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ABSTRACT

This report describes the Adult Literacy Software Working Conference, which was attended by 52 adult literacy practitioners, software developers, hardware vendors, other educational technology specialists, policymakers, and researchers. The conference participants identified market, program and staff, and design and quality issues related to adult literacy software development and discussed potential roles and actions for each of the major stakeholders in adult literacy software development to achieve necessary changes and improvements in the field. The four papers presented are as follows: "The Adult Literacy Software Developer's Perspective" (Robert A. Lemire); "The Adult Literacy Software Marketplace" (Tim Songer); "Instructional Software Quality: More Possible than Ever Before" (Richard L. Venezky); and "Literacy Software User Concerns" (Lucy Tribble MacDonald). Working group reports are on the following topics: drafting Adult Education Act legislation fostering software development and use; creating an ideal public-private venture to support the production and use of adult literacy software; and designing an adult literacy software product prototype combining elements of instructional quality and pedagogical effectiveness. (MN)

NATIONAL CENTER ON ADULT LITERACY

MOVING FORWARD THE SOFTWARE DEVELOPMENT AGENDA IN ADULT LITERACY

A REPORT BASED ON THE ADULT LITERACY SOFTWARE DEVELOPMENT CONFERENCE

Joyce Harvey-Morgan
National Center on Adult Literacy
University of Pennsylvania

PRACTICE REPORT PR96-02
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The National Center on Adult Literacy (NCAL) was established in 1990 by the U.S. Department of Education, with co-funding from the Departments of Labor and Health and Human Services. The mission of NCAL addresses three primary challenges: (a) to enhance the knowledge base about adult literacy; (b) to improve the quality of research and development in the field; and (c) to ensure a strong, two-way relationship between research and practice. Through applied research and development and dissemination of the results to researchers, policymakers, and practitioners, NCAL seeks to improve the quality of adult literacy programs and services on a nationwide basis. NCAL serves as a major operating unit of the Literacy Research Center at the University of Pennsylvania.

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MOVING FORWARD THE SOFTWARE DEVELOPMENT AGENDA IN ADULT LITERACY

A REPORT BASED ON THE ADULT LITERACY SOFTWARE DEVELOPMENT CONFERENCE[1]

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Abstract

While technology offers great potential for the field of adult literacy, one of the major obstacles to maximizing that potential is the lack of appropriate, high quality software products available for adult students. The following major issues have been identified, by multiple stakeholders in the adult literacy software and technology arena, as obstacles: (a) purchaser confusion, (b) the disparate market, (c) the conflict between the organizational and the individual consumer markets, (d) lack of adequate training and understanding among adult literacy practitioners about technology and its use, (e) lack of quality and

[1]The Adult Literacy Software Development Working Conference was held on October 18–19, 1994 in Reston, Virginia. The conference was organized by the National Center on Adult Literacy in collaboration with the U.S. Department of Education Office of Vocational and Adult Education and its Office of Educational Technology. Fifty-two adult literacy practitioners, software developers, hardware vendors, and other educational technology specialists, policymakers, and researchers participated. Four issues papers were written prior to the Software Development Working Conference: (a) *Adult Literacy Software: User Concerns*, Lucy Tribble MacDonald; (b) *Adult Literacy Software: The Developer's Perspective*, Robert A. Lemire; (c) *The Adult Literacy Software Marketplace*, Tim Songer; and (d) *Instructional Software Quality: More Possible Than Ever Before*, Richard Venezky. (See Appendix A for these papers.) Conference participants were divided into working groups to address three different topics: (a) drafting legislation pertaining to adult literacy so that software development and use is fostered and supported; (b) creating the ideal public-private venture to support the production and use of adult literacy software in a particular region or state; and (c) designing a prototype of an adult literacy software product that combines the best of adult game products with what we know about instructional quality and pedagogical effectiveness. (See Appendix B for reports from the working groups.) This paper attempts to summarize and look beyond the conference, making recommendations for further actions in the policy as well as development and practice arenas.

technical standards, (f) gaps in particular areas of need, and (g) lack of targeted financial resources.

Major recommendations for change include (a) creation of an adult literacy market continuum that allows comprehensive delivery of learning to the home, adult literacy programs, and the workplace; (b) development of quality and technical standards for software; (c) more focused identification of new product needs; (d) development of collaborations that leverage expertise of practitioners and buying power; (e) development of more products that are scaled up or retrofitted to the adult market from previous product development; (f) development of financial incentives for public/private partnerships and other collaborations; and (g) allocation of a percentage of all federal and state program funds for technology purchase and related staff development. Potential new roles and actions can be defined for each of the major stakeholders—developers, practitioners, and policymakers—in order to make the necessary changes and improvements in the field.

There is a real future to the domain of software development for adult literacy. The needs are great and much can be accomplished for the benefit of all by moving this agenda forward. However, it will take the resources, efforts, and creative energies of all of the stakeholders involved working together to make this future a reality.

BACKGROUND

In recent years, a number of studies, including the Office of Technology Assessment's Adult Literacy and New Technologies: Tools for a Lifetime (1993) and Terilyn C. Turner's *Literacy and Machines: An Overview of the Use of Technology in Adult Literacy Programs* (1993), suggested that the use and expansion of computer technology in adult literacy programs is essential for meeting the adult literacy needs of this country. These studies describe the potential that technology has for reaching new and underserved groups of adult students at any time and place, providing effective instruction, increasing student retention, and streamlining adult literacy program management and communication systems.

Some programs have been successful in implementing technology, but most have not. Both the OTA report and Turner outlined how the nature and structure of adult literacy programs affect the expansion of technology use. General problems inherent to this field, such as the lack of financial support, reliance on volunteers and part-time employees, and the patchwork nature of the adult literacy service delivery system create obstacles for the implementation of technology. The obstacles to expanded technology use are exacerbated by lack of support and encouragement for technology use in instruction from both policymakers and educators (U.S. Congress OTA, 1993).

In order to gain a more detailed picture of the use of technology in the adult literacy field, the National Center on Adult Literacy conducted a major survey in six states—California, Illinois, North Carolina, New York, Delaware, and Pennsylvania. The goals of the survey were to learn more about the actual extent of technology use within programs, the purposes for that use, the types of technology currently in use, the attitudes and beliefs of providers about using technology, and the perceived obstacles to expanding technology use. Over sixteen hundred surveys were mailed to a broad range of adult literacy programs—in public schools, community colleges, community-based organizations, correctional institutions, and public libraries; the response rate was 33%.

Survey results (Harvey-Morgan, Hopey, & Rethemeyer, 1995) indicate broad use of computer technology among programs, particularly for administrative purposes, but very little depth of use within programs. While interest in expanded use of technology was high, few practitioners are currently using technology to its maximum effectiveness. Primary obstacles to expanded use of technology were lack of adequate funding, federal and state policy restrictions on purchase of hardware, lack of adequate staff training, lack of adequate information on technology and its application to adult literacy, and lack of appropriate, high quality software.

As a result of the OTA report, NCAL's national survey, and the Center's activities and interactions with the field, NCAL's technology initiatives were refocused and a revised mission was articulated. Addressing the complicated and interconnected set of issues relating to adult literacy software—development, market, and policy—was identified as one of the priority areas for the Center's technology project to address. Other technology priorities of the Center include (a) increasing awareness about technology and its use among adult literacy providers by gathering and providing user-friendly information through print and electronic media; (b) developing a wide range of electronic

tools for dissemination of technology-oriented publications, databases, and video materials; (c) researching and developing effective technology training models and support materials; and (d) identifying and evaluating leading-edge technologies for their application to the field of adult literacy and helping to keep the field abreast of these developments.

KEY ISSUES RELATED TO SOFTWARE DEVELOPMENT

MARKET ISSUES

Understanding and defining the adult literacy software market is a major issue. Developers are quick to differentiate between the institutional and the consumer markets. While some developers see particular niches within the educational market (e.g., corrections and community colleges), many suggest that the institutional market is fragmented, confused, and not very profitable. Because this market is very much in flux, consumer expectations continue to change, which results in rising costs.

The consumer market appears to have great potential for the development of adult literacy software. There are approximately 50 million potential adult literacy students, and many of these could be reached in their homes. While many adults who need the services do not have access to computer hardware in their homes, many others do. The incredible home market response to *Hooked on Phonics* is often cited as an example of the potential of this market. At the same time, the risks of marketing directly to consumers were discussed. People are still not very good at articulating what they want or need in relation to technology and therefore are not very good consumers. Identifying the "price point" (what the market will bear that will still result in a profit for the developer) is a difficult yet important task. Small businesses, some of which represent fairly innovative product development, are particularly vulnerable in this uncertain market.

One of the crucial issues faced by developers is how to reduce risk and costs while improving quality. There are big costs up-front for research, conducting focus groups and market surveys (generally one third of the entire cost of getting the product to market). Adequate product testing and evaluation are also very costly. The result often is a rush to complete the development phase and move the product to market. Marketing and sales also represent major costs. Developers know that in order to maximize product effectiveness, the price should include training and the cost of service after the sale, yet they are reluctant to increase the price to include these services and costs. Multiple-platform needs further escalate the costs. Small development firms, in particular, have a difficult time with the lengthy cycle time that is typical from start of development to penetration of the market (it can be as long as 5–6 years). As a result, many have adopted a "wait and see attitude" about the adult literacy market.

PROGRAM AND STAFF ISSUES

A range of program and staff issues affect software development and use. As noted, the lack of availability of hardware in adult literacy programs

is a major issue. In addition, the hardware being used in approximately half of the programs is seriously outdated and unable to run current software. As technology continues to change, staying current is an ongoing dilemma for this field.

Lack of adequate training is a major issue for technology use. It affects adult literacy providers' ability to effectively evaluate, purchase, and use software as well as technology in general. While there is increasing attention within the field on staff development and on planning for staff development, much more needs to be done to design and deliver comprehensive, consistent, high quality staff development to the field. Many adult educators do not use technology as effectively as they might, and many still exhibit some fear of technology. More training time must be made available as well as more ongoing training opportunities. The typical "revolving door" of staff and volunteers in this field will mean that training will always be needed. Adult literacy programs must look for new ways to provide technology training and to encourage and involve staff members in that training.

Design and Quality Issues

From the perspective of adult literacy practitioners, many products seem to be developed without the end user in mind. Much development appears to be modeled on standard educational approaches, and products are therefore not nearly as engaging to the learner as they should or could be. Many have been developed with little apparent understanding of or sensitivity to adult users, their need to be treated as independent learners and to be put in charge of their own learning. Effective software should support and encourage that role.

Many products are not user friendly; their effective use relies too heavily on the technical knowledge of the learner and/or the teacher. If a product is too difficult to use, even if the content is excellent, it may go unused in the classroom or not be purchased at all.

Specific product gaps identified by practitioners include good software tools for assessment and good software for ESL students, students with learning disabilities, and new readers. Because individual adult's learning needs differ widely, effective assessment tools are essential. Good assessment tools need to be developed that are diagnostic rather than based simply on the pass/fail model.

Many frustrations exist for adult literacy practitioners because of a lack of standards—both quality standards and technical standards. It is extremely difficult for practitioners in this field to make good decisions about software evaluation and purchase. The lack of any kind of commonly understood and accepted standards exacerbates the problem.

A frustration expressed by developers is the issue of intellectual property rights relating to technology, specifically the cost of electronic images. The cost of buying permission to use an electronic image is up to four times the cost of buying a graphic image for a textbook.

