Department of Education, 1994). If we do not fundamentally change the system from externally approved professional development courses that do not align with teacher needs, teachers will be unable to take advantage of new, content-rich online professional development and it will not be integrated into a sustained professional development plan (Elmore, 2002).

Table 1. Learner-Centered Environments: Advantages and Challenges of Face-to-Face and Online Professional Development

Factors in Accessing OPD	Face-to-Face Professional Development		Online Professional Development	
	Current Challenges	**Potential Advantages**	**Current Challenges**	**Potential Advantages**
Opportunities for Learning	-Opportunities for learning are predominantly determined by geographic region.	-Opportunities for learning are centrally determined to align with district and school priorities, and sign-up is simple.	- Information on site content is hard to come by. -Central control over professional development funds limits teacher choices. - Aligns primarily with national NCTM but makes no adjustments to state standards.	-Diverse learning opportunities drawn from national or worldwide sites. -High level of quality control drawing upon nationally known experts in the field.
Accessibility (Time and Place)	-Time for formal PD, such as courses, workshops, seminars, etc. must fit into workday or released time schedule. -Participants and/or instructors travel to designated learning site(s).	-A predetermined schedule allows advance time-planning and requires less self-discipline to ensure attendance.	-Participants need self-discipline. -Teachers may have to be willing to spend time outside of school day.	-Time for learning is flexible and available to learners 24 hours a day, seven days a week (24/7). -Learning occurs anywhere and access is available when the learning is desired.
Individualiza-tion	-Most learning occurs in formal structures where one size fits all.	-Instructors are able to work in class with small groups or individuals requiring assistance.	-Infrequent pre-course diagnostic assessments of learner's needs.	-Learning experiences are tailored to support individual teacher's learning needs and support "just in time" learning.

However, the site review also identified features of OPD that demonstrate its potential to better address the learners' training requirements than current workshops do:

- OPD enables teachers who teach at different grade levels and with different mathematical knowledge to select from an *expanded range of courses* that could better meet their needs. The uncertified middle school math teacher could benefit from the SREB in-depth course to learn algebra (see Exhibit B-2). The under-certified elementary school teacher could hone in on an overview course on the teaching K-2 mathematical topics aligned with the National Council of Teachers of Mathematics (NCTM) frameworks (e.g., Connected University in Exhibit B-3). Instruction of teachers from varied mathematical backgrounds might benefit by utilizing online mathematics resources, including lesson plans, teaching strategies, and student problems,

such as those presented by the Math Forum or PBS Teacher Line (See Exhibit B-2).

- OPD can take place based on the *learners' schedules and locations*, enabling them to take advantage of OPD's expanded range of offerings. OPD can be delivered in smaller bites that fit into teachers' school-day schedules. The 24/7 availability allows teachers to extend learning into their home. Offering extended courses with rich mathematical content and pedagogy becomes a realistic possibility.
- OPD often can be tailored to the particular mathematical content that teachers will be teaching. Sites that have partnered with textbook publishers, such as TeachScape with SRA/McGraw Hill, offer online training tailored to those using their textbooks (See Exhibit B-1). State or locally approved OPD would match prevailing state content standards or state/locally perceived instructional needs. A good example is the LessonLab's partnership with the Los Angeles Unified School District/UCLA Collaborative Institute Program (LUCI), which relates classroom video content to California state mathematics standards (See Exhibit B-2). OPD also offers real-time access to an extensive body of lesson plans and teaching strategies about topics as teachers teach them.

Knowledge-Centered Environments in OPD

OPD offers a fresh start at developing research-based teacher training rich in mathematical and pedagogical content (See Table 2). Although face-to-face training has certain advantages, particularly in the ability to visit schools and see and discuss classroom pedagogy, for the most part OPD can match or exceed those of traditional teacher courses. However, progress in implementing research-based instruction is still uneven (See Table 2).

OPD sites often do not clearly *inform prospective customers how their training incorporates research-based designs*. Before signing up, teachers need access to accurate course descriptions about how mathematical concepts are modeled, practiced, and applied.

The mathematical content of many OPD sites is heavily *focused on introductory mathematical concepts*, a natural beginning point for this still-emerging form of professional training. A typical course may devote roughly a week to each major mathematical topic, such as numbers, measurement, statistics, or geometry. Under-certified teachers of early elementary math may benefit from this introductory treatment of mathematical concepts, but upper elementary and middle school math teachers need firmer grounding in more advanced mathematical concepts, content, and applications.

Because OPD courses are national in reach, these sites tend to *use the NCTM framework as instructional guideposts* (e.g., Connected Classrooms). But state mathematical standards, not the NCTM framework, determine what teachers are held

Table 2. Knowledge-Centered Environments: Advantages and Challenges of Face-to-Face and Online Professional Development				
Factors in Accessing OPD	**Face-to-Face Professional Development**		**Online Professional Development**	
	Current Challenges	**Potential Advantages**	**Current Challenges**	**Potential Advantages**
Research-based	-Individual workshops must separately translate research about pedagogical content into high-quality training.	-Lines up with state/local standards and local education context.	-Inadequate customer information about their research-based approaches.	-Intensive, up-front investment in research-based programming supports high-quality mathematical and pedagogical content, accessible nationwide.
Rich mathematical content	- Not able to teach much math content in one- or two-day workshops.	-Math content is specific to local curriculum. -Teacher is able to provide individualized help to convey difficult mathematical concepts.	-Focus is primarily on introductory math and not more advanced mathematics.	-Extended time and intensity of courses allows for teaching deep math content. - Extensive supplementary online resources enable teacher access to a wide range of special mathematical topics.
Sound pedagogical practices	-Limited to local examples of good teaching practice. -Participants passively view examples with little opportunity to engage in complex thinking.	-Participants can visit schools and classrooms of model teachers. -Participants can experience authentic practice role play teaching situations.	-Few sophisticated computer simulations.	-Using video, draws upon national and even international examples of good teaching practice. -Participants immersed in simulated environments that scaffold thinking to support complex learning.

accountable to teach. Moreover, mathematical experts differ on their acceptance of the NCTM standards.

But there are also clear opportunities that OPD offers to provide better quality professional instruction than short-term, content-weak workshops. Because of its scale, OPD can afford to review and incorporate research-based training, drawing on expertise from the country's leading experts. For example:

- Several OPD providers, including TeachScape, Pearson, Connected University, and Classroom Connect market themselves by highlighting the *research base of their instructional design*. One site, TeachScape, identifies

specific research-based principles and research sources that guide its coursework design (See Exhibit B-1). Classroom Connect's courses are designed to meet national standards for staff development, and incorporate research-based strategies and recommendations for adult learning.

- An *in-depth algebra course* is offered by the SREB "SpotLight on Algebra" that is appropriate for middle school teachers who want more than introductory math (See Exhibit B-1).
- *Video* can make national and even international examples of good teaching available. LessonLab uses international classroom videos and the Model Middle School Mathematics program uses video lessons to examine each of the five National Science Foundation funded programs (See Exhibit B-2).
- Good examples of OPD *aligning with state standards* can be found when states partner with OPD providers, such as Arizona's partnership with PBS Teacherline and Louisiana's adoption of the Blackboard platform so that Louisiana universities can offer teacher in-service training (See Exhibit B-2).

Community-Centered Environments in OPD

Online networking can create powerful communities of practice to support teacher learning (See Table 3). Using the Web's communication capabilities, some OPD sites are networking teachers through chat rooms, e-mail, discussion groups, and bulletin boards. OPD networks offer the potential of expanding teacher learning communities beyond their own school to include teachers throughout the United States and abroad. This is a radical departure for teachers who, until recently, did not even have access to telephones in their classrooms.

Although OPD programs feature access to online discussion groups to help teachers explore and clarify what they have learned, the limited evaluation evidence suggests that the results are not an overwhelming success. For example, teachers' evaluations of different components of a major online reading program rated discussion boards as the least useful among all 13 program components and the ones most in need of improvement (Haslam, 2003). Traditional classroom training, with an instructor up front, is by its very nature facilitated and more likely to stay focused.

Some OPD networks are addressing the challenges of providing meaningful community networks (Kleiman, Spielvogel, and Zorfass, 2001):

- Using *facilitators,* OPD discussions are better able to provide structure and depth rather than mere chat. The National Center to Improve Practice, sponsored by Education Development Center (EDC), suggests that a good online facilitator has to balance what is said in terms of direction. They found that simple, provocative statements can energize and focus discussions. PBS Teacherline (See Exhibit B-1) picks up on the idea of facilitated discussion by calling in experts for scheduled discussions, such as "Developing Algebraic Reasoning in K-9." The Math Forum (See Exhbit B-1), which

Table 3. Community-Centered Environments: Advantages and Challenges For OPD				
Factors in Accessing OPD	**Face-to-Face Professional Development**		**Online Professional Development**	
	Current Challenges	**Potential Advantages**	**Current Challenges**	**Potential Advantages**
Scope	-Community limited to own school or local area.			-Community extends nationwide and beyond.
Discussion value		-Physical presence in workshops facilitates group discussions.	-Often little more than chat rooms; -Interactions are individual-to-individual rather than true group collaborative learning.	

averages four million page views each month, often uses "teach2teacher" math experts to begin and ground the discussion with a research-based answer to a question. Its "videopaper" section informs and focuses online discussions by providing video examples of how a particular mathematical concept is taught in different classrooms. .

- Some OPD discussions also encourage sustained group -- rather than individual-to-individual -- interactions. Formats that encourage *group discussions around well-focused goals and tasks* tend to be more effective (Riel and Levin, 1990). Schools Around the World (SAW) is an example of a project fostering collaborative work to interpret what "world-class standards" mean in the real world -- in actual classrooms in Australia, the Czech Republic, France, Germany, Hong Kong, Japan, Portugal, the United Kingdom, and the United States. Technology enables participants in different countries to submit pieces of student work and discuss how the criteria they use to judge work compares internationally (Spielvogel and Hawkins, 1998).

