ECS Issue Paper

Technology

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Excerpted from
Smart Desktops for Teachers

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Executive Summary

The Education Commission of the States (ECS) decided earlier this year to address the question of how emerging technologies can help educators deliver standards-based education to K-12 students. ECS undertook three different research activities, the combination of which serve as the foundation of this report.

ECS first issued a Request for Information (RFI), in June 2000, which attempted to gauge the level and types of activities relating to "smart desktop" applications for teachers. The RFI was sent to two groups: (1) chief state school officers and (2) for profit and nonprofit organizations that provide smart desktop products and services. A more exhaustive survey of the field is intended in the future. Forty-four respondents completed the on-line survey.

ECS then invited a select group of more than 30 policymakers, educators and vendors to a meeting in July. The purpose of the meeting was to convene shapers, influencers and end users of smart desktop systems to identify issues and share perspectives. Participants heard from panelists representing three perspectives: teachers, policymakers and state representatives engaged in forging a smart desktop framework. Participants then discussed how technology could help teachers align standards with curriculum, instruction, assessment and productivity tools.

Participants recommended that ECS and the states consider several items when addressing how states, districts and schools might make optimal use of emerging technologies to enhance teacher performance and student achievement:

1. Change state adoption policies. State policies for adopting instructional materials can be ill-suited for fast-changing technology products. Vendors who respond to a state RFP will often have created several new versions of the product by the time an administrative decision is made, resulting in a situation where teachers are unable to use updated correlations to standards because the material is too dated.

2. Adopt new ways of thinking about education. State policies must extend beyond teachers and classrooms to a learner-centric approach tied to standards, benchmarks and performance. Policymakers should also consider more flexible approaches to financing.
3. Share intellectual capital. Education policymakers and administrators should make use of research available from various organizations when developing smart desktop guidelines and applications. Moreover, such research and information needs to be shared widely if it is to achieve the cross-fertilization desired.
4. Use the Web as a vehicle for disseminating information. ECS should make the Smart Desktops for Teachers study available on the Web provide a forum for sharing ideas and information on this topic and report on district and state agency activities. In addition, participants were encouraged to testify before the Web-Based Commission via e-mail.

Finally, ECS asked members of its staff to conduct independent research on the subject. The independent research was then joined with the information gathered from the survey and meeting to produce the following report.

The report addresses a number of issues. The section titled "Teachers Using Technology" provides background on the new technology offerings and discusses various policy implications. The section titled "Survey of Vendor Offerings" summarizes findings of the survey of vendors. The section titled "Ideal Smart Desktop" outlines how emerging technologies may best be used to enhance teaching and learning. Scenarios, respectively titled "Mrs. Chavez …" and "Mr. Brady…" provide descriptions of smart desktop technology applications. The section titled "Conclusion" not only identifies state activity, but anticipates future developments.

Teachers Using Technology

A new generation of products and services aims to integrate technology into the core elements of teaching and learning. These "smart" tools, computer software applications that can be customized for personal use, can automate tasks, build on existing applications, provide a repository of often-used resources, combine data from multiple sources into a central database and uniquely reconfigure data from multiple sources to meet individual user needs.

This new technology promises to transform education through tools organized on "smart desktops" for teachers. Businesses operating in the private sector have long used smart tools to manage and analyze information, make decisions, share knowledge, avoid redundancy, and train staff; but it is only recently that such Web-based tools have been made available to teachers. Teachers can now use electronic grade books, diagnostic testing and prescriptive instruction to monitor and modify student progress. They cannot only store, share and modify lesson plans and resources, but also capitalize on techniques for quickly interpreting data and modifying teaching strategies. Such technology – whether it is based on a system providing a single function or a system designed to provide a fully-integrated environment, which anticipates user questions – promises to close the accountability loop between standards, classroom practice and testing.

Smart Desktops Defined

A smart desktop is best defined as a Web-based environment, through and in which teachers can:

_ Find instructional resources correlated to standards
_ Create, customize or access lesson plans juried by their peers
_ Create syllabi and activity journals
_ Communicate and collaborate with peers
_ Store and retrieve information about individual students
_ Get "just-in-time" training and professional development
_ Conduct ongoing, diagnostic testing
_ Use timely information to make school improvement decisions
_ Exchange information with parents and students
_ Use productivity tools, such as electronic grade books and calendars.