RECOMMENDATIONS FOR THE FUTURE

MARKET

More attention and focus need to be placed on both the institutional/program and consumer markets. Both of these markets have greater potential than has been realized. As noted by several developers, the niches in the adult literacy software development market are generally within one type of organization (e.g., community colleges, corrections). Developers might do well to focus more of their attention on these and other specific niches (e.g., libraries). In addition, developers should focus their efforts on the identified software gaps in the market (e.g., assessment tools, ESL products, and software for learning-disabled students and new readers). Developers need to keep in mind that they are not selling to highly trained adult teachers. It is difficult to sell new approaches with which practitioners are not familiar; developers should focus on the familiar. Establishing ongoing relationships between developers and practitioners would help this learning process and help practitioners to feel that they are part of the system.

The home market is without question a large potential market for adult literacy/adult learning. Technology can provide a range of learning solutions at home as well as in the classroom. When considering the expanded learning potential of the at-home market, it is important not just to focus on computer technology. While this is a significant part of the market, many potential adult learners will not have access to a computer in their home. Developers must look more closely at those technologies that are found in nearly every home (e.g., the television, VCR, radio/boom box, and telephone). These technologies offer significant under-utilized potential for instruction. There may also be a considerable market for developers to team up with these low-end technology vendors and provide computer-assisted support (e.g., in complement to adult education television programming).

In addition, perhaps the adult market should be viewed as a continuum, with the 50 million adults in need of literacy learning available in multiple arenas—including home, classroom, and the workplace. New instructional models are needed that include an integration of the use of technology at home with some hours/weeks of group instruction or work with a teacher. New, more flexible paradigms need to be created to change the way teaching and learning are viewed. A shift to greater emphasis and validation of at-home instruction might mean a shift in the role of teachers. In theory, teachers could be on-line 24 hours a day. The home/school connection provides many opportunities, for adult learning as well as for parent-child learning. Developers should learn from the success of *Hooked on Phonics*; what was sold was not just a product, but a solution to home learning issues.

The use of technology for instruction in the workplace is yet another important part of the adult literacy market. Increasingly, workplaces are recognizing the need to provide basic skills instruction for their workers. In addition to viewing this as one market segment, it should also be viewed as yet another part of the integrated adult market. Because a number of

employers are beginning to see the value of delivering computer-based learning in employees' homes, more attention should be paid to this part of the market.

PROGRAM AND STAFF ISSUES

Adult literacy providers must be offered more opportunities to learn about technology and what it can do for them and their students. Technology provides a potential set of tools to create a lifelong learning system, and educators must learn much more about its capabilities to help adult students accomplish learning goals. Software developers, as well as other technology vendors, must reconceptualize their role and their business. Perhaps just as important as providing products, they must also see themselves as providing services.

Adult literacy providers must engage in a re-thinking and shifting of paradigms around the teaching and learning processes. First, it is essential that they broaden their perception of their own role, realizing that they have become (or must become) learners themselves. They thus face many of the same issues that their adult students face, and likewise, they must take responsibility for and take charge of their own learning about technology. Second, many adult educators, while teaching non-traditional students in non-traditional formats, still have very traditional beliefs about the teaching process and teach in a very traditional way. Technology challenges the traditional teaching paradigm and offers the opportunity to consider new roles. No longer is the teacher necessarily up front and in charge, but she/he may become much more of a facilitator, resource person, guide, or coach. In fact, even for institution-based instruction, technology may result in the teacher and student contact occurring through electronic means. It is essential that adult educators reconsider traditional paradigms and even begin to identify the new opportunities available.

DESIGN AND QUALITY

A number of principles can be identified as important for the development of software. First and foremost, we need to move away from a slick, quick-fix approach to software development and instead to focus on basic instructional principles. Instruction ought to be engaging to the learner, address specific learning goals, relate to prior experience, and make the learner an active part of the learning process. Software needs to be instructionally complete (from introduction and application to practice and transfer), instructionally appropriate to learner needs, and of an adequate level of instructional sophistication. Software development needs to address the differences between adults and children. Adults are generally more motivated than children and can assess and monitor their own progress.

Content needs to include authentic adult tasks, with real world images. Simulations should be utilized to enhance learning, with the capability built in for the user to be able to go to a tutorial when additional help is needed. Much more use should be made of intelligent, just-in-time tutors for providing learning support. Software should help adults learn to learn—learning to develop and use strategies as well as skills to overcome obstacles. In addition, adult students should be developing technical skills at the same time that they are developing cognitive skills.

An assessment and tracking system should be built into instructional software, allowing both the learner and the instructor to be able to track short- and long-term learning gains. The ability to re-enter instructional activities where they were left (as opposed to having to start again at the beginning) is an essential feature as well.

Instructional software needs to address the issue of transfer of learning. Instruction and opportunities for practicing skills need to occur within a variety of contexts if transfer of learning is to be achieved. There should be a balance between specific skill-based activities and a more holistic integration of skills. Scaffolding techniques should be utilized for the teaching of complex skills.

Many issues related to hardware affect software use. Specifically, there needs to be greater interoperability of hardware platforms and fewer changes within platforms to increase access and ease of use. Frequent changes within hardware development create a disincentive for use of computer technology.

Greater ease of use needs to be built into more products. Software still needs to be more user-friendly to operate. In particular, software should have any instructions and/or training required built right up-front into it. As many note, ease of use is a high priority right along with quality—a higher priority in fact than incorporation of the latest ideas.

More products need to be designed that create a shell or structure into which individual organizations and individuals can add or change specific content. More modular and open-ended products like this could be adapted and customized to different populations, learning environments, and learning styles. Such modifications to the software would need to be particularly user friendly.

Developers should focus development efforts on the market gaps identified by practitioners—diagnostic and prescriptive software packages, bilingual products including multi-cultural content for ESL students, and software packages for learning-disabled adult students and new readers.

Given the ongoing state of limited resources, developers should concentrate their efforts on scaling up product development, for use on simple (Apple IIe) hardware to advanced multimedia workstations (Pentium, Power PC). Developers should also look ahead to emerging technologies and develop for anticipated availability and future delivery through cable and fiber optics.

Development of Standards

Standards should be considered that address quality criteria as well as technical criteria. Standards could offer cohesiveness to the field; a general set of standards would make it easier to develop quality software. Further, the field is interested in standards because the average provider/teacher does not have the time or expertise to ensure that software meets some basic criteria.

Many questions can be raised on how standards should be set and who should be involved in setting them. A committee might be developed (with representatives from the practitioner and developer sectors) to establish standards and that this would foster important dialogue and promote collaboration. Some would suggest that policymakers should not be involved in setting such standards; yet others believe such standards should be federally mandated. Collaboration in software development between practitioners and developers in itself would inherently help to develop standards. The process for developing indicators of program quality was suggested as a process that could be replicated to help resolve the standards issue.

One of the difficulties identified in setting standards is agreeing on specific competencies, as there is little consensus in the adult literacy practitioner world about what demonstrates success. What do we assess? There is difficulty in setting standards for curricula when the target is not understood or agreed upon. Concern is often expressed that while standards may make sense, they must flexible, not be prescriptive, and not stifle creativity. Individualized authentic assessment presents a very high standard for software development, but it would be very costly.

Some question whether standards are the answer and propose instead a much greater emphasis on educating practitioners with tools for evaluating software. Because software will be evaluated differently by different instructors depending on how the software will be used, a rating system might assist practitioners in evaluating software.

PARTNERSHIPS

Partnerships offer many possibilities for addressing a number of the issues surrounding software development and purchase. The development of partnerships between adult literacy providers and software developers could be extremely beneficial to both sets of partners. Developers could gain a clearer understanding of the software needs of practitioners by communicating with them directly. Organized networks of providers might be developed for this purpose. Developers could also gain direct access to practitioner expertise, particularly in specific niche markets (e.g., bilingual and ESL populations). These networks would allow developers to more easily tap into relevant information, issues, and trends (e.g., SCANS, new national educational goals, new skills standards, and a focus on competencies). In addition, literacy providers could offer assistance to developers in the testing and evaluation of new software. Developers need to know more about whether their products are really successful in accomplishing desired learning outcomes.

Collaborative partnerships among different groups of provider agencies (e.g., multiple states, consortia of organizations) could help to focus needs and pool expertise and resources. For example, if $500,000 were required to develop and market a robust software product that addressed a specific need identified by multiple entities as a high priority, 10 of these entities could fund this by investing 50K each. The result would be a product that clearly addresses providers' needs (and thus student needs as well) and reduces the risk factor for all the developers involved. Because the cost of acquiring an individual customer is high, this kind of pooled customer arrangement would decrease that cost and thus likely reduce product cost as well. This might easily be done within a particular institutional system (e.g., as it has been done in the corrections system for the development of an integrated learning system [ILS]). This might also be done by several states pooling resources such as their staff development (353) funds. More focused investment of limited resources would result, with the likelihood of higher quality and more relevant products being developed.

The federal government could play a crucial role in the development of such consortia. Several actions are possible. First, incentives could be provided for states to collaboratively identify needs, plan solutions, and pool and leverage individual state resources. Additional incentives could be provided for states that are able to access and bring additional resources to the consortium. Consortia that bring together and leverage federal and state funds should also be considered. Constraints that limit such creative and fiscally sound consortial

investment and purchasing arrangements (e.g., restrictive state sourcing provisions) should be eliminated at both the federal and state levels.

A new funding flow is needed for government/industry partnerships. The federal government should consider the development of SBIR-type funds for investment in educational technology development. New funding sources are needed to stimulate private investment in this area, funding sources that cut across department lines, in particular, and funding sources that can help small businesses acquire investment capital. Flexibility must be a part of such funding structures, allowing, even encouraging, for example, the inclusion of multiple partners and the funding of Beta sites.

Funding incentives could also be provided for product development that is involved with appropriate re-purposing or scaling up earlier development efforts and investments. Indeed, much more attention must be paid to, and incentives provided for, more effective leveraging of resources already invested.

PURCHASE

Numerous suggestions can be made to improve the software purchasing process. From the perspective of practitioners, removing federal and state restrictions is a top priority. In some cases, there are restrictions on software as well as hardware purchase. A standard procedure needs to be developed for purchasing software, with flexibility built in that, for example, allows textbook moneys to be used. The availability of information resource centers could help providers determine what to purchase when they have resources available.

On-line communication is a natural medium to facilitate the access to information and to link the different stakeholders with each other. (The recent on-line availability of NCAL's software database provides a new and important resource in this regard.) Organized purchasing consortia could help practitioners centralize their product evaluation expertise, increase the efficiency of resource allocation, and help developers with the problems related to distribution. Expanding this idea further, the development of technology hubs might be considered. Rather than duplicate efforts in every program, technology resources might be expanded at key sites, and low-cost access be provided to community-based organizations.

Developers should make changes that would make purchasing of software more expedient. These include revising licensing requirements, expanding site licensing options, providing more leasing options, and bundling software differently.

CONCLUSIONS

The issues surrounding software development and use for the field of adult literacy are complicated and interconnected. While there are no simple or obvious solutions, and while it is unlikely that many, if any, additional public resources will be made available, there clearly are actions that can be taken to improve the current situation. Most of these involve rethinking, reconfiguring, and re-allocating resources (knowledge, information, and decision making as well as financial resources) currently in the system. Each of the following stakeholders has a role to play in this process.

POLICYMAKERS

In order to move forward a serious agenda of integrating technology into adult literacy programming and instruction, policymakers at both the federal and state levels need to remove disincentives and restrictions on technology purchase (both hardware and software). Furthermore, policymakers should begin to require, by gradual increments, the use of technology in all publicly funded programs. This requirement should first emphasize administrative data collection and transferal. In succeeding increments, technology-based assessment and instruction should be emphasized. Programs should be required to set aside a specific percentage of every adult literacy program budget for technology use. This set-aside should include specific plans for technology purchase, maintenance, and staff training. Policymakers should also work to encourage inclusion of technology purchase and use for adult education and literacy in other related legislative initiatives.