Assessment-Centered Environments in OPD

OPD faces special challenges compared with traditional professional development in accurately assessing teachers' understanding of course content and their ability to teach what they have learned (Table 4). When instruction provides few opportunities for actual practice, teachers are less likely to change behavior to reflect what they have learned about good practice (Guskey, 1989). In face-to-face workshops, teachers are able to demonstrate the pedagogy that has been modeled, which is not feasible online.

Moreover, research suggests that training is most effective when follow-up coaching, technical assistance, and assessment take place outside the workshop at participant teachers' schools. One experimental study found that, among teachers participating in the same workshop, 75 percent who were visited after the workshop and offered feedback used the newly taught strategies, compared with only 10 percent in the control group (Joyce and Showers, 1995). Because OPD enrollment tends to be an

Table 4. Assessment-Centered Environments: Advantages and Challenges of Face-to-Face and Online Professional Development				
Factors in Accessing OPD	**Face-to-Face Professional Development**		**Online Professional Development**	
	Current Challenges	**Potential Advantages**	**Current Challenges**	**Potential Advantages**
Continuous assessment	-Assessment and feedback not viable. -Participant instruction tied to group progress.	-Teachers have opportunities to practice what they learn and apply it in the classroom or other settings.	-Online assessments are not authentic measures of teachers' ability to apply what they learn in practice.	-Continuous assessment supports instruction adapted to individual participant progress.

individual decision, doing follow-up, assessment, and providing support in each school of participating teachers is problematic.

Although authentic participant assessments are difficult, a typical assessment required to successfully complete an OPD course in mathematics might include the following criteria (e.g., see Connected University or Pearson):

- Completion and quality of weekly assignments.
- Quality and frequency of online discussion.
- Completion of a major inquiry project demonstrating understanding and application of mathematical content and instructional methods.

Written responses to these or similar assignments can test understanding, but they do not yield authentic measures of teachers' capacity to apply mathematical concepts under real classroom conditions.

Examples of OPD sites providing more authentic assessments and feedback systems include:

- Riverdeep (See Exhbit B-1) has developed an online system for measuring continuous progress for learning technology, although not for math. This system's diagnostic assessment section measures a wide range of teacher technology skills efficiently by automatically adapting to the skill level of the individual test taker. Diagnostic assessment requires teachers to demonstrate their skills through a wide variety of question types, including simulated software use, classroom scenarios, and traditional multiple-choice items.
- Skillsoft (See Exhibit B-1), an online training provider for businesses, assesses a hierarchy of skills from lower-order ones such as restating information and identifying examples of concepts not previously encountered, to higher-order ones such as reproducing results or process with not

previously encountered situations, identifying conditions responsible for outcomes, and predicting results based on conditions.

- Video submissions, such as those required by the National Board (2001) certification process, enable teachers to submit actual classroom examples to demonstrate their ability to apply the knowledge and skills that they learn.
- Blended approaches that combine online with onsite instruction are common in postsecondary education settings such as the Rio Salado Community College (See Exhibit B-1) in Arizona, which serves 38,000 students through online courses but requires students to take midterm and final examinations in person at a proctored location.

Evaluation of OPD Results

To date, much of the evidence to support the application of online learning is anecdotal. *Among the 40 OPD courses reviewed by this study (See Part B), evaluation information was limited to a few examples based on teacher self-report data. No site offered independently collected, objective evidence of better teaching or improved student outcomes.*

But existing online mathematics programs and resources are often random in their coverage of mathematical topics, and assessments of the quality and appropriateness of the content are nonexistent. No central source exists for teachers to explore and assess the usefulness of different OPD offerings in mathematics. Diagnostic pretests are rare, instructional designs do not adequately incorporate authentic practice, and written assessments do not evaluate feedback data on how teachers apply what they have learned. In addition, OPD networks have tended to be superficial.

For instance, participants in one site gave overwhelmingly positive responses when asked if they have applied what they have learned in their classroom or would recommend the program to friends (See Connected University, Exhibit B-1). A training site called Marco Polo asks participants to rate trainers and course content, and is one of the few sites to follow up and ask respondents their frequency of site use. While this type of evidence should not be ignored, self-reports to the provider are suspect because respondents tend to give socially desirable answers (Phillips and Clancy; 1972). Anonymous and independent data collection improves self-report accuracy.

Evaluations of other areas of online adult training have involved mostly older generations of information and communication technology in postsecondary education (e.g., U.S. Department of Education, 1999) and the corporate sector (e.g., Van Buren, 2000). One example is the recent study of online learning in the military, which showed positive results for training soldiers on a variety of tasks when the trainers pay close attention to the quality of courseware design and delivery (Abell, ND).

One interesting study of MBA courses offered at the University of Baltimore found a divergence in student attitudes toward course materials and instructors. The

materials used in online courses received higher ratings than those used in traditional classroom settings. This was true even in comparisons of materials used by the same instructor in online and classroom-based versions. Conversely, students gave higher marks to instructors who taught face-to-face, including those who taught the same course in both the online and traditional format (Maeroff, 2002).

Thus, hard evidence based on evaluation results of OPD is not available to guide how to take advantage of technology to enhance the distance teaching and learning process (Institute for Higher Education Policy, 2000). Moving forward, if we want to expand access to advanced online coursework for teachers, we need to ask: What combination of instructional strategies and delivery media will best produce the desired learning outcome for the intended audience (Joy and Garcia, 2000)?

V: SUGGESTED ACTION STEPS TO STRENGTHEN THE BENEFITS OF ONLINE PROFESSIONAL DEVELOPMENT IN MATH

The demand for high-quality professional development to meet the NCLB requirements for "highly qualified" teachers creates an unprecedented opportunity for OPD to complement traditional face-to-face professional development. While many online mathematical resources and networking opportunities are available and expand upon face-to-face training, to help OPD realize its potential effectiveness, federal, state and local governments, as well as nonpublic providers, have a key role in developing and improving OPD.

We propose a set of actions to guide improvements in OPD that are consistent with research on teacher learning and our analysis of the strengths and weaknesses of current OPD sites,. To benefit from the potential of OPD, it is essential to obtain good information on its effectiveness, build on its strengths, and explore blended strategies that combine the advantages of OPD with those of face-to-face training. This would entail:

- Developing voluntary OPD standards for teacher learning in mathematics and other subjects to guide sites in developing OPD and teachers in what they should look for.
- Conducting research and evaluation to assess impacts and identify effective practices and collecting current statistics on the scope and nature of teacher participation in OPD.
- Addressing clear weaknesses of current OPD in assessing teacher learning and feeding back information for improvement and in structuring meaningful teacher networks.
- Developing more mathematically advanced OPD programs, with initial priority to middle school mathematics teachers.
- Creating an online professional development portal to help teachers find the sites and information they need to effectively participate in OPD.

Action Steps

The responsibility for taking these steps is shared among the federal government, state and local governments, nonprofit entities such as higher education and foundations, and the private sector. Their cooperative efforts are essential to develop the full potential OPD.

Non-governmental/private sector. Nongovernmental entities such as colleges and universities, textbook publishers, foundations, and other traditional providers of professional training are each positioned to develop, test, or implement improved and expanded online professional development. Five action steps are presented for their consideration.

1. Leading *professional organizations* in the field develop *voluntary OPD standards* for teacher learning in mathematics and possibly other subjects. The standards would provide pedagogical guidelines for developing OPD courses that are learner-centered, knowledge-centered, community-centered, and assessment centered, as well as technical guidelines for the technology. The standards should differentiate sites that provide in-depth program content for credit from resource sites that offer supplementary math content. The standards should address site content and accessibility with respect to meeting the four criteria for providing quality learning opportunities. The standards should also cover evaluative information. The International Society for Technology in Education's National Education Technology Standards for Teachers, which guide the preparation of teachers to use technology, could be built on to develop standards for the delivery of OPD.
2. *Professional organizations* can oversee operations of an *online professional development portal.* Professional organizations possess the credibility to provide independent, objective information on the quality of online programming in math and science. The portal also would support electronic practitioner networks to enable teachers and administrators to share their experiences and ideas. Research networks also could allow researchers easy access to up-to-date information on ongoing research and evaluation studies, funding sources, and a knowledge base of key documents and surveys relating to OPD.
3. *The publishers of mathematics textbooks and curriculum* logically have a comparative advantage to *link the professional training they offer online to the teaching of specific mathematical content* taught in the classroom. A dual approach of incorporating online training as a component, along with the face-to-face professional learning they normally would deliver, is consistent with research about the advantages of blended learning approaches. Through online training, textbook publishers would be able to reach and train their customers in a way other than through the current highly decentralized, face-to-face delivery system. Textbook publishers could routinely supplement current teacher manuals with companion online materials that offer a greater range of supplementary instructional ideas and examples tailored to individual teacher needs.
4. More c*olleges and universities,* as providers of pre-service training, can offer teachers rich, *in-depth, in-service coursework* online in mathematics. These courses could take advantage of an already strong online course presence in many colleges and universities. Online in-service courses could offer a neutral space to bridge the current separation between schools of education and college mathematics departments to jointly prepare teacher development programs that combine rich mathematical content with sound pedagogy.
5. *Foundations can take risks* in developing and rigorously evaluating model online mathematics training for teachers in order to objectively evaluate OPD's effectiveness. These could be part of current foundation-supported projects targeted on improving student learning in national priority areas, such

as among at-risk students. Effective online training would offer foundations one strategy to help them go to scale with promising programs.

