Educational Technology Plan for Virginia

2003-2009

April 29, 2003

Board of Education
Commonwealth of Virginia

Educational Technology Plan for Virginia 2003-2009
Table of Contents

Educational Technology Plan for Virginia 2003-2009

Executive Summary

Recently ranked as one of the nation's top 10 "New Economy" states (Atkinson, 2002), Virginia stands well positioned to experience economic growth and development as a result of its investment in information technology and high-tech industries. Virginia's leaders have prepared the state to be attractive to companies and investors by providing the technology infrastructure and skilled workforce today's businesses require. Critical to the state's ability to capitalize on this advantage is the extent to which Virginia's schools prepare the next-generation workforce for knowledge-based jobs that utilize cutting-edge information technology.

With the backing of the Governor and the General Assembly and a commitment of more than $326 million, Virginia has made enormous advances in infrastructure, hardware, software, teaching and learning resources, professional development, and administrative applications (Davis, 2001). The *Educational Technology Plan for Virginia* aims to capitalize on these advances by ensuring that all students develop the technology skills and knowledge to realize their potential as leaders in a technology-supported information economy.

As the No Child Left Behind Act of 2001 emphasizes the need to support education practices with scientifically based research, Virginia once again moves to the forefront. The research base that supports the *Educational Technology Plan for Virginia* underscores Virginia's commitment to long-range, effective, statewide integration of educational technology into teaching, learning, and school management.

Determining the Needs

In developing an educational technology plan, the Department of Education brought together key stakeholders from across the commonwealth to gather their thoughts on using technology to improve student learning and to develop a collaborative vision for Virginia. In addition, many other sources of data related to the current state of technology were reviewed. Department of Education staff and members of the Virginia Educational Technology Advisory Committee (VETAC) held a planning retreat to create a framework for developing the plan. The focus areas of integration, professional development, connectivity, educational applications, and accountability emerged from this meeting. Goals were established and focus groups were organized to develop targets, strategies, and measures of progress.

The Five Components of the *Educational Technology Plan for Virginia*

Integration refers to the appropriate use of specific technologies as highly effective tools in facilitating learning across all levels of cognitive inquiry and development.

Professional development covers both preservice and in-service training with a specific focus on the Virginia Technology Standards for Instructional Personnel.

Connectivity includes such concerns as the development of state and school division electronic infrastructures and the supporting software and hardware that would allow all users to have equitable technical access to local, state, and worldwide educational resources.

Educational applications relate to the instructional and administrative applications that will run over the infrastructure "highway" referenced in the Connectivity element.

Accountability addresses the broad assessment of information technology and of its specific value to teaching and learning environments, to data management, and to decision support functions as related to K-12 schools.

Measuring the Progress of the Plan

Available data on the current status of technology use in Virginia public schools highlight the importance of accurate information in an organized format. To measure progress toward the desired outcomes of this *Educational Technology Plan for Virginia,* structures must be put in place for the ongoing collection of data. These structures should provide for easy collection and analysis of information and ensure the consistency and accuracy of the data. Most important, the collection structures should be designed to minimize the reporting burden of stakeholders. Consistent collection and analysis of data on the evolving state of educational technology in Virginia will ensure the effective use of technology to improve student learning. In implementing this plan, divisions are encouraged to collect and utilize data to guide decisions.

Planning for Tomorrow

History reminds us that it is difficult, at best, to predict the future. Even so, schools must plan for the purposeful use of new and emerging technologies and the infrastructure, professional development, and resources to support them. No one can say which technologies will ultimately take root in education or how these applications will evolve, but it is important to consider the possibilities they offer. Carefully considering current trends is arguably the best way to identify and plan for future trends.

To assist school leaders in thinking beyond the present, each of this plan's components includes a vision scenario and a series of questions. These sections are intended to generate discussions related to future technologies and how they might be implemented in schools. They present trends that warrant consideration and incorporate current technologies that are not yet widely used. The technologies discussed are representative of broad categories of technologies that might impact schools in the not-so-distant future.

As science fiction writer William Gibson once said, "The future is here. It's just not evenly distributed yet."

Organization

This document is organized to provide support to school divisions in realizing their vision for the effective use of education technologies. The targeted visions, goals, and strategies for the five issue areas are supported by a gap analysis based on available data, a review of relevant literature, an implementation plan focused on key issues, and scenarios and questions to promote future thinking.