Federal policymakers should engage in a national technology utilization planning process and should begin to require states to do so in turn. Likewise, states should require individual programs to begin to do technology utilization planning and annual staff development planning that includes technology staff development.

The many types of partnerships discussed above offer considerable potential for improving the development and utilization of software by the adult literacy field. At the federal level, policymakers can play an important role in encouraging and facilitating collaborations among states and perhaps offering incentives for the development of such partnerships. In addition, federal adult education/adult literacy agencies could collaborate with other federal agencies to identify possible funding sources for small business incentive loans or grants for public/private partnerships for software development. Incentives could be offered to developers for scaling up or retrofitting current software for the adult literacy market.

Federal policymakers might help to promote the home market as an important arena for adult and family learning by initiating conversations about tax incentives or tax deductions for purchasing learning technology for the home.

Federal policymakers might also take a leadership role in the development of quality standards for software development. Adult literacy policymakers might conceivably team up with K–12 and higher education policymakers to facilitate the development of quality standards across the whole educational continuum.

State directors of adult education can play a key role in organizing partnerships with other states and with developers for the kind of collaborative development and purchasing described above. Within their states, state directors have a key role to play in identifying staff training resources and facilitating the implementation of collaborations for staff training.

DEVELOPERS

Software developers should seek out the niche markets discussed earlier. Not only will this help them to better define a viable market, but it should allow them to better determine specific software needs. Developers, too, can play a key role in the development and facilitation of partnerships and consortia. They, too, should take the initiative to convene groups of practitioners within the same sector to help define product needs and perhaps to leverage multiple resources for specific new product development.

Clearly defined quality standards will help all stakeholders. The easier it is for practitioners and individual users to make sense of software options, and to review and evaluate software against a set of commonly understood and accepted standards, the easier the purchasing decisions will be, and the more likely it will be that potential users actually purchase quality software. Taking an initiating role in the development of standards may initially appear to run counter to the interests of developers; however, because it would help to decrease purchaser confusion and uncertainty, it is more likely to help to strengthen the market in the long term.

Adhering to principles of educational quality and pedagogical soundness is essential for the development of effective software. Regularly seeking out practitioner expertise and product evaluation will help developers to more clearly match development efforts with customer expectations.

If we are to capitalize on the potential of the home market for educational purposes and make it an effective part of the continuum of adult and family learning, the same educational quality standards should be applied to products designed to attract the individual home consumer as well. Developers can play a major role in helping to create and define the home market as part of this important learning continuum.

Finally, developers need to reconceptualize their role and take greater initiative to deliver solutions and service not just products.

PRACTITIONERS

Adult literacy practitioners, too, have a crucial role to play in the improvement of the software development marketplace. More education and training on technology use are high on the priority list of actions they must take. Practitioners must continue to increase their knowledge, taking advantage of as many formal and informal learning opportunities as possible to learn about what technology can do for them and their students. The more knowledge they have, the better they will be positioned to make effective evaluation and purchasing decisions.

They can take the initiative to organize development and/or buying consortia, identifying their peers and helping to organize them into more powerful constituencies. They should take the initiative to work closely with developers, to provide information on development needs, and to offer to provide evaluation feedback on new products. In addition, they should make their voices heard by both developers and policymakers about the need for quality standards.

Finally, practitioners must take a long, hard look at instructional practices and processes. The potential of technology for improving adult literacy instruction will only be realized when practitioners shift their thinking about the teaching and learning process, when they truly begin to focus on the learner, not the program, as the starting point of the learning process.

There is a real future to the domain of software development for adult literacy. The needs are great and much can be accomplished for the benefit of all by moving this agenda forward. However, major changes need to be made—in terms of response to the market, approach to product development, allocation of resources, attention to quality standards, and development of new kinds of partnerships and collaborations. It will take the resources, efforts, and creative energies of all of the stakeholders working together to fulfill the potential of this domain.

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APPENDIX A: CONFERENCE PAPERS

The Adult Literacy Software Developer's Perspective

Robert A. Lemire
Lexia Learning Systems, Inc.

The Adult Literacy Software Marketplace

Tim Songer
Interactive Knowledge, Inc.

Instructional Software Quality: More Possible Than Ever Before

Richard L. Venezky
University of Delaware and National Center on Adult Literacy

Literacy Software User Concerns

Lucy Tribble MacDonald

The Adult Literacy Software Developer's Perspective

Robert A. Lemire
President, Lexia Learning Systems, Inc.

INTRODUCTION

This paper is based on the experience of Lexia Learning Systems, Inc. Since its origins, Lexia has been dedicated to the mission of harnessing technology to the acquisition of reading skills, particularly for those with learning difficulties. The development cycle for Lexia's current creations goes back to 1983, when Ed Cole (a noted neurologist specializing in reading disorders), Lit Meeks (a noted radio astronomer, author, and staff scientist at MIT's Lincoln Labs), and I (an independent investment advisor with an MBA, some knowledge of corporate finance and management, and a sense of the prevalent tutorial intensive remedial approach applied to learning disabled students) first met to consider how we might arrange for the design and development of computer-based programs for students, teachers, and clinicians. Together, we combined the language of neurology as it applies to reading, the language of science and new technology, and the language of money. This quickly led to the postulation of a simple microcomputer station that could harness the visual, auditory, and kinesthetic modalities of computers to serve the multisensory human acquisition of reading skills. This in turn led to a $50,000 National Institutes of Health (NIH) prototype development grant and a follow-on $500,000 grant to develop and field-test software for the computer system developed and tested under our first NIH grant.

Our early software was designed to develop experimental diagnostic and learning experiences on a DOS-based platform. We believed that for many, the missing key to the acquisition of reading skills is a sure grasp of sound/symbol correspondence, related decoding skills, and automaticity. To begin developing an effective treatment of this complex human process, designs were kept fluid to accommodate the quickly changing perceptions of student/teacher needs. From the start, it was our intention to develop tools for teachers, not to replace the teacher with a machine. To us, this meant developing systems that can be easily used, that can be integrated into existing teaching programs, and can report on the performance of students on demand.

By the completion of the second grant in 1989, we had successfully developed a prototype system that fulfilled many of our design objectives. In the absence of grant funding, we reorganized our corporate ownership and obtained modest private funding to support us into positive cash flow while we prepared our diagnostic product for market. We developed a marketing and sales program, administrative support, and a corporate structure to facilitate the enterprise as we strove for positive cash flow at a $20,000 per month burn rate. Without this structure, we could not have attracted the private venture capital needed to fund our operations.

It is in this context that our core development team comprised of three educators and two software developers began their work, with all but one working as part-time consultants. It is then that we began to learn about the

wide mix of noncompatible hardware and operating systems, of different network and class management systems, of different voice and graphic systems, of the inefficient decision-making and purchasing practices of educational providers, of the need for key product reviews, of the need for dealers and catalog houses, of the high cost of advertising and conference attendance, of the need for clear and simple installation and operating instructions, of the need to copyright and copy protect, and of everything else needed to succeed, especially the ability to obtain needed funding.

We became involved in the adult literacy market when informed that a literacy center had conducted a controlled competitive trial between our software, which had been designed for children, and traditional literacy materials and had found that our software added to the learning experience despite its many childish design elements. We have since begun to adapt our early elementary grade software to the needs of older students.

OVERVIEW OF THE SOFTWARE DEVELOPMENT CYCLE

The software development cycle at Lexia usually begins with our three educators, who are skilled in special education and the traditional approaches to remedial reading. Having worked together with our team of software developers for some seven years, they have gained a strong sense of our technology's functionalities and design possibilities. Once the educators focus on an educational need that fits our technical capability and corporate mission, they need to explore possible design approaches. The process leads to a product definition proposal that can be shown schematically as follows:

- Educational Need (of students and teachers)
- Competitive Efforts
- Proposed Educational Treatment (context, content, and format)
- Modalities

Visual/Auditory/Interactive (product look and feel)

- Story Boards
- Activities, Units, Content (branching, scope, and sequence)
- Management System (student/teacher help)
- Reports (student/classroom/longitudinal)

After staff discussion, the educators' proposal is reviewed by the technical team to assess feasibility and resource requirements. This results in a preliminary design that can be analyzed for cost, time, and other resource requirements as follows:

- Technical Rendition (user/teacher interfaces)
- Design Elements
- Platform Considerations
- Development Trials and Beta Sites
- Documentation Requirements
- Development Schedule
- Preliminary Budget

The proposal is then considered for corporate implications as follows:

- Mission Compatibility
- Market Analysis
- Marketing Channels
- Cost/Price Analysis
- Cash Flow Projections
- Resource Availability
- Alternative Funding (includes internal cash flow, additional equity, loans, private label, other)

A tentative decision to proceed leads to final product definition including flow charts, features that will encourage purchase, a detailed line item calendar showing individual tasks, completion targets, task integrations, deliverables, outside involvements, and so forth.

Despite these planning efforts, we have come to realize that creative efforts cannot be expected to comply with rigid schedules. In our business, delays are a fact of life and commitments are made with a healthy allowance for contingencies.

CRITICAL PRODUCT DEVELOPMENT CONSIDERATIONS AND DECISIONS

A decision to proceed with a new product must be rooted in a comprehensive cash flow analysis that accounts for all costs to be considered from the beginning of development through field testing and modification, promotion, marketing, sales, and support. Projected revenues must take into account price/volume relationships, time to market, a realistic sales curve, and purchase payment realities. Multiple cash flow analyses must be run for risk analysis of sensitivities to development delays, surprises in the marketing channel mix, pricing problems, and other contingencies. The less the visibility, the more caution is needed. It is not enough to see that an important learning need can be served by a potential proprietary product that would make a significant user difference. Users must be represented by informed ready and willing buyers with funds to spend. Marketing channels must take into account buying habits. Risk can be reduced by starting with a low, front-end cost entry product that can bootstrap development of a full line of needed products.

PRODUCT QUALITY STANDARDS

Although we know of no definitive educational software performance standards, many states support educational product preview centers that have developed criteria and procedures for assessing educational software. We are particularly familiar with the Arizona Department of Education Technology Education Services. The Arizona process applies the following 21 criteria with a score of 1 to 5 each and an overall ranking based on their total out of a possible 105.

- Accuracy
- Educational Value
- Appropriate Use of Computer Capabilities

- User-Friendly Content
- No Program Errors
- Clear and Logical Content
- Instructions Well-Organized, Useful, and Easy to Understand
- Flexible Application
- Freedom from Need for Teacher Intervention or Assist
- Free of Bias: Racial, Sexual, Political
- Graphics and Color
- Sound
- Grade Level Appropriate
- Quality of Screen Formats
- No Need for External Information
- Simplicity of User Response
- Provides for Self-Pacing
- Appropriate and Immediate Feedback
- Branching Occurs Through Student Control
- Summary of Student Performance
- Degree of Student Involvement

Standards such as these create the opportunity for developers to produce products that will meet the needs of their audience. Based on our experience with Arizona, Connecticut, and other preview centers, we believe that it may be useful to create a centralized electronic bulletin board for effective communication about such standards between providers, publishers, and preview centers.

PRICING DECISIONS

Pricing is a function of supply and demand—what the product will cost at different levels of production and what users will buy at different price levels. It is not enough to estimate value added to teacher and student learning productivity. Other buyer options to serve user needs must be known and analyzed along with other needs competing for available user funds. A pricing structure needs to be set in the full context of projected unit sales and revenue levels, actual unit costs, marketing costs, operating costs, product development costs, and needed contribution to profit and overhead. Changes in the marketing channel mix, for example, can make a significant bottom line impact. Direct selling may cost up to 20% of product price while distributors and catalogs may cost 40%. Although a stable pricing structure contributes to an orderly market presence, in the end, price must be set to move product. Unpublished site license and district pricing, if any, can provide needed flexibility.