Federal government. The federal government is uniquely situated to provide national leadership in innovative online professional development; share the funding risks; and independently monitor and evaluate online professional development initiatives in math. The federal government already supports substantial online professional development in math, but federal efforts involve a number of initiatives that are often not well coordinated and lack a coherent strategy. The new federal initiative to develop a national education technology plan offers a vehicle for pulling together these diverse federal efforts[i] (U.S. Department of Education, 2003).

Six actions steps are identified for the federal government to consider:

1. *Evaluate impacts and quality* of OPD in mathematics using rigorous methodology and independently collected data. The federal government has a major responsibility to support evaluations of OPD sties, which are national in scope. The evaluations should employ experimental design methods to assess how OPD improves teacher knowledge and skills and student outcomes. The evaluations can compare effectiveness for teachers participating in OPD, teachers receiving traditional short-term professional workshops, and teachers who receive no professional development in mathematics.
2. Conduct an *inventory* and assess currently supported online teacher training programs in mathematics (and other subjects) based on these standards. The inventory should be a multi-agency review, including the U.S. Department of Education, the National Science Foundation, NASA, and other federal agencies that support online math training. The inventory should assess programs with respect to their target audience, coverage of math topics, richness of content, and evaluation evidence of success.
3. Develop *quality criteria for funding* online professional development programs in math. The criteria should incorporate research-based principles of quality learning opportunities. These include such features as pretest diagnostics to guide teacher course selections of appropriate mathematical content; instructional designs incorporating opportunities to model, practice, and apply concepts and pedagogy; and authentic assessments of teacher applications of professional training. All new grants and continuations should be evaluated against these criteria.
4. Support the development of in-depth, content-based online *pilot programs to help states meet federal requirements for "highly qualified" teachers*. A focus on uncertified or under-certified math teachers would directly help those teachers who have the greatest need for in-depth math support. Research-based professional development modules could be piloted around core math topics such as numbers and operations for the elementary school teacher and algebra and geometry for the middle school math teacher.

5. Collect *up-to-date statistics* on online professional training. The National Center for Education Statistics needs to incorporate questions in teacher surveys about the extent to which their professional training is delivered online. Information on access at home, school, and other settings also would be useful.

6. Establish a *strong research and development* effort to learn how best to deliver online professional training in mathematics. The goal would be to identify how to take full advantage of the unique features of online professional development by incorporating the best ideas from adult learning as well as characteristics of effective content-driven professional development. Research and development should focus on strengthening features of OPD such as: courses tailored to pre-testing knowledge and skills; ways of modeling authentic classroom environments to simulate teaching applications; adaptive instruction driven by ongoing feedback; and the effective use of supplementary resources and chat rooms to improve training.

   Also, conduct cost-effectiveness research to shed light on the *relative advantages of OPD versus face-to-face professional development*. The cost advantages of OPD should be a function of the scale and sustainability of these efforts, although program start-up costs could be significant. Such research should focus on each of the stages of developing new OPD programs, including program development, delivery, and sustainability.

State and local education systems. The following three suggested initiatives take advantage of the unique position of state and local education agencies as both consumers of professional training for teachers and as major suppliers of approved professional development.

1. States can follow the lead of the Southern Regional Education Board (SREB) and collaboratively develop a *searchable database* of online professional programs and resources in mathematics appropriate for their state. The database would provide summary site information related to meeting OPD development standards. This database, which also could be part of the proposed federal online portal system, should develop common criteria for reviewing online materials, including teacher-learner focus, course content, potential for teacher-student interactions and networking, and student, teacher, and course evaluation data.

2. States can *approve and encourage teachers' use of research-based online courses and workshops* as part of their plans to meet the NCLB requirements for highly qualified teachers. Professional coursework should be content-based and focused on improving math teaching in line with state content standards at particular grade spans. Online professional development should include objective performance evaluations to measure teachers' successful participation.

3. States and localities in which significant online professional development occurs can *collect basic evaluative information,* including participant

characteristics, the nature of online course work, completion rates, and user satisfaction. States also should explore methods to collect effectiveness data on changes in teacher practice, teacher knowledge and student outcomes. State and local agencies with significant online investments should cooperate in developing a common core of measures to evaluate and compare their online training experiences. The U.S. Department of Education's Office of Educational Technology, which currently supports state grants to rigorously evaluate technology programs, could consider a grants program to evaluate these online efforts and prepare a meta-analysis of these findings.

In conclusion, a multi-level, coordinated initiative to strengthen online professional development in mathematics could spearhead reform of teacher professional development in general. The online investment is already considerable and the field, although still young, is well-positioned to incorporate the best from research and practice. However, it must be willing to invest in quality and assess the effectiveness of this powerful learning tool.

PART B

SCAN OF ONLINE PROFESSIONAL DEVELOPMENT PROGRAMS AND RESOURCES

POTENTIAL FOR ONLINE PROFESSIONAL DEVELOPMENT

E-learning opportunities are rapidly expanding in education, workplaces, the military, and other settings in the United States and abroad. These range from individual courses to fully accredited degree programs that utilize new and emerging information and communication technologies. It is estimated that between $7 billion and $25 billion had been invested in these online education and training activities by the end of 2003 (Grimes, 2000; Bassi and Van Buren, 1998).

Many terms have been used to describe Internet-based learning, including: e-learning, online learning, open learning, distance teaching and learning, virtual teaching and learning, blended learning, distributed learning, virtual school/virtual university, computer-mediated education, computer-assisted instruction, tele-learning, asynchronous and synchronous learning networks, Web-based instruction, and open university. This array of terminology is emblematic of the fact that this is still a young field. Nonetheless, it is evident from this scan that an ever-growing number of programs and initiatives are evolving to meet the learning and training needs of teachers, students, corporate leaders, and employees.

This review will distinguish between **Programs** and **Resources** for teachers of math. Professional development efforts that are classified as **Programs** (Exhibit B-1) offer comprehensive training materials and modules, supplemented by some combination of teacher(s) or facilitators(s), print materials, video(s) and online communities. These programs may offer synchronous or asynchronous learning experiences. In addition, all of these programs offer course credit toward a graduate degree or re-certification. In contrast, **Resources** (Exhibit B-2) represent a broad range of offerings for teachers of mathematics, including online courses, videos of master teachers, lesson plans, and other support materials for "what to do Monday morning." This review will also distinguish online professional development (OPD) by type of provider: **State and Local education agency** (Exhibit B-3), or the **College/University, Business, or Foundation sector** (Exhibit B-4).

Exhibit B-1. Selected Online Professional Development (OPD) Programs [Degree Credit]

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Contacts and sources)*	**Learner-Centered** *(Does the program meet the needs of the teacher?)*	**Knowledge-Centered** *(What is the content of the program, and is it research-based?)*	**Teacher Assessment** *(How does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program support a community for teachers?)*	**Other Notes** *(Miscellaneous information)*
1a. Connected University http://cu.classroom.com/logon.asp A division of Harcourt Education. **Program Evaluation** Self-reports: -89 percent of program learners report they have already applied their skills to instructional practice or plan to do so. -96 percent of program learners report they would recommend the program to friends or colleagues. -Connected University was to have completed an evaluation of its distance learning master's programs by 2003	**Type of courses**. The OPD community provides educators with Web-based courses, both guide-led and self-paced as well as other online resources. **Grade level**: Pre-K-12 **Pre-course skills assessment**. Online self-appraisals that can be used to track progress throughout participation. Virtual and/or live. **Virtual.** **Participants**. More than 80,000 learners participate in the program. **Locations**. Available in 38 states and selected postsecondary institutions (including Fordham, Pepperdine, and Texas Tech).	**Research base.** Standards for course structure not explicit. **Math Content**. "It Adds Up!: Success with K-2 Math Standards," "Best Calculations: Success with 3-5 Math Standards," "Data Analysis, Statistics, and Probability," "Geometric Reasoning and Spatial Sense," "Mathematics for Information-Age Decision-Making," "Number Sense: Teaching About Fractions, Decimals, Ratios, and Proportions," and "Patterns, Mathematical Modeling, and Number Theory." **Pedagogy**. Best-practice approaches and examinations of case studies, including lesson plans and online video clips.	**Participant assessment.** Must complete a course project to be viewable online and subject to public peer review. **Certification**. Courses taken via the program can count toward re-certification in several states, and the program partners with some universities to provide credits and CEUs.	**Discussion groups.** Learners are required to participate in discussions on message boards. **Discussions facilitated.**	Connected University has research reports from years 1 and 2 that were developed by third-party evaluators as well as ongoing feedback from end-of-course surveys, and reports from Fordham University and the Fund for the Improvement of Post-Secondary Education (FIPSE) project evaluators and from the American Museum of Natural History. .