Smart desktop technology also suggests improved cost-efficiencies within education and across society. This technology allows teachers to combine their instructional repertory – curriculum, content, assessment, professional development, instructional tools and productivity tools – with student academic standards for as little as $4 per student per year. It also allows parents access to the system at any time of day from outside the school building, removing barriers for increased parental involvement.

Finally smart desktop technology offers new means for gathering and analyzing data within the classroom, throughout the school, across districts, around the state. Teachers can now ask previously unanswerable questions about what works to enhance student achievement. They can conduct high-stakes tests, analyze and distribute the results, and prescribe interventions to enhance student achievement in a timely manner. In short, smart desktop applications offer "real-time" means for teachers to assess and respond to student needs.

It is for these reasons that both education and marketplace forces have been influential in the development of smart desktop systems. Investors view technological developments in education as a great market opportunity. Merrill Lynch & Co. estimated the e-learning market for grades K-12 alone to be $1.3 billion in 1999, increasing to $6.9 billion by 2003. Smart desktop technologies, fueled by capital investments, have driven established and start-up companies alike to compete for a foothold in this marketplace.

And it is not only educators and businessmen who are interested in smart desktop applications. States and districts also are shaping smart desktop tools to enhance teaching and learning, in order to close the gaps between standards, testing and classroom practices. Some agencies have designed their own systems, contracting with vendors for needed components.

State policymakers and education administrators need to be cautious, however, when dealing with vendors of emerging technologies. There are often hidden costs that extend beyond development. These costs include purchasing software, expanding system capacity, initial implementation, ongoing support and staff development. Smart desktops also can pose new problems and raise new policy questions. The use of individual student data, assessment data and performance data raises concerns about privacy, information misuse and poor analysis of data. Education decisionmakers and implementation teams would do well to consider all of these issues and concerns early in the decisionmaking processes.

Critical Questions for Decisionmakers

State policymakers and education administrators face a complex task when attempting to bring smart desktop tools to educators within their states. The following questions serve as guideposts to help state policymakers and education administrators work through options as they read through this report and develop their own Smart Desktop applications and policies:

General Policy Questions

- What is the role for states: are they obliged to provide an overarching framework within which schools and districts can participate in order to meet standards, or are they merely to support independent development by schools and districts?
- With a number of private sector companies indicating their products are correlated to state and national standards, what oversight is and should be provided for correlation of standards?
- Should the emphasis be on student achievement, teacher productivity, or both?
- What kind of a system meets the role decided upon: a large statewide system, a more moderate districtwide system, or a school-specific program that addresses specific educator needs?
- What barriers will educators encounter through such a system?
- What incentives might be developed to promote desktop applications within the decided system?
- How will the project relate to or change other state or district technology infrastructure plans?
- Does the state have a responsibility to train educators in the proper analysis of data in order to make the best use of data for making decisions?
- Will educators be held accountable to new standards in the proficient use of technology for improved teaching and learning?
- Should states consider an adoption list for Web-based content providers, as many states require of textbook companies?
- Is the state, district or school willing to commit the revenues required to realize desktop applications cost (e.g., costs for a large district might exceed $1 million plus per year)?
- If larger school districts can afford such systems, ought not the state assist smaller or poorer districts in acquiring similar tools?

_ If teachers make assignments and resources available to students and communicate with parents *via* the Web, should remedies for equity or equipment be available to those students who live in remote areas or have no access to the Internet outside of school?

_ Will disparities in access increase the "digital divide"?

_ What services should be provided to students?

_ Who ought to provide them?

_ Who ought to pay for them?

_ What are the costs?

_ What type of funding mechanism will be used?

Implementation Issues

_ What level of financial commitment is needed to implement and maintain this effort?

_ What infrastructure is required to support Internet access?

_ What is the quality and speed of Internet access for educators, in both urban and rural areas?

_ What are staff development and training needs?

_ How will the new system make instruction better, faster and easier for teachers?

_ Should incentives be provided for teacher participation?

_ What provisions should be made for technical support, training and professional development?

_ Does the system incorporate high-quality professional development modules for teachers available on demand (e.g., via text, video or a combination of both)?

_ What programs are needed to facilitate user feedback and ensure that the system is bug-free and user friendly?

_ Does the system provide the training to develop skills in data analysis?

_ Does the system allow for assessments of teacher competency and content knowledge?

_ Should there be a relationship to state assessment requirements?