FUNDING OPPORTUNITIES FOR DEVELOPMENT

We know of no development grant sources for educational software. We have relied on private venture capital to complete our initial product development phase, which is drawing to a close. Without significant insider

loans, the willingness of some of our staff to work under uncertain financial circumstances while others of us work without pay, and the patience of our investors, Lexia would surely have failed.

We have been successful in fostering private grants for schools who wanted our products. We look forward to having sufficient internal cash flow to support development. We are fortunate to have a private labeling agreement with a major publisher. Royalty advances have made it possible for us to port product to the Macintosh and have contributed to the development of our adult literacy product. Moreover, this relationship will hasten broad market introduction of the subject products and provide a future stream of cash flow.

It is our goal to effect an initial public offering to establish a public market for our stock. With other educational software companies selling at price-to-earnings ratios ranging from 26 to 36, this would give us access to needed funding for all our corporate needs.

DEPLOYMENT OF CAPITAL

Although established companies may be able to deploy internal cash flow to basic technology research and experimentation related to education, we do not have this choice. If research and development funds were available to us, there are several areas that we would investigate. These include the adaptation of our products to limited English proficiency and English as a second language. We would also like to explore the adaptation of voice recognition and handwriting technologies to our product offerings. We are grateful for the NIH grants that provided the initial research that we continue to mine. We worry about possible government reindustrialization grants to weapons providers that might swamp our efforts. We are racing to generate internal cash flow that will enable us to address the opportunities that we see and secure a place in this emerging industry.

SALES AND MARKETING OPTIONS

We market to schools, clinics, literacy centers, prisons, corporations, and individuals as follows:

- Direct Sales and Advertising
- Private Labeling
- Distributors
- Catalogs

We find that many schools rely on trusted distributors for product suggestions, demonstrations, and in-service support. Although this costs some 40% of the product price, it is an essential part of our marketing mix. Similarly, we find that catalog fees are a cost-effective alternative to direct mailings and advertisements. We are hopeful that literacy sales will both leverage our school sales and help offset their seasonality. We may adapt our products for retail marketing when resources become available.

VIEW OF THE LITERACY SOFTWARE MARKET

The market for literacy software is in a formative stage. The potential for technology-based instruction is just now coming into focus. Provider experience with available products remains inadequate for their long-term planning and budgeting requirements. This results in a spotty and uncertain

market for publishers. Fortunately, there is growing evidence that available products are efficacious and should be made widely available to providers as we work together to advance the art of helping others learn how to read.

The Adult Literacy Software Marketplace

Tim Songer
Interactive Knowledge, Inc.

INTRODUCTION

According to a recent survey conducted by the National Center on Adult Literacy (NCAL) that polled adult literacy providers in six states, 73% of respondents reported using computers for instruction and an additional 14% who are not using computers hope to in the near future (NCAL Survey, 1995). Given this figure, one could extrapolate that of the estimated 2800 literacy providers operating in this country (funded by Adult Education Act funds), over 2400 are potential buyers of adult literacy instructional software. The question of what will be purchased by these providers and how will it be used is one of many key issues facing the publishers and developers trying to sell to this market.

This paper will look briefly at several critical questions related to the adult literacy software market. Specifically, it will address the literacy providers in terms of who they are, how large their budgets are, and what they are likely to buy. It will also address the types of instructional programs offered, how they are staffed, and the types of students who attend. Although the software market potential is large, the actual revenue to software publishers from sales to literacy providers is still relatively small. The final section of this paper will look at barriers facing those who would like to purchase software.

Some of data that are used to provide the answers to these questions were located in the following sources:

- *Adult Literacy and New Technologies: Tools for a Lifetime,* an OTA Report published in 1993 (cited as OTA, 1993).
- National Survey of Computer Technology in Adult Literacy Programs produced in 1994 by the National Center on Adult Literacy (NCAL; cited as NCAL Survey, 1995).
- *The Educational Software Marketplace and Adult Literacy Niches*, a report prepared for the OTA by Education Turnkey Systems in 1992.
- *Software for Adult Literacy: Scope, Suitability, Available Sources of Information, and Implications for Government Policy*, a report prepared for the OTA in 1992 by Jay P. Sivin-Kachala and Ellen R. Bialo (cited as Sivin-Kachala & Bialo, 1992).

WHO ARE THE POTENTIAL BUYERS IN THE LITERACY SOFTWARE MARKET?

NCAL surveyed over 1600 adult literacy providers in six states (California, Delaware, Illinois, New York, North Carolina, and Pennsylvania) about their computer use. Over 500 responses were received. According to this survey, the largest single group of literacy providers, 33% of all respondents, is made up of adult schools that are administered by the local school district. Other types of programs include community colleges (18%), community-based organizations (18%) and literacy volunteer organizations (16%) combine with adult schools to make up 85% of the potential software market. The remaining 15% of the potential market for literacy software is composed of providers that are located in libraries,

correctional institutions, churches, universities, and a variety of public and private education and training centers (NCAL Survey, 1995).

Not all literacy programs use computers with their students but a vast majority do. Seventy-three percent of the respondents to this survey use computers right now and an additional 14% hope to in the near future. Of the 378 respondents who report using computers, 342 used computers for instructional activities such as classroom instruction or tutoring. Other uses of computers are for administrative purposes (82%), assessment activities (31%) such as testing, advising or placement, or networking activities (26%) such as e-mail or file sharing (NCAL Survey, 1995). It's clear from this data that most literacy programs believe that computers can help them achieve their educational mission.

HOW MUCH MONEY DO THEY HAVE TO SPEND?

Eighty to ninety percent of literacy programs are funded with public money. Federal literacy expenditure is small in comparison with both other federal education programs expenditure and with overall state funding for literacy. Ninety percent of an estimated $362 million in federal appropriations for literacy programs (FY1992) comes from the Department of Education (OTA, 1993). This figure does not include JTPA, JOBS, SLIAG, Refugee Resettlement, Even Start, Head Start, and Chapter 1 programs. While those program funds are increasingly available for literacy activities, it is still difficult to estimate how much is reaching the literacy providers budgets. The important point is that Federal dollars for literacy have doubled between 1987 and 1992.

Even better news is that states have greatly increased their contribution to the literacy efforts, increasing total allocations from $74 million in 1980 to over $657 million in 1992. The majority of this money is going to community colleges and school districts where over 80% of the respondents to NCAL's survey who report significant computer usage can be found. This is a significant market for literacy software publishers since 51% of community colleges and 33% of adult schools report annual literacy program budgets between $200,000 and $1 million.

WHO ARE THEIR STUDENTS?

Adult literacy students cannot be categorized only according to where they receive their instruction because very few providers specialize in teaching just one type of student. Many literacy providers offer classes in English as a second language, GED training, tutoring for non-readers and other important basic skills instruction. The students' ages range from teenagers to octogenarians. They come to the literacy programs because they have a sense of what they are missing. Unfortunately, only a fraction of the adults, as few as 10%, who need literacy instruction are receiving it. There are a variety of reasons why so few of those who need basic skills instruction receive it. Many never set foot in an adult education program. But of those who do go through the intake process, fifteen to twenty percent do not stay long enough to receive any instruction. Typically, after forty weeks, an average of about 12.5% of students who began attending are still active in the program (OTA, 1993). This attrition rate is astounding given the relatively high motivation level that both students and teachers bring to these programs. Technology has an important role to play in improving retention in literacy programs. Students feel that learning computer skills is critical to their future employability. Programs that allow student access to computers often report that students will double their time in the program in order to increase their time with the computer.

The number of people in this country that will be in need of basic skills instruction, by all estimates, will continue to grow over the next several decades. Several factors, including high rates of immigration, rising rates of poverty, and increasingly higher literacy standards will contribute to the problem. The growing number of immigrants is creating increasing demands on literacy programs to be able to teach English language skills to their students. ESL students all need English skills, but many also are illiterate in their native language. This creates a more complex and challenging set of instructional problems since both English skills and basic literacy skills are required. This is a very time consuming task and threatens to absorb more and more of our literacy providers' limited resources. Without greatly streamlining the instructional process through better techniques and the infusion of technological solutions, ESL students might overwhelm literacy programs across the country. ESL enrollment nearly tripled between 1980 and 1989. Currently, at least 36% of adult education students are receiving ESL instruction (OTA, 1993).

WHAT KIND OF SOFTWARE ARE STUDENTS USING?

In their 1992 report titled, *Software for Adult Literacy: Scope, Suitability, Available Sources of Information, and Implications for Government Policy*, Jay P. Sivin-Kachala and Ellen R. Bialo identified 1,451 stand-alone software products that were suitable for use in adult literacy programs. Of this group of products, 60% were titles that were part of a larger series and 40% were individual products. Not all of these titles were designed specifically for adults. A great deal of software used by adult educators includes products developed and marketed to K-12 schools, but used with adults for a variety of reasons. It is difficult to determine how many products on the market were designed solely for adults. This study found that 82% of the software products identified were suitable for the ABE population while only 34% of the products were designed for ESL students. Although many new ESL software programs have been released in the past two years, ESL instructors still report a great deal of frustration at the lack of useful software options for their students.

It seems that there is great potential for the literacy market to absorb many more ESL software products. NCAL's survey results support this supposition. Of programs using instructional software, only 34% were providing computer access to ESL students, compared with nearly 50% providing access to ABE and GED students (NCAL Survey, 1995). There are probably a variety of reasons for this disparity, but availability of good software is certainly a critical issue.

The Sivin-Kachala and Bialo report found their 1,451 software products by reviewing five published software lists, a private educational product database and to a limited extent, surveying literacy provider sites. By contrast, NCAL's survey asked for providers to list software products that they were currently using with students. Over 600 individual product titles were listed by the respondents to NCAL's survey. By far the most popular type of software listed was drill and practice. The literacy software market is full of drill and practice programs. While it is clear that literacy students need a great deal of practice in acquiring new basic skills, a major reason for the domination of this type of product in the market is the limited capabilities of the computers that many adult literacy programs use. New, more instructionally complete programs that require more sophisticated computer

power (such as multimedia) are currently entering the market. There appears to be great potential for success in offering these types of programs since 80% of the providers using computers already have drill and practice software and are not likely to be looking for more. As the price for multimedia computer systems continues to drop, the potential market for instructionally sound software that utilizes the hardware's potential will grow.

HOW DO LITERACY PROVIDERS DECIDE WHAT TO BUY?

The programs that are most progressive in terms of their use of technology tend to have a well defined plan for the purchase of software to support their curriculum. If budgets allow, computers will be purchased to run the best software available to fill their instructional gaps. But often, the computers already in place limit the potential software choices. Many of the programs with limited budgets must purchase hardware one year and software the next year. Purchase decisions are rarely made in a vacuum, but the availability of reliable information regarding software recommendations is still spotty and rarely up to date. Over 90% of literacy providers make software purchase decisions based on word-of-mouth recommendations by their colleagues. This phenomenon has several implications for the literacy software market in general. It is difficult for new publishers to break into the field. Older products stay popular much longer than in other markets where the consumers are more up-to-date on the choices available.

The adult literacy software market is still young—in particular when compared to the textbook market. Because of this, purchase decisions are often made based on the recommendation of a colleague who is perceived to have more experience with software. The market will mature as the decision makers become more confident in their ability to understand what is good software and how specific products will fill gaps in their curriculum the way texts and workbooks might have in the past.

WHAT ARE THE MOST IMPORTANT BARRIERS THAT POTENTIAL PURCHASERS FACE?