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Contacts and sources)*	**Learner-Centered***(Does the program meet the needs of the teacher?)*	**Knowledge-Centered** *(What is the content of the program, and is it research-based?)*	**Teacher Assessment** *(How does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program support a community for teachers?)*	**Other Notes** *(Miscellaneous information)*
1b. Pearson Skylight http://www.skylighte du.com/ **Program Evaluation**. Because many programs are still in the first two years of implementation, no evaluative data exists. However, the program was to have completed an evaluation of the distance-learning master's programs by 2003.	**Type of courses**. Online, site-based and video correspondence courses. Many are self-paced. **Grade level**: K-12 **Pre-course skills assessment.** **Virtual and/or live.** Virtual and live. **Participants**. More than 3,000 teachers have enrolled and completed the distance-learning graduate courses. Approximately 1,000 are enrolled in the master's programs. **Locations**. Site-based courses are in the greater Chicago area; see Web site for further details. **Drake, Concordia** and **Saint Xavier Universities** have partnerships with **Pearson Skylight** for graduate-level courses.	**Research base.** **Math Content**. Math content, including numeration and computation, critical thinking, statistics, probability and geometrical figures. **Pedagogy**. Teacher "Math Tune-Ups" are self-paced mini-tutorials. Site-based training utilizes strategy-based books and videos for professional development. Video-based courses incorporate classroom scenes of teachers modeling teaching strategies Lessons and learning activities within courses ask participants to connect their state or district standards to individual assignments.	Participant assessments **Certification**. No information available, but courses align with standards set forth by the National Board for Professional Training Standards.	**Discussion groups.** **Discussions facilitated.**	Other partners with Pearson Skylight include Nova Southeastern University, Saint Mary College of Kansas, Saint Xavier University, Concordia University, Dominican University, New York State United Teachers, Los Angeles Unified School District and Sarasota (Fla.) County Schools.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Contacts and sources)*	**Learner-Centered** *(Does the program meet the needs of the teacher?)*	**Knowledge-Centered** *(What is the content of the program, and is it research--based?)*	**Teacher Assessment** *(How does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program support a community for teachers?)*	**Other Notes** *(Miscellaneous information)*
1c. PBS TeacherLine – Module http://teacherline.pbs.org **Program Evaluation**. No data is currently available on users, completion or retention. Researchers were to begin to collect and analyze data in 2003.	**Type of courses**. Provides online facilitated and self-paced learning experiences (Math Academy). **Grade level**: Pre-K-12 Pre-course skills assessment. **Virtual and/or live.** Both**.** **Participants.** Approximately 11,000 educators nationwide are enrolled. Both in-service and pre-service professionals. **Location**.	**Research base**. Developed by leading educational producers in alignment with national standards such as ISTE and NCTM. **Math Content**. There are 43 math courses that cover topics such as: Applying NCTM principles, connecting math to real life, number sense, data analysis, working with special needs students, critical thinking, measurement, probability, geometry using technology, and many more. All with focus on specific grade levels. **Pedagogy**. Facilitated courses, as well as customized personal development plans, video teacher modeling of math lessons, questions and reflection.	**Participant assessment.** **Certification**. No certification, but teachers can receive local professional development credit (LPDC) or graduate credit from the University of Cincinnati (with enrollment in modified course offerings).	Discussion Groups. Online bulletin boards and chat forums. Discussions facilitated. Discussions are facilitated.	

[Cautionary Note: Sites Frequently Change: Check Site for Current Description]					
Programs *(Contacts and sources)*	**Learner-Centered** *(Does the program meet the needs of the teacher?)*	**Knowledge-Centered** *(What is the content of the program, and is it research-based?)*	**Teacher Assessment** *(How does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program support a community for teachers?)*	**Other Notes** *(Miscellaneous information)*
1d. Teachscape http://ts2.teachscape.com **Program Evaluation**. None cited.	**Type of courses**. Interactive, multimedia video cases. Programs are customized to meet the needs of the individual participant and the school district. **Grade level**. Video cases focus on 4th and 5th grade but can be used to provide guidance for any grade level. Pre-course skills assessment. **Virtual and/or live**. Virtual. **Participants.** Approximately 30,000 educators are involved with *Teachscape*. **Location.** Teachscape is based in New York City; however, as an online service can be accessed internationally.	**Research base.** A set of principles derived from current theory and research on how teachers learn and real-world experiences of educators. It supports and enhances "best practices." **Math Content**. Mathematic topics covered include: numbers and operations, pre-algebra, geometry, and data analysis and probability. **Pedagogy**. Learning groups that include a group of members from a school district, online public discussions across school districts, mentoring and coaching by veteran teachers, online digital video, peer review, learning forums, and an online library of relevant materials. Also encourages on-site study groups.	**Participant assessment.** Built-in ongoing assessment through peer review and self-reflection. **Certification.** Provides customized programs to prepare for certification.	**Discussion groups.** Online community forum provides interaction with other participants in a learning group or across school districts. **Discussion facilitated.**	**Teachscape** is collaborating with elementary mathematics courses for educators' professional development as part of the **Seeing Math Telecommunications Project** (funded by the U.S. Department of Education's Office of Educational Research and Improvement). This project will include the dissemination, research, and evaluation of the courses.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Contacts and sources)*	**Learner-Centered** *(Does the program meet the needs of the teacher?)*	**Knowledge-Centered** *(What is the content of the program, and is it research-based?)*	**Teacher Assessment** *(How does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program support a community for teachers?)*	**Other Notes** *(Miscellaneous information)*
1e. TeacherUniverse (Riverdeep) Interactive Learning **http://www.riverdeep.net/** **Program Evaluation**. None cited.	**Type of courses**. Participants learn how to blend technology into classroom instruction, while addressing the goals and objectives of their math curricula. **Grade level**: Pre-K-12 **Pre-course skills assessment.** AssessOnline is an integration assessment system used to assess how well teachers integrate technology into classes. Virtual and/or live. Both, allowing teachers to learn either side by side with a facilitator or online at their own pace. Participants. Teachers/Educators. **Location**. Has headquarters in California, Massachusetts, and Ireland.	**Research base.** Provides alignment of Destination Math with each state's standards. **Math Content.** Teachers learn to use Destination Math (their students' mathematics program) and integrate electronic curricula into daily math instruction. Some of the topics covered are mastering skills and concepts, pre-algebra, and algebra. **Pedagogy**. Pre- and post-assessments, actual hands on practice and projects, self-paced learning, audio and text interaction, visual demonstrations, and lesson plan creation using lesson plan software.	**Participant assessment.** AssessOnline is used after participants have taken courses to assess their progress. Web-based reports are generated to provide information to school districts as well as to the individual. **Certification.**	**Discussion groups.** Online bulletin board community. **Discussion facilitated.**	**TeacherUniverse's** Destination Math was awarded the 2000 EdPress Distinguished Achievement Award for Educational Technology Curricular Software and the 2000 EdPress Golden Lamp Award for Educational Technology Software. TeacherUniverse customized its AssessOnline program for Georgia to complement the state's InTech technology training program that provides administrators with online reporting.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Contacts and sources)*	**Learner-Centered** *(Does the program meet the needs of the teacher?)*	**Knowledge-Centered** *(What is the content of the program, and is it research-based?)*	**Teacher Assessment** *(How does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program support a community for teachers?)*	**Other Notes** *(Miscellaneous information)*
1f. Spotlight on Algebra—Southern Regional Educational Technology Cooperative - Southern Regional Educational Board (SREB) http://www.sreb.org/programs/EdTech/Spotlight/spotlightindex.asp **Program Evaluation**. None cited.	**Type of course**. Web-based course designed for schools and requires participant interaction under a qualified facilitator. It can be used alone or in conjunction with another professional development program. This course has a theatrical theme with nine chapters or "acts" divided into "scenes," allowing focus on specific topics. **Grade level**: 6-12 **Pre-course skills assessment**. **Virtual and/or live**. Virtual. **Participants**. Teachers and teachers-in-training. **Location**. Atlanta, Georgia.	**Research base.** Developed by a team of classroom teachers and university faculty. Approved by Georgia Professional Standards Commission, but no formal evaluation of results. **Math Content**. Algebra concepts covered include simple equations, linear equations, problem-solving with functions, graphs, polynomials, Pythagorean theorem, and quadratic equations. **Pedagogy**. Follows SREB Algebra I standards to help teachers give students a strong understanding and appreciation of algebra.	**Participant assessment.** **Certification**. Georgia teachers can obtain 5 staff development units (SDUs) toward re-certification.	**Discussion groups.** Once course is set up by SREB for a school, online discussions can take place. **Discussion facilitated.** Discussions should be facilitated by a math teacher.	