Vendor Selection

_ Is the quality of resources (lessons, materials, user interface) in keeping with the team's expectations and the agencies' other resources?

_ Are the resources truly correlated to the standards? By what process?

_ Is the system architecture truly an open one: i.e., can I use assessment questions or resources from a different vendor?

_ How is the privacy of student records protected?

_ What technical support is included? How are fees for additional support calculated?

_ What role does the firm play in the roll-out or implementation phases?

_ How do references rate the firm in terms of support and implementation; i.e., do they answer calls and requests promptly when "bugs" are encountered?

_ What is the firm's reputation among education clients?

_ What is the firm's track record and staying power in a competitive market?

Components of a Smart Desktop System

If the goal of building a teacher's toolbox is to improve student achievement, several components are necessary. Four of these components are identified as "cornerstones"; i.e., those elements most vital to enriching student learning. The cornerstones are Standards, Instructional Support, Assessment and Professional Development. Additional components include Access and Reporting Levels for various stakeholders, Data Collection and Analysis, Web-based Delivery, System Implementation and Teacher Productivity Tools. All are accessible as a smart desktop tool using current technology.

Table 1

Components and Definitions of a Smart Desktop

Note: ☐ = A cornerstone to higher student achievement

Component	Definition
Standards Database ☐ Local/District State National	The smart desktop system includes an on-line database of district, state and/or national standards. Ideally, the standards drive the development and delivery of other components.
Instructional Support ☐ Integrated Curriculum Strategies Learning Activities Lesson Plan Database/Templates Focused Tutoring/Assignment Management Research Database	The technology and software support an integrated approach to instructional delivery derived from the standards. It includes an on-line database of standards-correlated lesson plans. Teachers may direct assignments to students, including remedial or advanced variations depending on student needs. Teachers may access research-proven instructional strategies, examples of best practice and other research materials for on-demand training and development.
Assessment ☐ Creating Assessments Scoring Training/Guides Exemplary Student Work *Assessment Reports and Analysis* Curriculum-embedded assessment Stand-alone tests (state, entrance) Monitoring Progress On-line Assessment	Software guides teachers through the development of assessments to determine student mastery of material. Training for scoring performance-based or portfolio material is available, including examples of student work at multiple levels of mastery. Reports and analysis allow teachers to diagnose student strengths and weaknesses, prescribe learning activities and monitor progress. On-line assessments allow for rapid scoring and provide teachers with more time to analyze the results.

Component	Definition
Professional Development ☐ On-line Course Email Web Collaboration Face-to-Face Video/Quick Time	Software and tools are available for training. Systems offer opportunities for educators to advance all areas of teaching competencies through on-line courses and refreshers, discussions and collaboration with colleagues, and shared lesson plans and resources, including video-based examples of best practice.
Access and Reporting Levels Teachers School/District Officials Students Parents Community Members Preservice Teachers Teacher Educators	Educators, students and stakeholders have varying levels of access to tools, data and reports depending on need. Teachers may have access to such tools as an electronic gradebook, calendar, curriculum and content databases, etc. for the classroom. Students may be able to access assignments, works in progress, scores and resources anytime, anywhere Web tools are available. Principals may see schoolwide data and comparative data for the school and schools with similar demographic/SES profiles in the state. District administrators may see an aggregate of student information across schools. Parents may see the student's classroom assignments, test scores, absences, resources for home study, etc. Preservice teachers and colleges of education may have access to and training on the smart desktop system.
Data Collection and Analysis Data Analysis Data Mining/Data Warehousing Performance Comparisons Student Skill Inventory/Portfolios Web-posted Progress Reports	Comprehensive smart desktop solutions integrate student information systems with curriculum, instruction and assessment components. This allows for systematic data analysis and performance comparisons, data-based decisionmaking, and information sharing among all stakeholders in the educational effort.
Web-based Delivery Education Service Providers District- or State-Operated Systems	Districts and states may outsource all or portions of smart desktop systems to organizations that lease applications, thereby saving costs in equipment, software licenses and technical support. Alternatively, districts and states can run their own IT systems and seek outside providers for specific components. Most education agencies contract with vendors for at least part of the smart desktop system.