This document also reflects a change in how long-range technology planning is viewed in the commonwealth. This should not be seen as an updated planning document for a specified time period for the Virginia Department of Education. Rather, it should mark a starting point for a dynamic, collaborative planning process that is conducted by all stakeholders and guided by data and results. To this end, each section of the implementation plan suggests strategies and progress measures to be used by the state Department of Education, school divisions, and other key stakeholders as they work toward the goals and targeted visions for the five issue areas.

Goals

Integration

- Improve teaching and learning through the appropriate use of technology.
- Improve statewide equity in the implementation of technology-enhanced teaching and learning.

Professional Development

- Establish partnerships for identifying and delivering effective technology training to assist educators as they help students achieve high academic standards.
- Administer grant programs and financial assistance initiatives that support implementation of educational technology integration.
- Establish and maintain instructional technologist positions (including site-based technology resource teachers) in school divisions.

Connectivity

- Ensure that all public schools have access to integrated instructional and administrative services across interoperable high-speed networks.
- Ensure sufficient support for ongoing, reliable network operations.
- Provide leadership and resources to promote efficient procurement of infrastructure including the identification and procurement of emerging technologies.
- Ensure that school divisions have in place network security, filtering, and disaster recovery plans.

Educational Applications

- Improve teaching and learning through the appropriate use of network-accessible educational applications.
- Promote and develop Web-based applications, services, and resources.
- Offer digital learning opportunities at state and local levels.

Accountability

- Assess the value that information technology (IT) adds to teaching and learning environments.
- Provide appropriate decision support capabilities for all stakeholders.
- Assess information technology (IT) literacy.
- Ensure that local technology plans are consistent with the state technology plan.

The commonwealth's vision for educational technology is embodied in these ambitious goals. As educational technology stakeholders—educators, students, parents, business leaders, and policymakers—review the complete plan, they will find targeted visions to guide implementation of strategies intended to improve teaching, learning, and Virginia's economic development. These strategies illustrate possible actions for applying the power of technology to education. Working together, Virginians can develop these and other such strategies to build on a strong, existing foundation. Working together, Virginians can realize the potential of educational technologies, today and in the future.

Educational Technology Plan for Virginia 2003-2009

Introduction

Recently ranked as one of the nation's top 10 "New Economy" states (Atkinson, 2002), Virginia is well positioned to experience economic growth and development as a result of its investment in information technology and high-tech industries. Virginia's leaders have prepared the commonwealth to be attractive to companies and investors by providing the technology infrastructure and skilled workforce today's businesses require. Critical to the commonwealth's ability to capitalize on this advantage is the extent to which Virginia's schools prepare the next-generation workforce for knowledge-based jobs that utilize cutting-edge information technology.

Since the No Child Left Behind and the Enhancing Education Through Technology Acts of 2001 were passed by Congress, states and public schools have a renewed motivation to use technology to improve student achievement and to ensure that all students, especially those in high-need schools, have an equal opportunity to become technology literate. The commonwealth has seen tremendous changes in the ways technology supports and improves education since the launch of the *Six-Year Educational Technology Plan for Virginia* (Virginia Department of Education, 1996). With the backing of the General Assembly and a commitment of more than $326 million, Virginia has made enormous advances in infrastructure, hardware, software, teaching and learning resources, professional development, and administrative applications (Davis, 2002). The Commonwealth has consistently been viewed as a national leader in its commitment to employing powerful technologies to improve teaching, learning, and school management. The *Educational Technology Plan for Virginia* aims to capitalize on gains made since 1996 by ensuring that all students develop the technology skills and knowledge they need to realize their potential as leaders in a technology-supported information economy.

Even before Congress required states and public schools to determine technology's impact on curriculum and instruction, teacher knowledge, and student achievement, Virginia took steps to ensure the value of its technology investment. For example, the General Assembly commissioned a study of technology availability and usage in each public school in the Commonwealth to determine if the implementation of the plan was providing the desired results (Milken Exchange, SRI, North Central Regional Educational Laboratory, 1998, p. 1). The researchers who conducted the assessment reported that "while Virginia has committed significant resources to technology—translating into more computers in the classrooms and measurable steps forward—equitable access to equipment and improved academic performance have not yet been established throughout the school system" (Milken Family Foundation, 1999).