Exhibit B-2. Selected Online Resources for Professional Development

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2a. Association for Supervision and Curriculum Development (ASCD) http://www.ascd.org **Program evaluation.** None reported	**Type of resources.** OPD courses focusing on curriculum and supervision. Video courses and workshops are also available. **Grade level.** Pre-K-2 for math. Pre-course skills assessment. Virtual and/or live. **Virtual** Participants. **160,000 participants worldwide** **Location**. Online international	**Research base.** **Math Content.** Early childhood mathematics is only math course among 25 courses. How instructional approaches are applied to mathematics instruction, as described in the Curriculum and Evaluation Standards for School Mathematics, released by the National Council of Teachers of Mathematics (NCTM). **Pedagogy**. Interactive exercises allow participants to apply the standards to their own lessons.	**Participant assessment.** **Certification**. ASCD awards a certificate of completion that includes 5.5–27.5 hours that can be used toward continuing education credit in most states.	**Discussion groups.** Opportunity for ongoing conversations and exchanges of ideas among educators across the country focused on improving the quality of professional development. Practitioners' Perspectives provides an opportunity to conduct discussions and problem-solving sessions online. **Discussions facilitated.** Yes: Practitioner Perspectives	More than 20 six-month courses are offered.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2b. Classroom Connect http://www.classroom.com **Program evaluation.** Customer testimonials.	**Type of resources.** Professional development and curricula resources. Access to lesson plans that include links to goals, preparation, procedures, assessment and standards. **Grade level.** K-8 **Pre-course skills assessment.** Self-appraisals enable learners to assess their skills against national standards. **Virtual and/or live.** Virtual and live. Online courses (Connected University). (Also, face-to-face workshops and conferences, and print newsletters. **Participants.** 80,000 subscribers have used Connected University, a division of Classroom Connect. **Location**. Nationwide	**Research base.** Classroom Connect's online professional development is designed to meet national standards for staff development and incorporate research-based strategies and recommendations for adult learning. **Math Content.** Best Calculations: Success with 3-5 Math Standards; Data Analysis, Statistics, and Probability; Geometric Reasoning and Spatial Sense; It adds up!: Success with K-2 Math Standards; Math in the Middle: Success with 6-8 Math standards; Mathematics for Information-Age Decision-Making; Number Sense: Teaching About Fractions, Decimals, Ratios, Proportions; and Patterns, Mathematical Modeling, and Number Theory. **Pedagogy**. Learn from model teachers.	**Participant assessment.** Self-reports of use. **Certification**. Many courses are available for graduate credit and Continuing Education Units (CEUs).	**Discussion groups.** Site has an online community, access to nationwide Internet education events and face-to-face development workshops **Discussions facilitated.** No	**Classroom Connect** was featured at the 2000 National Commission on Mathematics and Science Teaching for the 21st Century conference. The site received the *2002 SIIA Codie Award* for the "Best New Education Solution" and the *2002 EdPress Distinguished Achievement Award Finalist* for the "Golden Lamp Category: Instructional Material/Internet-based/Children Category." Part of Harcourt Education.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2c. Modeling Middle School Mathematics (MMM) http://mmmproject.org/ **Program evaluation.** There are no evaluations of the online video. The National Science Foundation (NSF) curricula have evaluations that are being reviewed by the National Academy of Sciences.	**Type of resources.** Online videos of math topics and classrooms are available from the Show-Me Center. The videos were developed through an NSF project, using video lessons and Web-based Internet materials to examine each of the five NSF-funded middle school mathematics programs. (**Pathways to Algebra and Geometry (MMAP)** Voyager Expanded Learning, publisher; **Mathematics in Context (MiC)** Encyclopedia Britannica, publisher; **MathScape** Glencoe/McGraw-Hill, publisher; **Connected Math Project (CMP)** Prentice Hall, publisher; and **Math*Thematics*** McDougal Littell, publisher.) **Grade level.** 6-8 Pre-course skills assessment. Virtual and/or live. **Virtual** Participants. **Location**. Nationwide	**Research base.** **Math Content.** 10 video lessons cover five NCTM content strands: numbers, algebra, geometry, measurement, and data analysis. **Pedagogy**. Video lessons of classrooms.	**Participant assessment.** No **Certification**. No	**Discussion groups.** No **Discussions facilitated.**	Selected as an Eisenhower National Clearinghouse "Digital Dozen" Web site.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2d. ExploreLearning http://www.exploremath.com **Program evaluation.** Customer testimonials.	**Type of resources** Modular, interactive simulations in math and science for teachers and students. Designed as supplemental curriculum materials that support state and national curriculum standards. **Grade level.** 6-12 Pre-course skills assessment. Virtual and/or live. **Virtual** Participants. **Location**. Nationwide	**Research base.** Results of meta-analyses showing the effectiveness of representing new knowledge in graphic/nonlinguistic formats. **Math Content.** Hundreds of simulated math activities organized around topic structure similar to NCTM. **Pedagogy**. Emphasizes visual examples to facilitate learning.	**Participant assessments.** **Certification**.	**Discussion groups.** Online teacher forum. **Discussions facilitated.**	Groups such as the Eisenhower National Clearinghouse have recognized it for mathematics and science education.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2e. The George Lucas Educational Foundation (GLEF) Edutopia http://www.glef.org **Program evaluation.** None cited.	**Type of resources. GLEF** video galleries and articles document and disseminate models of innovative practices in K-12 for professional development, classroom innovation, and community involvement. Professional development training in project-based learning, assessment, and technology application to instruction. **Grade level.** K-12 Pre-course skills assessment. Virtual and/or live. **Virtual** **Participants.** GLEF provides assistance to teachers, administrators, school board members, elected officials, parents, researchers and other community leaders The foundation's semi-annual newsletter has 48,000 subscribers. GLEF's Web site attracts an average of 14,000 hits per month. **Location**. Nationwide	**Research base.** Correlates with ISTE, NCATE NETS standards. **Math Content.** Supports mathematics indirectly through improvements in such areas as innovative classroom construction (e.g., technology integration), educator development, and community involvement (reducing digital divide, business partnerships, etc.). **Pedagogy**. Films, books, newsletters and CD-ROMS, as well as videos, research and articles available on its Web site.	**Participant assessment.** **Certification**.	**Discussion groups.** Yes **Discussions facilitated.** No	**GLEF** also receives financial and in-kind assistance from corporations such as Apple Computer, Eastman Kodak, Microsoft, Time Warner, and Xerox.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2f. LessonLab http://www.lessonlab.com **Program evaluation.** None cited.	**Type of resources.** *LessonLab* focuses on classroom video explorations. The software has two sections, *LessonLab Viewer* and *LessonLab Builder*. The Viewer allows teachers to learn, analyze and improve their teaching practices, as well as collaborate with other teachers both online and in-person. LessonLab Builder enables teachers and content providers to build digital libraries of case-based material. **Grade level.** K-12 Pre-course skills assessment. **No** Virtual and/or live. **Available online only, online facilitated, or combined online and face-to-face.** Participants. **Location**. U.S. counties working with **LessonLab** include Duval, Leon, Osceola and Miami-Dade in Florida, and Buncombe and Wake in North Carolina.	**Research base.** Based on pioneering work in video documentation and analyses. **Math Content. LessonLab** is the basis for the *TIMSS Video Studies and Explorations of Algebra Teaching* course. Offered either as a six-week, online-facilitated course with optional credit from UCLA Extension or as a non-facilitated course that permits self-paced learning but without course credit. **LessonLab** has videos of more than 20 lessons in the Connected Math Program "Shapes and Designs" unit. **Pedagogy**. *LessonLab* offers software, videos and a technological platform to support the development and implementation of professional learning programs. **LessonLab** has developed an international video database with more than 2,000 hours of video collected from mathematics and science classrooms in seven nations.	**Participant assessment.** Describe and rate lessons. **Certification**. No certification, but facilitated courses can be taken for credit.	**Discussion groups.** Yes **Discussions facilitated.** Yes	**LessonLab** is in partnership with textbook publishers, large school districts, states, and other public and private organizations promoting teacher professional development, including Pepperdine University, the Los Angeles Unified School District, and the Chicago Public School system. **LessonLab** and **Pearson Professional Development** are creating a Connected Math professional development course: the first module was to be available in 2003 at **Connected Math** program workshops.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2g. Marco Polo http://www.marcopolo-education.org **Program evaluation.** One of the most extensive evaluations, although relies only on participant surveys and not independently conducted evaluations. More than 100,000 surveys have been collected that include write-in comments and quantitative data. Foundation staff members examine the data and are constantly evaluating the program to meet teachers' standards. Refer to http://www.marcopolo-education.org/state/state_progress.aspx for specific evaluations from each state.	**Type of resources.** The site includes lesson plans, student interactive content, downloadable worksheets, panel-reviewed Web sites, and additional resources such as the National Council of Teachers of Mathematics (NCTM). All lessons reflect national standards and are classroom-ready. **Grade level.** K-12 Pre-course skills assessment. Virtual and/or live. Participants. More than 140,000 teachers have been trained by **Marco Polo**'s professional development program. Approximately 10,000 teachers per month use **Marco Polo** training. More than 900,000 user sessions are recorded on its Web site every month. **Location**. A network of 50 states plus the District of Columbia use **Marco Polo** to help train teachers in content aligned to state education standards.	**Research base.** Resources are standards-based in seven content areas, and expert panels in each area review entries for accuracy, currency, relevance, and potential bias. **Math Content**. Conforms to K-12 NCTM standards and provides interactive tools and problem sets, lesson plans and Web-sources **Pedagogy**. Six-hour training sessions to learn how to integrate Marco Polo content into curricula and to develop Internet lesson plans and activities.	**Participant assessment.** No **Certification**. No	**Discussion groups/listserv.** Yes **Discussions facilitated.** No	

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2h. Math Active http://www.mathactive.com **Program evaluation.** None cited.	**Type of resources.** Although primarily a site to support students learning math, there is also training for math teachers to use standards and distance learning and the Internet. **Grade level.** K-12 Pre-course skills assessment. Virtual and/or live. Participants. **Location**.	**Research base.** **Program evaluation.** **Math Content.** Math Curriculum Matrix: Download lessons, study guides, and practice problems linked to the core performance objectives of state math standards. **Pedagogy**.	**Participant assessment.** **Certification**.	**Discussion groups.** **Discussions facilitated.**	