Component	Definition
System Implementation Training and Professional Development Train the Trainer Self-paced Tutorial Face-to-Face Technical Support	A carefully planned implementation can determine the ultimate success or failure of any technology endeavor, especially one as powerful as a smart desktop system. Decisionmakers buying vendor products need to know specific training and support items included and the costs of additional consultations. Other implementation factors include additional staff training and troubleshooting, and teacher time to assimilate and adapt tools in productive, innovative ways of enhancing student achievement.
Teacher Productivity Tools Assessment Reports/Test Scores Electronic Gradebook/Attendance Electronic Report Card Calendar Syllabus Creator	Smart desktops may provide a variety of productivity tools that teachers can use to manage, analyze and share information.

The Ideal Smart Desktop

If an individual were attempting to create an "ideal smart desktop" for teachers, he or she may consider building the system around the following components:

1. Standards. The system would provide Web-based links to local, district, state and national standards. The Workspace Toolbox would contain the standard specific to their grade and subject matter, so teachers would not have to "search" for the standard. "Common denominator" standards would eventually be developed and incorporated into the system, creating an "ease of use" across district and state lines while retaining the integrity of the learner outcomes.
2. Pedagogy/Learning Activities. The system would provide teachers direct links to standards-based "learning activities" and "teaching strategies." Embedded in the "learning activities" and "teaching strategies" would be considerations for best practices founded on brain-based learning. Theme-based units, project-based learning, inquiry-based learning, discovery learning and cooperative learning strategies also would be available for exploration and consideration. Each activity and strategy would ultimately be linked to research supporting its use. (Video "refreshers" and case studies also would be available.) A specialized subdivision of instructional strategies would integrate technology within classroom settings, as well as within distributed learning environments. Scenarios could include using one computer in a classroom, combining standards with technology integration, reaching into the home and community, and using technology to write journal entries or to record observations outdoors (e.g., with probes).
3. Resources. The system would integrate text, voice and videos of best practices in instructional delivery, classroom management and assessment practices. Other resources would encompass video, digital and printed materials that could be purchased directly on-line. Music, photos, virtual fieldtrips, virtual dissections, simulations and cyber-student collaboration projects also would be included. The Workspace Toolbox would include such standard pieces as on-line encyclopedias, dictionaries, museums and libraries. It also would include tips and techniques for integrating technology to meet learner outcomes, all of which would be complimented with video examples of successful practices ranging from the one-

computer classroom to the use of mobile technologies. Resources also would be cross-referenced with those housed at the local, regional and state levels for teacher check-out. Specialized subdivisions of such resources would involve:

- Meeting the needs of special children
- Bilingual teaching strategies
- Challenging the gifted learner
- Content-specific strategies of integrating technology to meet learner outcomes
- The teaching of reading in grades 5-12
- Basic math skill-building strategies (aligned per standard and "learner activity").

Resources would be kept current to address emerging challenges and student needs as reflected in data-mining from the Smart Desktop.

4. Assessment and Evaluation of Student Learning. The system would provide assessment models, each of which would be correlated not only with a particular standard but with the "learning activities" and the "teaching strategies" to create a whole evaluation picture of a student's learning achievement archived over time that would extend from K-12 into postsecondary and other adult learning programs. (This component would include both lower-cognitive and performance-based assessment examples: e.g., on-line multiple-choice tests to digital performance-based portfolios). The system also should incorporate the following activities and components:

   - Interim testing would occur several times over the course of a year, in order to provide "prescriptive intervention" prior to end-of-the-year, high-stakes testing.
   - An integrated feedback loop, tied directly to tested state standards and any curriculum the school follows, would allow for accurate, ongoing, non-disruptive assessment of student and class progress. (This would return instructional time to the school day, freeing teachers and students from the anxiety generated by additional rounds of high-stakes testing.)
   - On-line portfolios, where students keep their work across grades and courses, would be included and accessible from anywhere using any browser.
   - Performance-based evaluation criteria would be included. (Teachers could establish categories defining what work is "proficient," "exemplary" and "needs improvement." This would allow teachers to access student examples of work paralleling each descriptor.)
   - Student achievement would be archived, allowing data-mining techniques to be used for making reports directly to the State Department of Education in accordance with accountability programs. (The classroom could, figuratively and literally, be linked directly to the statehouse and provide timely information in policymaking initiatives to support student learning.)
   - Student performance levels would be measured against a standards mastery (criterion-based).
   - Student grades and test scores would be compared among classes within the school and district, as well as against interstate and international scores.
   - Visuals would show teachers overall class performance per standard. The visual representation, as correlated with student achievement, could be accessed in order for

teachers to re-teach, offer prescriptive tutoring if necessary, or provide more challenging coursework over the course of the entire year.