There are a variety of reasons why literacy providers do not purchase technology. Funding is the number one issue (NCAL Survey, 1995). But it is not the only reason that more software is not purchased and used. Many of the barriers result from the nature of the literacy field and its reliance on part time and volunteer instructors. These people do not have time to learn computers systems and often do not feel comfortable with new software products. There is usually no budget available for paying part time instructors to be trained on using new technology. Software publishers can address the need for training by providing simpler tutorials for instructors as part of their products. Successful publishers have included very clear product documentation that instructors can read and understand. Early literacy software products, particularly integrated learning systems (ILS), had very complex student tracking and reporting capabilities that were difficult to use and interpret. Publishers are learning more about what information instructors need and are tailoring their reporting function to meet those needs.

Also, new multimedia products are more visually appealing and create the opportunity for a more intuitive interface that is easier for both students and instructors to use with ease. There is a need for increased funding of software purchases and, clearly, literacy software publishers cannot solve this problem alone. However, innovative publishers can address many of the other barriers

stated by providers. Many technology related fields require that sales and marketing efforts be very educationally oriented in order to convince unsophisticated purchasers that now is the time to buy. Successful literacy software publishers will follow this example by helping their sales staff become educational consultants rather than order takers.

WHAT ARE CLEAR TRENDS THAT MIGHT PREDICT FUTURE PURCHASES?

In a market that still seems to be overrun with products designed for Apple II and IBM AT computer platforms, it is difficult to predict anything beyond the hope that someday the majority of adult literacy providers will leave the 1980s behind..There are a number of powerful literacy solutions available right now that take advantage of advanced networking capabilities, multimedia, digital audio, digital video and CD-ROM. Research into the way adult literacy students learn and the need for interactive programs that capture their attention and create effective learning opportunities has led to better instructional software. But the software publishers will never succeed if their products are beyond the capability of their prospects' computers. The established base of hardware is still mainly older computers with few peripherals. These machines are slowly being replaced with new, inexpensive systems, many capable of running multimedia software. This trend toward purchasing of more powerful hardware systems is critical and must continue.

In its survey, NCAL asked programs to list important purchases that they would make given additional resources. At the top of the list are new computers and new software. The peripherals mentioned most often are CD-ROM drives followed by videodisk players and laser printers. This market has much catching up to do in terms of hardware acquisition and that seems to be a very high priority for most programs.

CONCLUSION

It is clear that technology has an important role to play in the literacy field. Appropriate software and access to computers will help move students through a literacy program more quickly and will help keep students in the program until they reach their goals (OTA, 1993). The adult literacy software market is still maturing and will require that buyers be better informed of the capabilities of technology. Software publishers must be prepared to take the lead in this process given the limited time and resources of the programs to train instructors on the uses of new technology. The market is growing and funding from both federal and state sources has expanded rapidly in the past decade, creating new opportunities for software sales. Specific populations, such as ESL students, are underserved by the literacy provider network and are given limited access to technology. It is likely that new software solutions for ESL students would be successful in this market, particularly since this population will continue to grow for many years to come.

The personal computer software market in 1990 was estimated to be over $4.6 billion. K-12 educational software sales were $230 million and adult literacy software sales were estimated to be only $10-15 million (OTA, 1993). Much has changed since 1990 that points to a growing opportunity in this market. The successful publishers in this field will find their niche in areas of growth such as ESL and/or multimedia and create their market through a positive, consultative sales approach.

Instructional Software Quality: More Possible Than Ever Before

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Improving instructional software quality, like improving morals and compassion in the countryside, is an ennobling goal to set, but is more often ignored than taken seriously. Instructional software producers are neither philosophers nor academic pedagogues. Most are connected to profit-desiring organizations that measure success in units sold and not in GED diplomas issued or words decoded. The textbook publishers have, for more than a century, finessed the quality issue for print materials, substituting glitz for pedagogical soundness. Why, then, burden the electronic publishing industry with such an issue? Won't developer pride and consumer pressure lead to satisfactory products? This brief paper, more an outline than a comprehensive treatment, is an exploration of both why the obvious does not lead directly to the desired result and what quality is or should be for the coming decade. Its focus is on quality of instruction, that is, the pedagogical elements of instructional software, with attention to not only what we should be able to achieve today, but what we should aspire to accomplish tomorrow. What is said here is meant for discussion and not as a vade mecum for evaluating courseware quality. The ideas offered are not fully cooked, but nevertheless ready to be chewed on.

WHY QUALITY?

The K-12 educational industry can give limited attention to instructional quality because children have little capacity for evaluating pedagogical soundness, and teachers, for a variety of reasons, are more focused on classroom control, student boredom, and teaching preparation time than they are on instructional methods. Therefore, the materials that keep student attention and require minimal extra work for the teacher are favored over those that might have higher instructional quality but require more teacher effort. But in adult education, these conditions do not hold. Adults usually prefer learning over entertainment and teachers are far more concerned about reaching a wide diversity of learners than they are about classroom control. Given the unattractive economic benefits of the adult education profession, the majority of the teachers who remain in the field do so because they are committed to helping others learn. Therefore, high quality courseware will, in the long run, win out over pizzazz and entertainment.

WHAT IS INSTRUCTIONAL QUALITY?

For discussion here, quality of courseware reflects two distinct classes of issues: pedagogy and implementation. In this paper, I am focused only on pedagogical quality: the instructional soundness of materials, their potential for inducing or encouraging learning, and how well they help instructors to be more effective teachers. I am not interested in the esthetics of screen displays, the robustness of programs, or the felicity of interaction between machine and student. These are all serious issues, but well known to the industry and well

intended to in a sufficient number of examples. Instead, I want to focus on pedagogical quality, the neglected stepsister of present day courseware development. My primary assumption is that the last 100 years of educational psychology has not been a Marx Brothers comedy or a demonstration of chasing after the wind. In spite of disagreements over methods, fuzziness of constructs, and vast lacunae in the theoretical and empirical landscape, a science of instruction does exist and is far enough advanced to inform courseware design. Quality courseware could reflect deliberate pedagogical design, with definable empirical support.

TYPES OF INSTRUCTIONAL SOFTWARE

Courseware quality cannot be evaluated independently of the goals of the courseware itself. However, the traditional classification scheme for instructional software—drill and practice, tutorial, and so forth—is outdated. What is most important for classification is not a unidimensional collection of categories but a set of descriptors that define components critical for instruction. For example, software tools appear to be distinct from simulation programs, but when intelligent help is added to a spreadsheet, this distinction begins to disappear. Instead of proposing another archival scheme for classifying courseware, I suggest three dimensions that are critical to instructional soundness and therefore could be objects of quality evaluation: completeness, appropriateness, and sophistication. These are not the only dimensions of instructional quality that are critical, but they provide a foundation for demonstrating how instructional quality might be defined and therefore evaluated.

COMPLETENESS

The first dimension is degree of instructional completeness. For teaching a concept, several phases are required in most instructional theories: introduction of the concept and linking it to what the learners already know; demonstration of its application or consequences; practice, which might be in any one of a dozen or more paradigms; and then transfer and maintenance. Within most of these phases, appropriate evaluation and feedback to the learner are assumed. A few instructional programs take on all of these components; others only do one or two. A program that provides practice in three-column addition with carry should not be criticized for failing to introduce this concept if, in fact, it does not claim to do so. On the other hand, a program that claims to be a complete instructional program but fails to attend to transfer of what it teaches is incomplete.

Because repetitive processes are generally easy to implement on a computer, drill and practice is probably the most common type of instructional software available today. But with inexpensive multimedia, opportunities exist for developing effective approaches to other components of instruction and for developing complete instructional packages. In mathematics, for example, application of particular formulas, such as those for computing the areas of geometric figures, might be shown in a variety of contexts, with challenges to find other applications within similar contexts. Similarly, with film clips, sound, and animation, students could be challenged to decide which science problem-solving techniques are most appropriate for problem scenarios adapted from everyday life.

Even within a particular component of instruction, completeness is an issue. A program that presents vocabulary words with multiple choice

synonyms in a drill format with no other appurtenances of instruction than feedback on correctness of response represents the lowest level of completeness possible. Further steps toward completeness would include retesting on items done incorrectly, diagnosis of student errors according to type of distracter chosen and type of word missed, presentation of sentence exemplars for words that students request help on, suggestion of mnemonics or other learning aids for words frequently missed, and summary statistics for the teacher, both on student scores and on item scores.

APPROPRIATENESS

The second dimension of instructional quality is pedagogical appropriateness. There is no exact science of instruction, and common sense still occupies an honored position, yet some ideas appear to be well enough established to be treated seriously. For example, discovery learning, no matter how appealing it may be in the suburbs, is rarely an efficient classroom strategy. For many basic skills such as those required for reading, writing, and mathematics, diagnosis and remediation approaches appear to be critical. That is, correct diagnosis of learner needs is important for instructional selection, yet most available skills programs offer only a single route for all learners, disregarding individual deficits in skills and knowledge. More sophisticated programs attempt to diagnose common deficits and misconceptions, and they provide appropriate remediation.

An the lower elementary levels, deductive learning is rarely successful. Telling first graders, for example, a rule for pronouncing the letter *c* is usually not an effective method for teaching decoding. At higher levels, such rules are not only appropriate but usually effective for learning. At issue here is both developmental appropriateness and subject matter appropriateness. Younger children, for example, are not particularly effective at monitoring their own learning and determining what they have achieved. Older children are more capable of doing this and appropriate instruction should incorporate such self-assessment as a technique for encouraging independent learning.

Determining subject matter appropriateness requires first a separation of fads from basic, empirically supported practice. Reading instruction in particular has been plagued for centuries by a meaningless methods debate that today pits whole language against phonics. Good reading instructors draw from both—and from a wide range of other ideas to adapt instruction to individual needs and learning styles. Current research in mathematics, science, and social studies teaching provides directions for building appropriate instruction in these areas. Research will not identify the one best method for teaching a subject; instead it identifies elements that are critical for learning to take place.

SOPHISTICATION

The third dimension is sophistication of instructional strategy (or strategies). The most common form of computer-based instruction, apart from drill and practice, is a form of direct instruction. The concept, idea, or procedure is told directly without metaphors, scaffolding, demonstration, or the like. This approach has its place, but instructional science has demonstrated far more effective methods for particular topics and particular learners. For example, scaffolding approaches show considerable promise in teaching many basic and mid-level skills. A procedure might be repeatedly demonstrated in different contexts, with increasing demands upon the learner so that in time the learner does the task completely without support.

Similarly, misconception approaches appear to have validity for certain types of science teaching. These require the construction of tasks that will reveal misconceptions, with carefully planned sequences for moving the learner from a particular misconception to the correct formulation of a concept. Sophistication is not a goal within itself. Sophisticated courseware will use instructional paradigms that are efficient and are appropriate for a task and a set of learners.

A further issue of sophistication concerns how a program interacts with the learner. Not all courseware can have natural language discourse, full tutoring, and deep diagnosis of deficits and misconceptions. However, the world of instruction has marched far beyond the simple correct-incorrect feedback of yesteryear. One critical need of high quality software is user modeling, that is, ongoing analysis of responses and of response characteristics to adjust either the content of instruction or interaction parameters. Learners who are responding quickly with the correct answer might need more challenging tasks, while those responding more slowly with high error rates probably need less challenging tasks. How much user modeling needs to be implemented is a function of the goals of the program and the instructional methods adopted; however, some user modeling should be found in all programs.