The Virginia Department of Education used these and other findings and recommendations to strengthen educational technology initiatives and to move closer to realizing the full potential of the technology already in place throughout the Commonwealth.

As the No Child Left Behind Act of 2001 underscores the need to support education instructional practices with evidence-based research, Virginia has once again moved to the forefront with a comprehensive plan that

includes a review of literature related to the effective use of technology in education. The review, along with a thorough needs assessment, provides a base for the implementation plan that follows. The research supports the targeted visions, goals, and strategies proposed in this document. Furthermore, it underscores Virginia's commitment to effectively using technology to add value to teaching and learning and to improve education in Virginia's public schools.

Determining the Needs

In developing the *Educational Technology Plan for Virginia*, the Department of Education brought together key stakeholders to share their thoughts on using technology to improve student learning and to develop a collaborative vision for Virginia.

Department of Education staff and members of the Virginia Educational Technology Advisory Committee (VETAC) held a planning retreat to create a framework for developing the plan. From this meeting emerged the five components of technology integration implementation consistent with the purposes of the No Child Left Behind Act and central to the Enhancing Education Through Technology Act: (1) integration, (2) professional development and support programs, (3) connectivity, (4) educational applications, and (5) accountability. Goals were established and focus groups were organized to develop targets, strategies, and measures of progress. An initial draft of the plan was sent to administrative and educational technology representatives of school divisions, professional associations, higher education, and the vendor community. Feedback from these groups is reflected in this document.

In addition, a review of other sources of data related to the current state of technology was conducted. Data from the following sources were used:

- *Report to the Commonwealth of Virginia: An Analysis of the Status of Education Technology Availability and Usage in the Public Schools of Virginia*, a report compiled by the Milken Exchange, the North Central Regional Educational Laboratory, and SRI International, December 31, 1998;
- *Key Questions about Internet Connectivity in Virginia Schools*, a report compiled by the Virginia Department of Education, September 1999;
- *High School Technology Capacity*, a report compiled by the Virginia Department of Education, November 29, 2000;
- *Technology Capacity in Support of Instruction in Virginia's Public Schools 2000-2001 School Year*, a report compiled by the Virginia Department of Education;
- *Technology Counts 2001*, *Education Week*, Volume XX, Number 35, May 10, 2001; and
- *Technology Counts 2002*, *Education Week,* Volume XXI, Number 35, May 9, 2002.

Measuring the Progress of the Plan

Current data, using standard definitions, on the use of technology in Virginia's schools and classrooms is needed to measure progress towards meeting the plan's goals. Revisions to the goals, and subsequently the targets of the *Educational Technology Plan for Virginia* will be based, in part, on the results of consistent statewide data collection of educational technology use in Virginia's schools. School divisions must have in place a standardized, dependable, and accurate data collection system. A standardized system allows for uniform collection, reporting, and analysis of data on the application and use of educational technology by administrators, teachers, and students.

In addition the data enables educators to make critical decisions regarding effective uses of technology to improve teaching and learning.

Planning for Tomorrow

History reminds us that it is difficult, at best, to predict the future. To appreciate this point, one need only refer to Ken Olsen's 1977 contention that "There is no reason for any individual to have a computer in their home" (Jukes & McCain, n.d.). As in this case, predictions can often lead to embarrassment and can quickly remind us that it is foolish to attempt them in the first place, particularly when it comes to technology. Even so, schools must plan for the purposeful use of new and emerging technologies and the infrastructure, professional development, and resources to support them.

To assist school leaders in thinking beyond the present, this plan includes a vision scenario and a series of questions to promote future thinking about each component. These sections are intended to generate discussions related to future technologies and how they might be implemented in schools. They present trends that warrant consideration and incorporate current technologies that are not yet widely used. The technologies discussed are representative of *broad categories* of technologies that might impact schools in the not-so-distant future and are aligned with the components proposed in this plan. When and how these technologies might appear will vary greatly, according to the needs and characteristics of the schools in which they will be implemented. To be more specific would only add to the growing list of inaccurate predictions.