5. Professional Development. Professional development would be embedded within each component. These elements would include:

   _ On-line course delivery

   _ E-mail and Web-based collaboration (listservs, threaded discussion, etc.)

   _ Video streaming and Quicktime movies in providing models of best practice

   _ Face-to-face only

   _ Face-to-face coupled with virtual support systems

   _ Reflection and journal writing

   • E-mentoring/peer coaching.

Reflection on practice would be pervasive in the process, with the Smart Desktop playing a pivotal role in "action research" undertaken by education professionals. Professional development would be data-driven and timely, as teachers would use the extensive information gained from the Smart Desktop. Teachers also would collaborate in curriculum planning in a virtual environment, using the same Smart Desktop space. Each teacher would be allowed to act independently or in conjunction with others in the manipulation of on-screen elements of the Smart Desktop from any location. (On-screen video conferencing could provide support when teachers choose to work as a virtual group.)

6. Classroom Management. Teachers would be able to post their course outline, assignment deadlines, testing dates and project parameters on-line. This allows students the ability to find the information they missed during an absence and the opportunity to collaborate on projects from anywhere in synchronistic and asynchronistic environments. Student work could easily be archived, allowing teachers to track individual and group progress.

7. Home-School Connection. Parents would be able to access a child's grades and on-line portfolio via the Web. Teachers and parents could exchange e-mail as well as communicate via video conference. Home-bound students could participate in class via video streaming or in asynchronistic environments. The result would be the creation of virtual Parent Centers, where information and resources are provided in helping parents learn more about how they can help their children meet learner outcomes. Teachers would be able to point to specific strategies and resources that parents could use, based on student skill inventory results. Thus, allowing teachers the ability to create digital curricula and deliver coursework on-line, while leveraging technology's strength and broadening public educational systems into home-school environments, especially after the development of "common denominator" standards.

8. Productivity Tools. Student information systems would be merged with cornerstones (curriculum, instruction, assessment and staff development), with all data being integrated and mined to create a coordinated means for submitting district and state reports. Such productivity tools would include:

   _ A digital gradebook would be furnished; however, links from the gradebook would show the student's on-line portfolio.

- Pre-test and post-test evaluation of a student's skill level would be provided. Interim testing occurs several times over the course of a year in order to provide "prescriptive intervention" prior to end-of-the-year, high-stakes testing.
- Prescriptive tutoring based on student skill inventories would be an integral component, possibly structured around a combination of computer-based and face-to-face tutoring.
- Web-based communication and collaboration components would be provided, including: threaded discussions, listservs, e-mail, across-district posting of activities and meetings, public or private across-district posting of meeting notes, and public or private chat rooms.
- On-line testing and writing instruments for students would be available, with "real time" results being readily available.
- Syllabus, newsletter and calendar creation would be available.

9. Teacher Education Programs. Schools of education faculty would integrate the use of Smart Desktops in a student's four-year program, with the Smart Desktop being aligned with the school of education's curricula. Pre-service teachers also would be able to work with their mentor teacher prior to classroom experience, thus providing hands-on interactions merging theory and practice.
10. Local and Global Community. Community members at-large would be able to access individual school profiles of student performance via Smart Desktop features, as well as interact with students and teachers through special "virtual" visits into classrooms and homes as guest speakers. Teachers would be able to cross-reference local organizations and needed services in preparing curriculum, possibly furthering the implementation of Community Service curriculums.
11. Grant Writing. Teachers and district personnel, using data available from the Smart Desktop, would better be able to determine student needs and thereby focus on specific grant opportunities. Data minded from the Smart Desktop could be included in the grant submission.

Caveats

The chief causes for concern over Web-based accountability tools are quality, costs and misuse or poor analysis of the data. Web-based systems that track student progress offer many benefits to teachers, administrators, students and parents, but the quality and usefulness of a smart desktop system can vary widely. Policymakers and administrators also must be concerned about differing district and state standards, disparate assessment tools used to measure student achievement against the benchmarks, imprecise correlation of resources and lesson plans to established standards, and vendors who claim that their product is aligned to standards when in fact both the product and standards have changed. Finally, though the cost per student for the software or resource package may be reasonable, the information infrastructure, training and support for a complex information system are costly to develop, implement and maintain.