A CONCLUDING NOTE

Much more could be said here about the characteristics of quality software. But the message by now should be obvious, that whiz bang games, mindless drill and practice, and old fashioned behavioral paradigms have limited utility and will seldom score high on the quality charts. Adults in literacy programs usually have special needs that relate to why they did not learn to read and write while in school. Serious instruction for them requires appropriate and sophisticated instructional paradigms, with a high degree of completeness of instruction. Such instructional programs are necessarily complex and therefore are more expensive to implement than simpler ones. The potential payoff is higher, however, in that the probability of learner progress should be significantly higher. At present I know of no instructional program that a large number of instructors claim is truly effective in teaching some important set of skills or concepts. With higher quality programs, we should achieve this goal. With the multimedia capabilities that are now available on the market at reasonable prices and with the knowledge base now available for instruction, we should be able to develop and distribute programs that receive rave notices from both learners and instructors and which under critical inspection are judged to be of high quality.

To reach this goal, we need to establish quality standards that reflect an advanced, but changing educational psychology, and then motivate developers to reach for higher quality without stifling innovation. There will always be a place among instructors and students for smaller programs that focus on restricted sets of skills: practice for mathematical operations, vocabulary expansion, and the like. These should not be ignored, but rather evaluated with standards appropriate for their size and intentions. The main targets of the ideas advocated here, however, are the fuller instructional programs, integrated learning systems, and the like that could have a major impact on adult literacy instruction over the coming years. Lower technologies such as audiotapes and handheld devices are also of interest, but require pedagogical standards that are appropriate for their capacities. Left for

discussion is who should be responsible for drafting quality standards, how specific these standards should be, and how they might change as the knowledge base for them changes.

Literacy Software User Concerns

Lucy Tribble MacDonald

Literacy providers cover a broad spectrum from one on one volunteers to adult education instructors teaching at community colleges. Yet they all have a similar focus—adult education. This paper has been developed with input from this broad range of providers— a volunteer tutor program, a library-based literacy program, an adult education program, a deaf program, an ESL program, and a large adult education program at a community college.

This paper addresses three major areas of concerns related to software use— general barriers to technology use, learner issues, and provider issues. Since hardware and software concerns are often intertwined, this paper will include technology as it reflects upon software issues.

BARRIERS TO TECHNOLOGY

The following three basic barriers to the use of software need to be addressed before specific concerns can be addressed: why use technology, how to use technology, and how to find out about literacy software.

Why Use Technology

In a literacy setting that emphasizes the human resources, it is not always evident why technology should be used. Many literacy providers do not see technology as a resource, as a productivity tool, or as an aid to the learner.

The first breakthrough often occurs at the administrative level, when the provider can see increased efficiency in the use of record-keeping software. In the State of Oregon, for example, literacy providers firs received equipment and software in 1982 to track data and make federal reports.

How to Use Technology

Another major barrier to the use of software comes both at the pedagogical stage, when trying to decide how to use the software in instruction, and at the training stage, in learning how to operate both the equipment and the software.

If the technology arrives before either of these stages is addressed, it may sit idle, because the user has no training in its use, and there is no overall plan for fitting the software into the delivery of literacy services.

How to Find Good Literacy Software

A crucial concern is the lack of access to information about what technology/software is available for the literacy field. Frequently, providers will receive a grant and then desperately call around trying to find the appropriate equipment and software. Calling around does not refer to checking any adult literacy database, but rather randomly checking on what other sites are doing or calling a friend. As an adult literacy and technology consultant, I receive frequent phone calls when grants are due. Providers often ask me what to buy. However, my wish list may not be the best fit for them and their needs, but due to lack of time, they may buy someone else's

list of an integrated learning system (ILS), which they have only heard about and have not necessarily seen.

These are major, and sometimes hidden, barriers to the use of technology. Some publishers have addressed the issue of how to use technology with videos, such as Tom Snyder's the One Computer Classroom for the K-12 market or the Educational Activities pamphlet for adults, called How to Tutor with a Computer. To look at the curriculum as a whole and see where all the software fits, Educational Activities has developed a solutions matrix, which helps users see the whole spectrum.

COST

Once these issues have been addressed, then the provider is ready to address the issue of money. However, most providers begin here, without having a clear idea of where they are going. In fact, we know that money is not the primary issue, for we have seen sites that had plenty of money, but the technology still remains unused and undervalued by the providers. This is not to say that money is not important. It is.

The issue of money takes two tracks; funding the hardware and software and the actual cost of the software itself.

Funding

Funding barriers may come in grant restrictions, such as not being allowed to spend literacy dollars on technology or being limited to using a specific percentage. Other grants may allow for the purchase of hardware, but not software. Frequently budgets will have lie items for equipment, but software dollars must come out of meager materials and supply dollars.

Cost

The cost of the software itself is an important issue. What providers need is *affordable* software. Barriers occur frequently as a result of the way the market is structured. For example, if literacy providers are not affiliated with a school, they are frequently prohibited from purchasing from educational price lists.

Since many providers have limited technology, they are frequently unable to take advantage of bulk purchase pricing. Small providers with many locations may not be able to avail themselves of site licenses for software. There needs to be more flexibility in purchasing of software by providing lab packs, bundles, or alliances with schools for bulk purchases.

A hidden cost is the staff time required to learn the software and for training. Frequently, this cost is not factored into the funding equation.

ACCEPTANCE

Literacy providers themselves frequently have difficulty reconciling human resources and technology. Tutors are often drawn from retired or older populations, from people who did not have access to technology in their school days or in their adult years and therefore do not see the benefit of such technology.

Acceptance of the technology may come first from the younger learners. Older learners may fear that they might break the equipment; this becomes another barrier to the learning process.

Technology may be viewed by the administration as an afterthought to the program, not as an integral part of it. Computers may be seen as part of the clerical area of the program, not as part of the instructional area. Indeed, sometimes computers that are not highly used in instruction may be "recalled" to the office staff.

SOFTWARE

Adult literacy has been viewed as a spin-off market with, at best, redesigned K-12 software and, at worst, straight-across-ports of K-12 software. This engenders the very worst fears of the adults—returning to school, where they may have failed in the first place.

Software is needed that addresses this market directly. The focus needs to be on an adult audience, with adult needs and interests. Furthermore, the software should address such literacy issues as difficulty in reading, by providing auditory directions and considering bilingual directions as well. Any printed directions should be at the users' reading level.

Waiting for Godot Syndrome

Many providers are waiting for just the right solution to arrive. They may stay in the research and data collection stage, saying that there is no appropriate software or that research has not shown the benefit of the use of technology for literacy students.

They may have seen equipment being supplanted by newer, faster, and "better" machines. They may have seen good software die by the wayside for lack of support and lack of upgrades. They may have seen few ways to grow with the technology and, hence, experience a reluctance to begin. As they wait for the right t time, technology passes them by.

LEARNER ISSUES

Access

As the availability and use of telecommunications and new technologies rapidly increase, so does the possibility of creating an information and technical apartheid. One of the crucial issues that surrounding access is an issue of values—one which says that only the advanced learner should have access to technology. Individual learners compete for limited resources, whether they be in a lab, at an individual station, or at a library.

Another access issue is the mindset that technology must be a one-on-one medium. There may be ways to give learners greater access by developing collaborative ways to use technology and to use single computers with groups of learners.

Part of the learner access difficulty is the lack of knowledge of what is available. Library-based literacy projects may be know to the literacy providers but not marketed by the library itself, thus leaving a lot of downtime that might otherwise get used.

Lack of training for tutors and lack of interest in computers on the part of the tutors may also discourage student usage.

Applicability of Content

Many users dislike the perceived and real content of material designed for children. There is a lack of content that is critical to adults in the areas of life skills, workplace skills, and parenting. A related offender is the issue of graphics. While positive reinforcement is appreciated, juvenile graphics may be demeaning. Graphics are an extremely powerful memory tool that can be used to reward the learners and reinforce the topic. At the same time, they should be appropriate for the learner.

Ease of Use

A major barrier for students (and tutors as well) is the lack of a consistent interface from product to product. Software must be easy to use with audio directions and pictorial clues for moving from place to place. Products should provide a consistent interface across the wide range of software, so students do not have to learn artificial new steps with each piece of software.

There is also a lack of instructional consistency. This is often handled by the teacher and/or tutor, but it is distracting to the student. For example, sometimes the students are looking for a main idea, while other times they are looking for the topic sentence, totally unaware that these are similar concepts.

It takes time for students to realize what a computer can and cannot do. For example, the computer cannot spell for the students, but it can spellcheck content. The learner will still have to choose the correct spelling.

Finally, there may be a lack of software choices, leaving students to do the same lessons over and over.

ISSUES FOR PROVIDERS

One of the major issues for providers is how to weave the technology into the curriculum, not making it an add-on, but an integrate pat of the program. Some of the issues are:

- Should the software be supplemental to the program?
- Should the software be used as a substitute tutor?
- Should the software provide the instruction?
- Should the software be used as a productivity tool, such as in word processing, spreadsheets, and databases?

These are not mutually exclusive issues. However, they are major concerns that need to be addressed, because the answers drive the choice of software and the use of the technology.

Providers are also wrestling with how to tie software to existing text-based materials. How should they develop lesson plans for computer-based tutoring? And finally, should they expect tutors to develop their own computer-based lessons?

How do providers know if their software will meet the broadest needs of the learners? What will be the most cost effective and serve the largest numbers of students?

Providers need to sit down at the computer as the learners would and view software through learners' eyes.

WHAT IS CURRENTLY MISSING?

As we consider the broad usage of adult learners and the software currently available, a number of gaps become apparent. The following have been identified as some of what is missing:

- Software with a primary focus on adults with adult needs and interests.
- High interest/low level materials with reading level appropriate directions—auditory if need be and bilingual if need be.
- Reading and writing integrated interactive programs.
- Diagnostic reading programs with high interest/low level materials.
- High interest/low level software for Macintosh
- More CDROMs.
- Bundling of hardware and software.
- Reading programs with editors, that would allow students and tutors to add their own material—necessary in a whole language approach.
- Mini-authoring parts of packages would allow for adaptation or addition of material, for example, Word Attack, where you can add your own words within the shell.
- Comprehensive plans to see where individual pieces of software will fit. This way vendors can market to specific niches.

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APPENDIX B: WORKING GROUP REPORTS

Working Group I: Drafting Adult Education Act Legislation: Fostering Software Development and Use

Working Group II: Drafting Adult Literacy Legislation: Fostering Software Development and Use

Working Group III: Creating Ideal Public-Private Venture to Support Production and Use of Adult Literacy Software

Working Group IV: Designing Adult Literacy Software Product Prototype: Combining Elements of Instructional Quality & Pedagogical Effectiveness

Working Group V: Designing Adult Literacy Software Product Prototype: Combining Elements of Instructional Quality & Pedagogical Effectiveness

Working Group I:

Drafting Adult Education Act Legislation:

Fostering Software Development and Use

A. Activities that the legislation needs to support

The legislation must support the activities and purchases necessary to create a strong infrastructure which enables new models of instruction, greater access to the learning tools of the future for adult learners, and systematic means for increasing the effectiveness of adult education programs. To these ends, the specific activities which must be supported by the Adult Education Act include the following:

Building the Technology Infrastructure:

The purchase of hardware and software for instruction to expand the home and community-based access to effective mediums for instruction

The development of quality, scalable software, from audio to video, multi-media to broadcast/cable and on-line

The development of systems which support center-based instructional technology, distance learning, and new means of mass education

Coordinated Technology Planning:

The development of national operational standards for all software and for the integration of emerging technologies into adult education

The creation of a local, state and national technology plan which maximizes existing resources and supports the development of scalable technology initiatives.

B. Overview Section of the Act

Towards these ends, it is recommended that the new act include an introductory section which details the rationale for making technology more accessible to and for adult learners. Included in this rationale should be a reference to the widely accepted and proven effectiveness of the impact of technology in the field of primary and secondary education. This section should also reference the many ways that technology is included in existing sections of the act in order to enhance the ongoing activities supported by the act. In addition, this preamble would note the addition of an entirely new section of the act which will support the use of technology to address the potential for a currently untapped market of adult education software products.