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2i. The Math Forum http://www.mathforum.com **Program evaluation.** None cited.	**Type of resources.** The forum is a center for mathematics and mathematics education, providing resources, materials, activities, and educational products and services to support teaching and learning. **Grade level.** K-12, college, and advanced post-secondary Pre-course skills assessment. **No.** Virtual and/or live. **Primarily virtual but live workshops.** Participants. **About four million page views each month.** **Location**. Nationwide	**Research base.** Offers best practices based on expert judgments. **Math Content.** - 7,000 items in the collection, organized under the headings of Mathematics Topics, Resource Types, Mathematics Education Topics or Educational Level. -Library of mathematics problems and solutions. -Teacher2Teacher **Pedagogy**. Uses problem-based learning and video examples.	**Participant assessment.** No **Certification**. No, but links to online courses offered by Drexel University.	**Discussion groups.** Threaded discussions such as -Teacher2Teacher exchanges about classroom techniques, activities, resources, professional development, etc. -Online "video paper" poses a problem with video instructional example for discussion. **Discussions facilitated.** No	The Math Forum was one of five sites awarded the 2002 "Sci/Tech" Web Award in the Mathematics category. The Math Forum was among the five Webby nominees for "Best Education Site" of 1999. The Math Forum was one of PC Magazine's Top 101 Most Incredibly Useful Web sites in the Information category for 2003.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2j. Mathline PBS TeacherSource http://www.pbs.org/mathline **PBS Teacherline** http://teacherline.pbs.org/teacherline/modules/catalog.cfm#result **Program evaluation.** None cited.	**Type of resources. PBS Mathline** and **Teacherline** offer a series of 43 math courses, video lessons, lesson guides, and suggestions for online discussions facilitated by classroom teachers in online learning communities. Facilitated Internet discussion forums **Grade level.** K-12 Pre-course skills assessment. Virtual and/or live. **Virtual** Participants. **Location**. Nationwide and some courses are state-specific tied to state math standards.	**Research base.** Based on NCTM standards. **Math Content.** -43 Courses. Appears to emphasize hands-on, introductory math and using technology; less emphasis on teaching teachers rigorous mathematics. -Virtual academy offers instruction in NCTM principles and algebra at K-12 NCTM grade bands. -Lesson plans for many math subjects. **Pedagogy**. Emphasis on visual displays, real-world uses, applications of technology including interactive applets to download.	**Participant assessment.** **Certification**. Yes, for courses.	**Discussion groups.** Yes. **Discussions facilitated.** Yes for courses.	Several states have partnered with **PBS Mathline** and local public television stations to provide professional development for educators.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2k.NCTM Illuminations http://illuminations.nctm.org/ **Program evaluation.** None cited.	**Type of resources.** Extensive and varied support resources that align with NCTM standards. **Grade level.** Pre-K-12. Pre-course skills assessment. **No** Virtual and/or live. **Virtual** Participants. **Location**. Nationwide	**Research base.** Based on NCTM math principles and standards. Requires referenced sites to be accurate and well organized using NCTM principles. **Math Content.** An extremely large and rich set of lesson plans, list of Web resources, online instructional tools, investigations for particular concepts; and activities to support inquiry-based practice (investigations) aligned with NCTM grade bands. Features interactive applets to illustrate math concepts. **Pedagogy**. Often provides real-world data to develop mathematical concepts. Contains tools that can be used to graph, visualize, or compute mathematical problems.	**Participant assessment.** No **Certification**. No.	**Discussion groups.** No **Discussions facilitated.**	**Illuminations** includes a partnership between the National Council of Teachers of Mathematics and the Marco Polo Education Foundation.

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
2l. **TeachersFirst** http://www.teachersfirst.com **Program evaluation.** None cited.	**Type of resources.** **TeachersFirst** collection of Internet resources, and lesson plans drawn from around the world; resources are grouped by subject and grade level, **Course Structure**. **Grade level.** K-12 Pre-course skills assessment. Virtual and/or live. **Virtual** Participants. **Location**.	**Research base.** Each resource is selected and examined by one of **TeachersFirst's** reviewers, who have classroom teaching experience **Program evaluation.** **Math Content.** Materials focus on classroom instruction and teaching issues, and are arranged by subject area and grade level. **Pedagogy**. Organized by classroom resources (math instruction), professional resources (teaching help), and site resources (using the Web).	**Participant assessment.** No **Certification**. No	**Discussion groups.** No **Discussions facilitated.**	TeachersFirst is a division of Network for Instructional TV, Inc., a not-for-profit learning technologies corporation

Exhibit B-3. State Education Agency- and Local Education Agency-Level Online Professional Development Math Initiatives

Arizona

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
3a. Arizona School Services through Educational Technology) http://www.asset.asu.edu **Program Evaluation**. None cited.	**Type of resource.** Provides online facilitated and self-paced learning experiences (Math Academy). **Grade level**. K-12 **Pre-course skills assessment.** MyCompass™, a confidential self-assessment tool, can help members evaluate their technology competencies, create an individualized professional development plan, link needs to online training, and report progress. **Virtual and/or live.** Both. **Participants**. **Location**. Arizona	**Research base.** Developed by leading educational producers in alignment with national standards such as ISTE and NCTM. **Math Content**. Spring 2004 catalogue offered 15-45-hour courses for K-5 in algebraic thinking, data analysis and probability, measurement, and integers. Shorter staff development programs in such areas as geometry, algebra and number concepts. **Pedagogy**. Facilitated courses, as well as customized personal development plans, video teacher modeling of math lessons, questions and reflection.	**Participant assessment.** Yes (see pre-course assessment) **Certification**. Yes. Several Arizona universities	Discussion groups. **Online bulletin boards and chat forums.** **Discussions facilitated.** Discussions are facilitated.	Extensive coordinated partnership with: Arizona State University, Arizona State University (ASU) West, Arizona Department of Education, Apple Corporation, Cox Education Network, Intel® Teach to the Future, Assessment, PBS TeacherLine and local PBS partners, Microsoft Corporation, Navajo Education Technology Consortium, Northern Arizona University, LA County Department of Education, United Learning Partners (United Streaming).

Arizona

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
3b. United Learning http:///www.unitedlearning.com **Program evaluation.** None cited for professional development. (United Learning had an evaluation done in 2002 by Cometika in which student achievement after one month increased by 12.6 percent over controls. However, these are extremely short-term impacts.)	**Type of resource**. Provides digitally streamed instructional videos. **Grade level**. K-12 **Pre-course skills assessment.** No **Virtual and/or live.** Virtual **Participants**. Educators and resource librarians. **Location**. Nationwide	**Research base.** Videos are based on state standards. **Math Content**. -Professional development courses focus on using Internet resources in mathematics. -Many student curricula resources including: numbers, probability, slope of a line, measurement, and problem-solving. **Pedagogy**. Video modeling and presentations.	**Participant assessment.** **Certification.** No certification, but one credit can be earned from National-Louis University for participation in the course "Multimedia in the Classroom."	**Discussion groups.** No **Discussions facilitated.**	Resources on **Arizona School Services through Educational Technology (**ASSET) portal: http://www.asset.asu.edu

Chicago

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Contacts and sources)*	**Learner-Centered** *(Does the program meet the needs of the teacher?)*	**Knowledge-Centered** *(What is the content of the program, and is it research-based?)*	**Teacher Assessment** *(How does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program support a community for teachers?)*	**Other Notes** *(Miscellaneous information)*
3c. IBM's Reinventing Education (RE) (Chicago example) http://www.ibm.com/ibm/ibmgives/grant/education/program/reinventing **Program Evaluation**. No Chicago data cited. IBM reports that lower-achieving students in the one reinvention site with the most mature implementation did have achievement gains in math and other subjects.	**Type of resource**. The focus of Chicago's **Reinventing Education** project is professional development for 7th- and 8th-grade math teachers. The goal is to infuse technology into the curriculum. By using technology, teachers would have the ability to enhance their own content knowledge and share experiences with their peers. **Grade level**: 7–8 **Pre-course skills assessment**. **Virtual and/or live.** **Participants**. Chicago Public School teachers and administrators. **Locations**. Various schools in the Chicago Public School system.	**Research base.** National Board for Professional Teaching Standards and the Interstate School Leader Licensure Consortium standards. **Math Content**. The project concentrates on geometry, algebra, and measurement and analysis. **Pedagogy**. IBM's Learning Village is the suite of applications that enables teachers to build and share standards-based lesson plans, implement promising instructional practices and strategies, and seek answers from peers and teacher educators in other institutions.	**Participant assessment.** **Certification**. Chicago Public Schools (CPS) and Roosevelt University are developing a professional development certification track that will satisfy state and CPS requirements for credit toward teacher certification, re-certification and graduation.	Discussion groups. Online interactions with other educators. **Discussions facilitated**	Refer to *Appendix E* for more information on IBM. Chicago Public Schools was awarded an NSF grant for three to five years; the grant is aligned with the RE initiative. Chicago Public Schools is taking control and oversight of all project efforts. The school system will sign a licensing agreement with IBM defining the use of Learning Village within the school district. The agreement will provide licensing for up to 2,500 users and will cover planned scale-up activities.

Louisiana

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
3d. Blackboard http://www.blackboard.com **Program evaluation.** None cited.	**Type of resources.** **Blackboard** provides an infrastructure and offers the ability to create an online course and discussion area. Districts and instructors use **Blackboard** for different purposes, including online courses, discussion forums, e-mail, and administrative and student needs. In Louisiana, online communities within Blackboard facilitate statewide collaboration. All technology district coordinators are in an online community. **Grade level.** Grades: 8-12 Pre-course skills assessment. Virtual and/or live. Participants. **Location**. The Calcasieu Parish Public Schools have been using Blackboard for two years.	**Research base.** **Math Content.** The Louisiana Department of Education is providing professional development and online classes using **Blackboard** as part of the **Louisiana Virtual School (LVS)**. Teachers can access online professional development mathematics resources through **Blackboard**. **Pedagogy**.	**Participant assessment.** **Certification**. Courses are offered for college credit in several districts. Each district operates its own professional development programs and courses for credit.	**Discussion groups.** **Discussions facilitated.**	

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** **(**Does the program assess and reward teacher performance?**)**	**Community-Centered** **(**Does the program create teacher networks?)	**Other Notes** *(Miscellaneous information)*
3e. Louisiana Virtual School (LVS): Algebra I Online http://www.lcet.doe.state.la.us/distance/ http://lvhs.doe.apexvs.com **Program evaluation.** None cited	**Type of resources.** A pilot project of the LVS in 2002-3 offered Algebra I to schools, with one or more sections of Algebra I being taught by an uncertified teacher. **Grade level.** Middle school **Pre-course skills assessment.** Uncertified middle school teachers of math. **Virtual and/or live.** Face-to-Face and online Participants. **Location**.	**Research base.** **Math Content.** Middle school algebra (e.g., operations and properties of real numbers, equivalent expressions and equations, solving and graphing linear equations and inequalities, and systems of equations, inequalities, functions). **Pedagogy**. Provides the uncertified in-class teacher with (a) the opportunity to extend his/her knowledge of Algebra I and skills for teaching Algebra I and (b) the support/tools needed to facilitate the in-class algebra learning activities. Throughout this project, the in-class teacher is engaged in face-to-face and online professional development opportunities designed to (1) help facilitate the in-class Algebra I learning activities of students, (2) build capacity for strong mathematics instruction, and (3) support the teacher's efforts to attain secondary mathematics certification.	**Participant assessment.** **Certification**.	**Discussion groups.** **Discussions facilitated.**	