No one can say which technologies will ultimately take root in education or how these applications will evolve, but it is important to consider the possibilities they offer. Carefully considering current trends is arguably the best way to identify and plan for future trends. Districts involved in future planning should engage in activities that promote creative thinking.

As science fiction writer William Gibson once said, "The future is here. It's just not evenly distributed yet."

Organization of the Plan

The *Educational Technology Plan for Virginia* reflects a philosophical change in how long-range educational technology planning is viewed in the Commonwealth. It holds that technology planning should be a collaborative venture by those who share a vested interest in educational technology, teaching and learning, and that planning is an evolving process guided by data and results. As such, this plan should not be viewed as an updated planning document for a specified time period for the Virginia Department of Education and school divisions. Rather, it should mark a starting point for a dynamic, collaborative planning process.

This document identifies five essential components of a comprehensive educational technology program: Integration, Professional Development and Support Programs, Connectivity, Educational Applications, and Accountability. Each component is defined and related to issues of stakeholder concern, and a rationale reflects the fundamental reasons behind the goals. The strategy for accomplishing each goal includes

- a set of **Targets**, or visions, for the use of technology in teaching and learning;

- a description of the **Direct Benefit to Teaching and Learning** of each target;
- a statement of the **Reality**, or current status of the target in Virginia schools;
- a description of the **Gap**, or action necessary to reach the target;
- the **Progress Measures**, or the indicators, that will determine accomplishment of the goal; and
- **Collaborations to Reach the Target:** a list of key actions or responsibilities that can be undertaken by the following entities who have a vested interest in educational technology and teaching and learning:
    - **Department of Education**
    - **School Divisions**
    - **Stakeholders**

Department of Education strategies are established to provide direction for the Targets. Division and stakeholder strategies represent a multitude of actions that can be taken by school divisions and other stakeholders to reach the specific targets.

This document is organized to provide support to school districts in realizing their vision for the effective use of education technologies. The targets, goals, and strategies are supported by statements of the commonwealth's needs based on available data, a review of relevant literature, an implementation plan focusing on key issues, and scenarios and questions to promote future thinking. It is important to note that the strategies are not all inclusive but rather serve as a foundation on which to build.

Integration

Integration is consistently using technology appropriately and effectively to facilitate learning for all students. This element specifically addresses equity of access, technology integration partnerships, and site-based collaborations between administrators, teachers, and students needed to infuse integration into common teaching practice.

Goals and Targets for the Integration of Technology

Goal 1 Improve teaching and learning through the appropriate use of technology.

Targets

1. **Administrators have a vision and plan for technology use and integration.**
2. **School leaders provide support for integration of technology into instruction.**
3. **Leaders can effectively evaluate instructional uses of educational technology.**
4. **Technology integration partnerships are established among educational technology stakeholders.**
5. **Teachers effectively integrate instructional technology.**
6. **Teachers collaborate to improve and enrich instruction using technology.**
7. **Teachers use technology-based intervention strategies to improve student achievement.**
8. **Teachers understand and model the acceptable use of technology in teaching and learning.**
9. **Students routinely use technology in a variety of learning activities across the curriculum.**
10. **Students will have information literacy skills.**
11. **Student learning and achievement will be enhanced through the effective integration of technology.**
12. **Student learning and achievement will be enhanced through the use of advanced technologies.**
13. **Computer/Technology Standards of Learning (SOL) are fully integrated across all curriculum areas.**
14. **Instructional personnel meet *Technology Standards for Instructional Personnel (TSIP).***
15. **Students meet Computer/Technology Standards of Learning (C/T SOL).**

Goal 2 Improve statewide equity in the implementation of technology-enhanced teaching and learning.

Targets

1. **Educators and students have access to technology to support instructional goals.**
2. **Appropriate technology-based instructional strategies are used for students with unique needs.**

Integration: A Review of the Literature

The Enhancing Education Through Technology Act of 2001 aims to help students become technologically literate and to promote the integration of technology into curricula, instruction, and professional development for the purpose of improving student achievement.