C. Specific Changes to Existing Sections of the Act

C.1. State Grant Section –10% expansion of authorization level ($39 million). All new funds would support the following:

C.1.a. Purchase of software and hardware. States would be given explicit permission to spend x% of their state education grant dollars to support the costs of new hardware and software needed for instructional programs. Target 66% of the new funds for this purpose.

C.1.b. Funds to support the collaborative use of existing technology resources. Specifically, the act would allocate funds through the state grants that programs could use to pay the marginal costs incurred when accessing under-utilized computer or media labs already in place in public schools, libraries, job training agencies, and community centers.

C.1.c. $30,000 to each state to support the development of State Technology Plans. To encourage broad-based and practitioner-driven planning, states would be asked to detail in their annual state plan for the immediate year following the passage of the legislation, the process they will undertake to gather local input and direction for their technology plan. Included in this detail would be the description of input processes, partners, timelines and technical assistance needs. In the second year immediately following the legislation, states would be expected to include the outcome of this process—their state technology plan—as an integral part of their overall state plan.

Plans would be expected to be long term in nature and define goals for gaining access to technology and, where necessary, define any unique hardware, system, or software needs of the state.

Partners in the state technology plan development must include the following:

- Literacy practitioners
- Literacy researchers
- Literacy policymakers and grantmakers
- Public broadcasting
- Telecommunications companies
- Broadcast/cable companies
- Software developers
- Higher education agencies
- PICs/SDAs
- Public libraries
- Regional education centers

The state technology plan must develop options for the following:

- Joint purchasing of hardware and software
- Opportunities for distance learners
- Public/private ventures to expand hardware pool

Role of SLRC in providing technical assistance for practitioners specifically as needs relate to technology

The plan must be predicated on a preceding local planning process which provides input on the aforementioned and other issues. See Section C.3.b.

C.2. National Institute for Literacy Section

C.2.A. Explicit mandate to develop operational standards for adult education software development. Representatives from the following sectors should be included in the standards development process: practitioners, software developers, telecommunications companies, cable and broadcast companies. The Institute would be required to develop the process and plan in coordination with Linda Roberts' Office—see D.1.a.

C.2.b. Revise current language to enable the National Institute for Literacy to seek out and develop partnerships with national foundations.

C.3. 353 Section

C.3.a. $5.4 million to support 353 projects of local programs which help teachers and administrators integrate technology into their programs or classrooms, train teachers and administrators to use on-line services, and provide basic training for practitioners to ensure that they can provide substantive input into the state technology plans.

C.3.b. $6.5 to be granted to local programs to build and maintain technology-based systems for tracking and evaluating program effectiveness.

D. 1 New Section of the Bill

D.1.a. This section would direct that Linda Roberts' office be reformulated as a permanent Deputy Secretary's office with a specific set of responsibilities for coordinating state planning and developing a process for a national plan to achieve the technology goals laid out in the act.

D.1.b. This section would authorize the $100,000,000 for the purpose of addressing the shortage of high-quality adult educational software products.

The section would set parameters on acceptable processes for developing new products which would include the following requirements:

- All products be developed through a partnership, including the software developer, practitioners and telecommunications or broadcast/cable companies.
- All products be developed in a manner that makes the products scalable for planned mass use, i.e., a video that could be used in the future for a computer-based multi-media software product.
- Participants in the process would include public broadcasting, higher education agencies, software developers, literacy practitioners, Dept. of Labor, telecommunications companies.

- Planning and production grants would be available from these funds for projects of national significance conducted at a local, state, regional, or national level.

E. Moving the Bill

E.1.a. We need to find lead sponsors for the technology section who can be counted on to really stake a claim to its passage. Representatives/Senators who we may want to approach include Sawyer, Bingaman, Kennedy and Simon.

E.1.b. We need to find someone to draft the bill. Although we could approach the staff of the suggested senators, we may achieve our goal more effectively by finding a skilled bill writer who works with a selected group of people to draft the bill. Andy Hartman recommends that we go as far as we can so that the Congressional or Senate offices don't have to generate the work. They may not be able to follow through and they may not be willing to assign staff resources to the task of drafting the language. Andy also suggested that we package our ideas into an individual bill that could then be integrated into the Adult Education Act through the legislative process.

E.2.a. Our stakeholders analysis produced the following:

• State Directors	Some for, some against, a very powerful group that must be examined more closely
• White House	Linda Roberts should follow-up with Paul Diamond
• Providers	Most likely to be supportive if they do not perceive technology funds cutting into already meager program support. Therefore, the bill language will need to be clear about all technology activities being supported with new funds

Elementary and secondary education leadership may oppose this effort.

Supporters should include:

Software firms	National Coalition of Literacy
Research corporations	Vocational Ed. Community
The Business Roundtable	Dept. of Labor
The U.S. Chamber of Commerce	UAW
ASTD	Dept. of Ed.

Working Group II:

Drafting Adult Literacy Legislation:

Fostering Software Development and Use

Objective #1

Stimulate the development and use of learning technologies for adult learners.

Policy Items

- *An SBIR grant-like program to stimulate new content/ technology development.* The goal would be to emphasize the use of existing methods, practices, and resources and the scalability of such projects. The grant program would be managed by the National Institute for Literacy
- *A learner-based technology stamp act to both stimulate demand for literacy services and fund technology purchases by literacy providers.* This program would look like the food stamp program with a few changes. The stamps would be distributed by public libraries to adults with literacy needs by some sort of means test. The stamps would be turned into existing literacy programs that are funded under the National Literacy Act. Each stamp would have some sort of face value. The stamps when collected by a literacy program could then be turned into the Dept. of Ed. for money earmarked for technology.

Two ideals are taking place. First, programs would have an incentive to go out and find new students who had these stamps and thus build up the number of students served, and they would be rewarded with new technology. The more students they serve the more money they receive for technology.

Second, students would benefit by having programs look at them as consumers; thus programs would have an incentive to be customer oriented and students would benefit from the additional services. The program would be managed by the U.S. Department of Education.

- Program to provide seed grants to encourage cooperation between federal, state, public and private groups that provide literacy services. The goal is to get local groups to talk and develop ways to leverage technology resources to meet literacy needs in their community.

Objective #2

Ensure adult learners access to the National Information Infrastructure (NII).

Policy Items

- *Encourage community use of existing technology resources in schools and other learning sites.* Develop small grant program to provide funding for adult literacy incidental costs. Many schools and nonprofits have technology but don't allow access to adult literacy students because of the cost of incidentals, such as additional security, modems, etc. The grant program would provide incentives to open up access to adult literacy students.
- *Give priority NII funding to organizations/communities that provide community access points.* Develop concept of hubs so costs can be distributed and smaller CBOs can gain access at a low cost.
- *Ensure universal access for adult learners at the lowest possible cost* by encouraging corporations and nonprofits that provide access to NII to develop low cost options for adult learners.

OBJECTIVE #3

Incorporate technology into all adult education programs funded by the federal government. Include programs under Depts. of Education, Labor, HHS, Commerce, etc.

Policy Items

- *Require all federal education and employment and training programs to prepare a technology impact statement*
- *Provide funding for technology training/awareness and technology assistance to front-line literacy providers and policymakers.* Develop an Eisenhower-type program for adult literacy technology training.

OBJECTIVE #4

Leverage existing technology models and programs that have proven effective.

Policy Items

- *Create grants to re-purpose/re-task/scale existing methods, practices, and products that have a proven track record of success.* The goal is to take model ideas and demonstration projects and move them beyond their present scope.
- *Encourage the use of new technologies like distance learning, CD-ROMS, on-demand video programs, and on-line communications.*

Administration

Create an Assistant Secretary of Education for Technology to administer the funds, with a staff and budget.

Development grants to be administered by NIFL

Technology stamps to be distributed by libraries.

Funding

Sources for entire technology bill:

Money from Spectrum Allocation to be used for technology projects $300 million

Re-allocation from existing programs

JTPA, TIAP, IITF	$100 million	
Community matching	$100 million	
	Sub total:	$500 million
15% to adult education .15 x 500	$ 75 million	

Plus

10% set aside from adult basic education $ 30 million grants for stamp act.

TOTAL SET ASIDE FOR ADULT LITERACY $105 MILLION

Working Group III:

Creating Ideal Public-Private Venture to Support Production and Use of Adult Literacy Software

Proposed Product/Service:

1) Development of national standards for all segments of the adult literacy education market. These standards will be created to address the following critical components:
   - Computer hardware platform
   - Software development process
   - Reporting of product evaluation results
   - Accreditation of literacy "clinicians" who would help programs make and implement literacy software plans and decisions
2) Definition of all segments of the adult literacy software market, including:
   - Federal- or state-funded programs
   - Corporate-funded programs
   - Union-funded programs
   - Institutions without means for purchase of technology
   - Individuals who want further education, need to improve their literacy skills, have the means to purchase solutions but are not currently being served
   - Individuals who want further education, need to improve their literacy skills, are not currently being served and do not have the means to purchase solutions

Proposed Partners in this process

- Educational product developers
- State Literacy Resource Centers
- National Center on Adult Literacy
- National Institute for Literacy
- State and federal policymakers
- Literacy students
- Literacy providers
- Computer hardware manufacturers
- Telecommunications industry members

- Employers
- Associations
- Philanthropic foundations

Responsibilities and Roles:

Activity

1. Create a catalyst for starting the process
2. Charter the venture to be named PATS (Partnership for Adult Literacy Technology Standards)
3. Begin fundraising, develop a budget, and agree on a project timeline
4. Create standards, develop certification process, and develop process for endorsing products that meet new standards
5. Revise Student Loan process to allow borrowing to fund literacy instruction
6. Certification of:
   - Literacy products
   - Clinicians and practitioners
   - Students
   - Employees/employers
7. Dissemination of results, marketing of services and training of clinicians, practitioners and employers
8. On-going evaluation and revision of standards

Start-up Funding Sources:

Sallie Mae Human Investment Loan

Private Partners Seed Grants from:

- Software product developers
- Hardware manufacturers
- Telecommunications industry partners
- Employers

Foundations

Ongoing Funding Sources:

Revised Student Loan Program

Fees from:

- Clinician accreditation
- Product certification fees
- Learner competency certification from individuals or employers

State and local funding

Adult Education Act

Working Group IV:

Designing Adult Literacy Software Product Prototype:

Combining Elements of Instructional Quality & Pedagogical Effectiveness

Revised Charge: Design a prototype of an adult literacy software product that combines instructional quality and effectiveness

Goal: Build listening, speaking, reading, and writing skills in English, within a life-skills context

Target: Non-literate adults (16+ yrs.), non-English speaking

Description: A comprehensive multimedia package that enables the learner to become competent in the skills needed to exist in the USA today

Media: CDI
CD-ROM
Video cassettes
Audio cassettes
Speech recognition
Text-to-speech
Smart cards
Computer laptops
Video camcorder and/or digital still camera

STRATEGIES

CDI

- Used as support tool for delivery to whole group class as "warm-up"exercise and introduction of key vocabulary
- Collection of real world images/video clips to document and model lifeskill situations
- Build common experience base and knowledge for learning
- Model language interactions
- Deliver via large-screen TV or projection
- Springboard for dialog drills and paired practice

CD-ROM (Windows and Macintosh)

- For use in media/language lab by individuals/small groups

- Simulations with tutorials (as needed) to provide instruction
- Activities to reinforce language:
  - Letter recognition
  - Sight words/phrases
  - all activities embedded in a life skills context
  - Skills practice pulled from and put back into context
  - Problem solving
  - Decision making
- Understanding of technology tools that are used to communicate and to learn other ideas. Tools such as computers and videos.