Maine

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
3f. Maine-Math https://list.terc.edu/mailman/listinfo/maine-math. **Program evaluation.** None cited.	**Type of resources.** A listserv for mathematics teachers in Maine. The purpose of this list is to provide a forum for Maine math teachers to share and receive information related to math education, network with colleagues and obtain the latest news regarding math opportunities through the Maine Mathematics and Science Alliance (MMSA), the Association of Teachers of Mathematics In Maine (ATOMIM), and the National Council of Teachers of Mathematics (NTCM). **Grade level.** Pre-course skills assessment. Virtual and/or live. Participants. **Location**.	**Research base.** **Math Content.** Topics of interest to Maine math teachers, including conferences, new math articles and sources, policy issues, creating and using online networks **Pedagogy**.	**Participant assessment.** **Certification**.	**Discussion groups.** **Discussions facilitated.**	

Maine

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
3g. Maine Local Assessment Development (LAD). http://www.state.me.us/education/lsalt/LAD/homepage.htm. **Program evaluation.** None cited.	**Type of resources.** Valid, reliable assessments, aligned with Maine's *Learning Results*, suitable for inclusion in Local Assessment Systems. **Grade level.** 3-12 Pre-course skills assessment. Virtual and/or live. Virtual. Participants. **Location**. Maine.	**Research base.** -LAD assessments have demonstrated content validity with respect to Maine's *Learning Results* by virtue of established alignment to the performance indicators (clarified by national standards documents where appropriate). -The field test data provided for LAD assessments indicates the level of reliability. **Math Content.** Assessments linked to standards and covers three grade spans: 3-4; 5-8; 9-12 **Pedagogy**. Supplemented with newsletter and online discussions.	**Participant assessment.** **Certification**.	**Discussion groups.** Yes **Discussions facilitated.** No	

Maryland

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** (Does the program assess and reward teacher performance?)	**Community-Centered** (Does the program create teacher networks?)	**Other Notes** *(Miscellaneous information)*
3h. Thinkport http://www.thinkport.org/default.tp **Developed by** Maryland Public Television and the Johns Hopkins University Center for Technology in Education. **Program evaluation.** None cited.	**Type of resources.** **Thinkport** is a free online resource for Maryland educators, families and community members. Participants can take online courses, build a classroom Web site, create lesson plans, utilize a video service and take online field trips. The courses can be facilitated or self-paced with tutorials and "How To" support materials. **Grade level.** Pre-course skills assessment. Virtual and/or live. Virtual. Participants. **Location**. Maryland	**Research base.** **Math Content.** **Thinkport** offers courses from **PBS Teacherline** and **Johns Hopkins Center for Technology in Education**. Some math courses through **PBS TeacherLine** include "Math in Everyday Life for Grades K-5" (and for grades 6-8) and "Shaping Up: Teaching Geometry Using Technology for Grades K-2" (and grades 3-5). **Pedagogy**.	**Participant assessment.** **Certification**. The Maryland State Department of Education (MSDE) offers one credit for the courses offered through **TeacherLine.** . Courses through the **JHU Center for Technology in Education** are worth two MSDE credits.	**Discussion groups.** Yes **Discussions facilitated.**	MD Smart, funded by an Eisenhower grant, is an ongoing project through the **JHU Center for Technology in Education**. The project works with selected teachers to conduct research in their classrooms to determine the effective practices of Web-based and multimedia instructional activities in math and science.

New Hampshire

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
3i. New Hampshire Educators Online (NHEON) http://www.nheon.com/index.php. **Program evaluation.** None cited.	**Type of resources.** Resource for curriculum planning and professional development. NHEON supports the proficiencies within the NH Curriculum Frameworks and provides a Web portal for NH educators to share best practices. **Grade level.** K-12 Pre-course skills assessment. Virtual and/or live. Participants. **Location**. New Hampshire	**Research base.** **Math Content.** Aligns with NH math (and other) frameworks **Pedagogy**. For math and other subjects: -Online local support centers. -Project ACROSS helping career changers become teachers. -LoTI self-assessment tool -NH professional development calendar and opportunities -Promising practices guide. -Frameworks linked to online resources. -Online mentoring toolkit.	**Participant assessment.** Online assessment tool (for technology). **Certification**. No.	**Discussion groups.** **Yes.** NH Math Listserv **Discussions facilitated.**	

Texas

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
3j. TexasTeachers.net http://texas.teachers.net (Member of national Teachers.net) **Program evaluation.** None cited.	**Type of resources.** **Type of initiative**. This is an Internet site for Texas teachers in all grades and subjects to exchange information. They can post lesson plans, use a chat board, join a mailing list, and attend live, online meetings with speakers. **Grade level.** K-12 Pre-course skills assessment. No Virtual and/or live. Virtual Participants. **Location**. Texas, nationwide, and worldwide participation.	**Research base.** **Math Content.** -Integrates Texas-specific content with similar Teachers.net site that is global. -Math chat contents determined by users. -Math lesson plans **Pedagogy**.	**Participant assessment.** No **Certification**. No	**Discussion groups.** Chat rooms organized by grades, subject, and interest groups. Threaded e-mail, listservs, and live chats. **Discussions facilitated.** Yes, for many live scheduled online meetings.	

Texas

Programs *(Contacts and sources)*	**Learner-Centered** *(Learning environments)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment and Program Evaluation** *(Does the program assess and reward teacher performance?)*	**Other Notes** *(Miscellaneous information)*
3k. T-Star Online: Texas School Telecommunications Access Resource (T-STAR) http://www.t-star.org	**Type of initiative**. **T-STAR** was established in 1991 to provide telecommunication services to all school districts in Texas. School districts utilize **T-STAR** to acquire professional development, for-credit courses, and electronic field trips. Texas school districts can continue to obtain the same type of satellite programming with their existing **T-STAR** system from other providers. **Course Structure**. **T-STAR** includes online components as well as provides continuing professional development via the Internet with CPE Video On Demand. **Interaction**.	**Grade level**: K-12 **Math Content**. Professional development resources include mathematics content. **Pedagogy**.	**Certification**. Teachers can receive continuing professional development credits. **Recommend program to others**. **Program Evaluation**.	Because of budget cuts, **T-STAR** went off the air on May 17, 2003. However, **Texas Education Telecommunication Network (TETN)** will continue to train educators via satellite conferencing and possible online components. Refer to the **TETN** Web site for more information: http://www.tetn.net

Exhibit B-4. Colleges and Universities, Corporate Training Institutions, and Information Technology Foundations

Colleges/Universities

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
4a. Arizona State Understanding Teaching and Math-ed-ology (uses Technology-Based Learning and Research (TBLR) at ASU) http://ilearning.asu.edu/mathematics.asp **Program Evaluation**. None cited.	**Type of resource**. Online professional development: Math-ed-ology consists of 42 multimedia modules, and Understanding Teaching is an online interactive system that teaches professional standards for teaching mathematics. **Grade level**: K-12 **Pre-course skills assessment.** Math-ed-ology offers self-assessments at any time. **Virtual and/or live.** Virtual. **Participants.** Math-ed-ology is for teachers and Understanding Teaching is for teacher trainers. **Location.** Arizona	Research base. **All information is based on NCTM standards. Math-ed-ology work supported by the National Science Foundation.** **Math Content**. Math-ed-ology examples of content include: geometry, symmetry, spatial sense, problem solving, and money. Understanding Teaching content is the NCTM standards. **Pedagogy**. Math-ed-ology: expert commentary, animated sequences, self-assessments. Understanding teaching: real-world instructional environment using exploration, observation, lesson plan development, and video clips.	**Participant assessment**. Math-ed-ology offers self-assessments at any time. Certification. **Yes.**	Discussion groups. No. **Discussions facilitated.**	*TBLR* is an R & D unit at Arizona State University that developed both Understanding Teaching and Math-ed-ology.

Colleges/Universities

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
4b. University of Georgia/Georgia Tech – InterMath http://www.intermath-uga.gatech.edu **Program evaluation.** None cited.	**Type of resources.** Mathematical investigations that are supported by technology. InterMath includes a workshop component as well as an ongoing support community with a lesson plan database and a discussion board. **Grade level.** Pre-course skills assessment. Virtual and/or live. Participants. **Middle schools, with priority for historically underserved populations.** **Location**. Georgia	**Research base.** Malone and Lepper (1987) identify four sources of intrinsic motivation in learning activities: (1) an appropriate level of challenge, (2) appealing to the sense of curiosity, (3) sense of control, and (4) involved in a world of fantasy **Math Content.** Algebra, geometry, number concepts and data analysis aligned with Georgia standards. **Pedagogy** -Workshops built around problem-based learning (i.e., investigations) with a follow-on component where teachers design investigations for their own classrooms. -Ongoing system to support teachers beyond the initial laboratory/workshop.	**Participant assessment.** Yes. Electronic portfolio of projects. **Certification**. Graduate credit or staff development units can be awarded.	**Discussion groups.** Yes, Threaded discussion by math content area. **Discussions facilitated.** No. but participants can submit math questions to experts.	

Colleges/Universities

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
4c. Rio Salado Community College http://www.rio.maricopa.edu **Program evaluation.** None cited.	**Type of resources.** - Claims to be one of the first and largest online community college programs. -Offers education degrees in elementary, secondary, and special education through online courses. -Professional development for math specialists. **Grade level.** K-12 Pre-course skills assessment. **Placement tests available.** Virtual and/or live. Virtual and live (practice teaching) Participants. 20,000 (all subjects) **Location**. Arizona.	**Research base.** **Math Content.** -Elementary teachers required to take math methods. **Pedagogy**.	**Participant assessment.** In-person midterm and final exams. **Certification**. It has six associate degrees and 12 certificate programs.	**Discussion groups.** **Discussions facilitated.**	Accreditation from the Higher Learning Commission, a member of the North Central Association. The National Council of Instructional Administrators awarded the Exemplary Initiative in Educational Technology for the Online Post-Baccalaureate Teacher Preparation. It also received the Alfred P. Sloan Foundation Sloan-C Award for Excellence in Online Access

Colleges/Universities

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
4d. University of Maryland University College http://www.umuc.edu/gen/virtuniv.html **Program evaluation.** None cited.	**Type of resources.** Education degree programs available online. **Grade level.** Pre-course skills assessment. Virtual and/or live. Participants. **Location**.	**Research base.** **Math Content.** -The Master of Arts in Teaching (MAT) for students who hold a degree outside the field of education and wish to earn teaching certification in math and science. -Master of Education (MEd) with a specialty in instructional technology is designed for professionally certified pre-K-12 teachers and other educators who seek an advanced degree. **Pedagogy**. Online programs at **UMUC** allow students to interact directly with instructors and course mates through WebTycho, the university's own online delivery software.	**Participant assessment.** Yes, online quizzes and exams. **Certification**. Accreditation in Middle States.	**Discussion groups.** Yes **Discussions facilitated.**	

Colleges/Universities

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
4e. Teachers College of Western Governors University http://www.wgu.edu/wgu/index.html **Program evaluation.** None cited	**Type of resources.** Provides online, competency-based degree and certificate programs for educators and aspiring educators. It has the first national online teacher certification programs in elementary education at the bachelor's, master's and post-baccalaureate degree levels. **Grade level.** Pre-course skills assessment. Virtual and/or live. **Virtual** Participants. **Location**. Nationwide.	**Research base.** **Math Content.** Teacher certification, including BA and MA degrees in math. **Pedagogy**. Students earn their degrees by demonstrating their skills and knowledge in required subject areas through a series of carefully designed assessments. Programs developed use more than 10,000 state and national teacher standards and requirements, including 25 states' teacher performance standards and those from NCATE, INTASC, NBPTS, NCTM, and the National Reading Panel.	**Participant assessment.** **Certification**. Teaching certificates and math endorsements are recognized by multiple states.	**Discussion groups.** **Yes.** **Discussions facilitated.**	It is accredited by four regional commissions: Commission on Colleges and Universities of the Northwest Association of Schools and of Colleges and Universities; the Higher Learning Commission of the North Central Association of Colleges and Schools; the Accrediting Commission for Community and Junior Colleges of the Western Association of Schools and Colleges; and the Accrediting Commission for Senior Colleges and Universities of the Western Association of Schools and Colleges. It is also nationally accredited by the Distance Education and Training Council.

CORPORATE INSTITUTIONS

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
4f. Blackboard http://www.blackboard.com **Program evaluation.** None cited.	**Type of resources.** Provides a Web-based server software platform that offers academic and financial management applications. Building blocks allow third-party developers to extend software. **Grade level.** K-12 through universities. Pre-course skills assessment. Virtual and/or live. Participants. **Blackboard** serves a customer base of 5.4 million worldwide. Including 1,000 U.S. school districts in 42 states. **Location**. Worldwide	**Research base.** **Math Content.** **Pedagogy**. -Learning management system includes assessment management, assignment management, and content management and sharing, -Content management system includes learning content management, e-portfolio management, virtual hard drive management, and library digital asset management. -Portal provides central location for accessing district-level content or online communities.	**Participant assessment.** **Certification**.	**Discussion groups.** **Discussions facilitated.**	

CORPORATE INSTITUTIONS

[Cautionary Note: Sites Frequently Change; Check Site for Current Description]					
Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
4g.Click2Learn http://home.click2learn.com	**Type of resources.** Enterprise Suite: -Learning management -Content management -Virtual classroom -Collaboration center -Personalized delivery -Performance management -Information management -Simulation editor -Auditing Participants. Customers in many industries, as well as in the military, government, and Fortune 100 companies.				Training Magazine APX 2003 Award. Deloitte and Touche named **Click2Learn** one of the 50 fastest-growing companies in Washington state in 2001 and 2002.

CORPORATE INSTITUTIONS

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4h. NETg http://www.netg.com **Program evaluation** *The Next Generation of Corporate Learning* is an in-depth two-year study sponsored by **NETg's** parent, the Thomson Corporation. The study found that a structured curriculum of blended learning generated a 30 percent increase in accuracy of performance and a 41 percent increase in speed of performance over single-delivery options.	**Type of resources.** Structured, blended program consists of three key components: content, technology, and services. Claims it has the largest library of corporate learning resources in the world. Participants. Over four million learners trained by 1,000 employees.				

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Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
4i. SkillSoft http://www.skillsoft.com	**Type of resources.** -Learning solutions (e.g., multi-modality learning, reference ware library). -Technology solutions (e.g., search all learning resources, create content, multilingual, and personalized e-learning plan) -Customized solutions **Participants.** More than 4.5 million registered users and a customer base of more than 2,500 companies.				

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Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
4j. Apple Professional Development Online ttp://ali.apple.com/apdo/. **Program evaluation.** None cited for professional development.	**Type of resources.** Online resources primarily in technology applications -online courses; -atomic (short tutorials) learning library -educator resources -professional library. **Grade level.** K-12 Pre-course skills assessment. Virtual and/or live. Participants. **Location**.	**Research base.** **Math Content.** **Pedagogy**. -"Atoms of learning" — more than 4,000 short, video tutorials covering over 35 of the most common software applications -Over 180,000 K-12 online resources that align with every state's standards.	**Participant assessment.** **Certification**.	**Discussion groups.** **Discussions facilitated.**	Incorporates research learned from Apple Classroom of Tomorrow.

FOUNDATION

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Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
4k. Cisco Networking Academy Program **Program evaluation.** None cited for instructor training	**Type of resources.** Internet-based delivery of industry-aligned information technology courses worldwide. The Cisco Networking Academy curriculum is developed by education and networking experts, it prepares students for industry certifications, including Cisco Certified Network Associate (CCNA™) and Cisco Certified Network Professional (CCNP™), as well as Network+ certifications. **Grade level.** Pre-course skills assessment. Virtual and/or live. Virtual and live Participants. **Location**. Over 2,000 academies worldwide.	**Research base.** **Math Content.** **Pedagogy**. Provides for instructor trainee - Academy Instructors have 24 months to complete all requirements for CCAI certification. **- A**nnual self-assessment and goal-setting activities. -Train-the-trainer (thorough knowledge of the content portion of the training; model pedagogical practices; discuss and demonstrate the strategies used in the training so each instructor will be able to replicate the training; allow opportunities for instructor trainees to practice what they learn.)	**Participant assessment.** Instructor trainee results as shown by written and skills test data. **Certification**. Yes	**Discussion groups.** **Discussions facilitated.**	

FOUNDATION

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Programs *(Source and evidence of program effectiveness)*	**Learner-Centered** *(How does the program address teacher needs?)*	**Knowledge-Centered** *(What is the content of the program and is it research-based?)*	**Teacher Assessment** *(Does the program assess and reward teacher performance?)*	**Community-Centered** *(Does the program create teacher networks?)*	**Other Notes** *(Miscellaneous information)*
4l IBM's Reinventing Education http://www.ibm.com/ibm/ibmgives/grant/education **Program evaluation.** None cited for	**Type of resources.** Partnerships with education organizations to develop technology solutions designed to help support school reform efforts and raise student achievement. Includes 27 schools of education in nine states. **Grade level.** Pre-course skills assessment. Virtual and/or live. Participants. **Location**.	**Research base.** **Math Content.** **Pedagogy**. Nine Reinventing Education grant teams -- the urban school district and/or state education department, plus one or more colleges of education -provided with a Web-based instructional platform - Riverdeep Learning Village. -Portfolio of teaching tools educators can use to assist teachers. -Schools of education will integrate Riverdeep Learning Village into their course work for both pre-service teachers and in-service training to learn best practices in lesson planning, work with mentors and faculty for ongoing guidance and support, and access effective curriculum and practices. -School districts and states use for induction and in-service.	**Participant assessment.** **Certification**.	**Discussion groups.** **Discussions facilitated.**	

FOUNDATION

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4m. Intel Teach to the Future http://www.intel.com/education/teach **Program evaluation.** Self reports. The Center for Children and Technology found that 97 percent of participating teachers reported that the ideas and skills they acquired would help them successfully integrate technology into their student activities. Also, 96 percent of teachers said they would recommend the program to a friend or colleague. 88 percent reported that after completing training, they felt well-prepared to integrate education technology into the grade or subject they taught.	**Type of resources.** **Teach to the Future** helps both experienced and pre-service teachers integrate technology into instruction, and enhance student learning. Participating teachers receive free training and resources to promote effective technology use in the classroom. **Grade level.** Pre-course skills assessment. Virtual and/or live. Virtual Participants. More than one million teachers in 26 countries have completed training. **Location**. Worldwide.	**Research base.** **Math Content.** Intel also supports online algebra professional training based on TIMSS. **Pedagogy**. Teachers learn from other teachers how, when and where to incorporate technology tools and resources into their lesson plans. In addition, they are instructed on how to create assessment tools and align lessons with educational learning goals and standards. The program incorporates use of the Internet, Web page design, and student projects.	**Participant assessment.** **Certification**.	**Discussion groups.** **Discussions facilitated.**	

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