VIDEO

- Independent use beyond the classroom
- Short clips with worksheets (integrated w/CDI module)

AUDIO-CASSETTES

- Listening skills/speaking skills practice
- Simple dialogs
- Individual (home) use
- Supported w/worksheets and/or workbooks

SMART-CARDS

- Provides method to store portfolio assessment
- Tracks learner's actual language skills development over time
- Documents and records computer-managed activities
- Provides portability for assessment tracking

TEACHER TRAINING

- Emphasis would be on the train-the-trainer technique
- Videos (with accompanying manuals) would illustrate actual classroom use of the system with students
- Electronic
  - E-mail to communicate among users of the system
  - Usenet group or listserv to "broadcast" successful strategies
  - Videoconferences
  - On-line action research to aggregate approaches and strategies tried
- Workshops/common interest roundtables at annual/regional meeting(ALT, COABE, AAACE)

INSTRUCTIONAL STRATEGIES OVERVIEW

- Build upon what good ESL teachers do effectively on a daily basis
- Allows teachers to demonstrate sound/effective methods

- Uses technology to facilitate warm up drills. Leads to other instructional strategies
- Integrates print with oral skill development
- Reading, writing, speaking, listening, math in all lessons
- Focus on simulation activities but can go to tutorial for help
- Content relevant to end user
- Modular approach serves different:
  - Learning environments
  - Audiences
  - Learning styles
- Different delivery methods (can pick and choose) print, CDI, CD-ROM, video, audio, software, speech recognition
- Easy to manage (instructor)
- Easy to use (student)
- Bookmarking
- Networking (for record keeping)
- Placement tests/oral assessment
- Certificate of attainment
- Smart cards
- Management component to prepare student portfolios

FOR HOME USE

- Videos with supporting print material (CD to print take home worksheets)
- Audiocassettes with supporting print
- Cameras –write story around photos for language experience approach
- Laptop for home use/family literacy
- Books (novels, etc.)

TEACHER TRAINING

- "800" or "900" telephone number
- Videos to demonstrate how product is actually used
- Hints from other teachers
- Use product and then follow-up teacher workshop

R & D ASPECT

- Linkage to research—emerging technologies, updating and refinements

Working Group V:

Designing Adult Literacy Software Product Prototype:

Combining Elements of Instructional Quality & Pedagogical Effectiveness

In this report we describe a prototype software designed to accelerate the development of literacy skills in individuals over age 18. Literacy is defined here as the ability to read, write, speak, listen, compute, think critically, and learn on one's own. The approach we are advocating is highly motivating and helps these learners find the confidence, skills, and knowledge necessary to be successful in work and society. An important feature of our prototype environments is that they are designed to support a variety of individual differences in linguistic and conceptual development. Our environments are effective because they engage learners in authentic tasks. In addition, our prototype environment provides scaffolds that support the learning activities. Because our prototype environment helps learners learn-to-learn, and helps them use technology to achieve authentic goals, learners develop important sets of cognitive and technological skills that will be useful all of their lives.

In the discussion that follows, we first document the need to dramatically improve the kinds of services that are available to adult learners. We then propose some basic principles for a prototype software environment designed to enhance literacy skills.

The Problem

The need to focus on literacy is clear from the research literature and is reflected in several recent publications, the Office of Technology Assessment Report, *Adult Literacy and New Technologies: Tools for a Lifetime*, and the National Center for Educational Statistics, *Adult Literacy in America.* Literacy skills are foundational for lifelong learning. Difficulties in reading, along with difficulties in acquiring the cognitive and metacognitive skills for learning through reading, are major reasons for problems throughout life.

The persistent problems that plague learners with low literacy skills have led to several discussions about potential remedies. One approach proposed is to teach academic survival skills while focusing primarily on vocational education to help learners develop a specific skill or trade. A second approach is to attempt broad-based remediation of academic skills.

A problem with many variants of the "vocational plus survival skills" approach is that skill training is often very narrow and does not help students deal with the highly probable fact that, given the increasingly fast paced nature of change in this country, people will learn new skills many times during their lifetimes and therefore will need learning-to-learn skills. A problem with the second approach, "academic remediation," is that it often

involves the same type of instruction that was not successful in the first place and therefore fails to have the positive effects that we all desire.

During the past decade, researchers from several different areas have begun to formulate a general approach to instruction that appears much more promising than either the "vocational plus survival skills" or the "academic remediation" approach. The new approach combines some advantages of each of these approaches while also placing them in a larger, more meaningful problem-solving context. For example, the new approach focuses on the notion of "cognitive apprenticeships" (see, for example, Brown, Collins, & Duguid, 1989; Collins, Hawkins, & Carver, 1991; Cognition and Technology Group at Vanderbilt (CTGV), 1990) that include much more emphasis on the importance of reflecting on and discussing strategies and procedures for knowledge transfer than do more typical apprenticeships that focus on skills training. In addition, the new approach acknowledges the importance of traditional academic skills and well-organized knowledge, yet it situates learning in the context of authentic, meaningful problems so that learners better understand why they are learning new information and when that information is useful. A major feature of the cognitive apprenticeship approach is that it encourages sustained thinking about issues over significant periods such as weeks and months.

Differences Between Traditional Instruction and Apprenticeships

A paper written in 1940 provides an excellent illustration of the difference between typical educational environments and cognitive apprenticeships. Entitled "Poor Scholar's Soliloquy" (Corey, 1944), the article provides a personal account of a student named Bob who is not very good in school and had to repeat the seventh grade. Many would write Bob off as having a low aptitude for learning. But when you look at the kinds of learning that Bob is capable of achieving outside of school, you get a very different impression of his abilities.

One part of Bob's soliloquy discusses the fact that the teachers don't like him because he doesn't read the kind of books that the teachers value. The favorite books he uses include *Popular Science*, the *Mechanical Encyclopedia*, and the Sears and Wards catalogs. Bob uses his books in the context of pursuing meaningful goals. He says of his books: "But I don't just sit down and read them through like they make us do in school. I use my books when I want to find something out, like whenever Mom buys anything second hand I look it up in Sears or Wards first and tell her if she's getting stung or not" (p. 219).

A little later, Bob explains the trouble he had memorizing the names of the presidents. He knew some of them like Washington and Jefferson, but there were 30 altogether and he never did get them all straight. He seems to have a poor memory. Then he talks about the three trucks his uncle owns and the fact that he knows the horsepower and number of forward and backward gears of 26 different American trucks--many of them diesels. Then he states: "It's funny how that Diesel works. I started to tell my teacher about it last Wednesday in science class when the pump we were using to make a vacuum in a bell jar got hot, but she said she didn't see what a Diesel engine had to do with our experiment on air pressure so I just kept still. The kids seemed interested, though" (p. 219).

Bob discusses other areas of his schooling, like his inability to do the kinds of (arbitrary) word problems found in the textbooks. Yet he helps his uncle solve all kinds of complex trip-planning problems when they travel together.

Bob also discusses the bills and letters he sends to the farmers whose livestock is hauled by his uncle and notes that, according to his aunt, he made only three mistakes in his last 17 letters--all of them commas. Then he says: "I wish I could write school themes that way. The last one I had to write was on 'What a Daffodil Thinks of Spring,' and I just couldn't get going" (p. 220).

Bob ends his soliloquy by noting that, according to his Dad, he can quit school at the age of 15 and he feels that he should. After all, he's not getting any younger, and there is a lot of stuff for him to learn.

Bob's soliloquy is as relevant to the 1990s as it was to the 1940s. It contrasts the difference between attempts to learn in typical school environments and opportunities to learn in the context of real-world apprenticeships such as the one that Bob received with his uncle. Our goal should be to develop learning environments with the advantages as an out of-school apprenticeship.

Design Principles of for a Prototype Software Environment

The design principles that underlie our prototype software environment are consistent with constructivist approaches to instruction and are grounded in well designed instruction. Specifically, our environment is designed to address several critical needs for accelerating literacy development as described below.

Instruction is set in a real-world context. The context for learning will involve real-world problems that literacy can help overcome. For example, imagine driving down the road and trying to follow written instructions to navigate to a place you have never been. You have to process an incredible amount of information in order to arrive at the appropriate location. This is a real-world task that many of us take for granted yet we do it often. The prototype software will be based around video-based interactive environments that present this type of problem to the learner. This gives the learner a purpose for developing these skills and places them in a context in which they might be used in the future.

Challenging and motivating. The prototype learning environment we are proposing will place the learner in real-world situations that are both challenging and motivating. The environments will be challenging in that the learners will be asked to build their literacy skills in order to successfully complete the real-world challenges they confront. These will be motivating in that the learners will be able to see that as they improve their skills they are able to succeed in more and more difficult challenges.

Modular with no floor, no ceiling. The prototype software is designed so there is something for learners of all levels. For example, instead of expecting all learners to successfully navigate the driving environment using written instructions, learners with less developed skills might simply be asked to find the exit off of the interstate by matching the word "exit" to the sign in the learning environment. Further, the environments are modular in that many different real-world scenarios could be developed and added to the environment. For example, modules could include shopping for items in a grocery store, traveling on public transit, or even finding the time and channel for a favorite TV program from a program listing.

Learner helps to set goals. In these environments the learner can set individual goals. For example, in the driving example, the learner could

decide that she/he simply want to work on identifying street names or they could set a more rigorous goal of traveling to a new place in real time following a set of written instructions.

Learner should be an active participant. In this prototype software the learner is actively engaged in the learning process. Instead of sitting back and receiving instruction, the learner has to actively seek information in order to successfully interact with the environment. For example, in the driving example, the learner would have to try to figure out where he was in relation to the written directions. If his skills were not sufficiently developed to do that on his own, he could use tools available to him to help make sense out of the information he was given. At any time the learner can request information or help from the intelligent tutor as described below.

Intelligent tutor provides just-in-time learning support based on learner level. A major component of our prototype system involves the use of an intelligent tutor that provides instruction to the learner at an appropriate level when needed. At any point, the learner as ask for help from the tutor, or the tutor can offer help if s/he determines that the learner may be having difficulty. As the learner navigates the system, the tutor monitors how well the learner is doing. If the learner is doing well, the tutor simply lets the learner proceed. If a problem is encountered, the tutor attempts to provide the learner with suggestions or information that will help the learner to continue navigating the environment in a successful manner.

Learning available anytime and anyplace. The learning environments we are proposing should be accessible to learners at any time in a variety of settings. For example, learners should be able to learn in schools, adult literacy programs, the workplace, or even at home. To make this possible, the software program must be delivered in a variety of formats. In addition to a ubiquitous CD-ROM format, the program should be deliverable over newly developing distributed media systems such as the ones being developed by the nation's computer and software companies, phone companies and cable systems. In sum, learning opportunities should be available at any time at any place.

Integrate both strategies and skills. The prototype environments will require the learner to use both strategies and skills to successfully overcome the challenges they confront. What we are trying to develop are a complete set of behaviors and cognitions that will help the learner succeed in the real-world, thus we want to go beyond a skills-only approach to learning.

Affordable. The cost of this system must be within the reach of all service providers. Because of the modular nature of this program, as well as the flexible delivery paradigm, the price-point for this software should be quite reasonable. For example, service providers could purchase modules as needed and continually add to the environment. Or through a system such as Bell Atlantic interactive media system, users could purchase instruction at a remote site, such as home or work, as needed for as long as they need it.

Summary

The goal in this report was to present the concept of a prototype software environment that can be useful for all learners who need to improve their literacy skills. It is our belief that a prototype environment designed with the principles discussed above would allow learners to develop meaningful skills that could be used for solving real-world problems in the home, community,

and workplace. Technology serves as a scaffolding tool that provides the learner with a powerful and meaningful learning environment.

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