The advent of the information age and the emergence of an information-based economy, which requires facilities with networked information technologies and the ability to make sense of an abundance of data, have changed what it means to be literate. In 1989, the American Library Association's Presidential Committee on Information Literacy (Association of College & Research Libraries, 1989) commented on the seemingly overwhelming amount of information available, and noted that sifting through and making sense of it required a person to be *information literate.* Information literacy was defined as being able to recognize when information is needed and to find, evaluate, and effectively use that information. The committee defined information-literate people as those who "have learned how to learn." *The Nine Information Literacy Standards for Student Learning*, established in 1991, grew out of this work (American Association of School Librarians, 1998).

Rafferty (1999) describes three kinds of literacy: (1) representational literacy, which involves interpreting information, visuals, and media; (2) text-based or alphabetic literacy, which includes narrative, expository, and document literacy; and (3) tool literacy, which involves knowing how to use computers, networks, and other technologies. Participation in a global, information-based economy requires skills in all of these and schools can help students develop these skills by integrating technology into curriculum and instruction.

While information-literacy skills are essential for managing the abundance of information (Thornburg, 1999), many researchers agree that success in the information age, during and beyond school, also requires developing higher-level skills, such as critical thinking and problem solving (CEO Forum, 1999; Jones, Valdez, Nowakowski, & Rasmussen, 1995; Panel on Educational Technology, 1997). The National Educational Technology Standards (International Society for Technology in Education, 2000) address the use of technology for these purposes. They encompass not only basic computer operations and concepts, but social, ethical, and human technology issues such as productivity, communications, research, problem solving, and decision making. The standards assume that technology is not an end in itself but a tool for accomplishing other meaningful purposes in school, work, and life. Many states have adopted or adapted these technology standards for their students.

The expectation that educational technology will successfully support learning and student achievement depends on its effective integration in classrooms. This requires teachers to know more than basic technology skills—they must also know appropriate strategies for incorporating technology to support curricular goals. Many researchers, educators, and policymakers agree that successful technology integration emphasizes content and pedagogy, not simply hardware (Cuban & Kirkpatrick, 1998; Earle, 2002; Olson & Clough, 2001; Panel on Educational Technology, 1997; Rogers, 1999; Schwab & Foa, 2001).

Two decades of research have provided substantial information about the ways teachers accept and integrate technology into their classrooms, and about the barriers schools commonly face as they attempt to integrate

technology. Several researchers describe staged models of technology adoption by teachers (Hooper & Reiber, 1995; Sheingold & Hadley, 1990). Perhaps the best documented, most widely accepted of these comes from the seminal, longitudinal Apple Classrooms of Tomorrow™ (ACOT) studies that began in 1985 (Dwyer, Ringstaff, & Sandholtz, 1991). These theories center on the idea that most teachers progress through a series of stages as they integrate technology into curriculum and instruction.

The earliest stage is usually technology-centric; teachers focus on the basic operation of hardware and software, often at the expense of instructional goals. Common to the next stage is the replication of familiar teaching strategies and learning activities through the use of technology. For example, teachers may use word processors to create worksheets for seat-based work or may create lecture materials for classroom display (Cuban, Kirkpatrick, & Peck, 2001; Earle, 2002; Pierson, 2001). At more advanced stages of integration, teachers can capitalize on the inherent capacities of technology to create learning activities and environments that could not otherwise be accomplished.

There is no common timeframe that all teachers follow, nor do all teachers reach the final stages of technology integration. Recent research indicates that one key requirement must be in place before teachers can move into the most advanced stages—the ones that most benefit student engagement and achievement. That key to the successful use of technology in education is support, both technological and pedagogical. School leaders must articulate and support a clear vision for the use of educational technologies before they can be effectively integrated into teaching and learning (Conyers, Kappel, & Rooney, 1999; Honey, Culp & Carrigg, 1999; Holland & Moore-Steward, 2000; Honey, Jones, 2001).

What constitutes support? At the building level, principals should recognize effective technology use and support the integration efforts of their teachers. They should guide their staff members in the application of meaningful learning activities supported by technology and be able to evaluate teachers' use of technology in order to help them improve and increase their teaching skills (Holland & Moore-Steward, 2000). While it is not essential for principals to be expert in every aspect of technology, they should be comfortable with many of the tasks and skills members of their staff member may encounter in their work and know where to go to find help when necessary (Jones, 2001).

Current technology standards for instructional personnel (TSIP) should specifically address standards for administrators or educational leaders that reflect their leadership, management, evaluation, and program responsibilities. The ISTE NETS•A standards could serve as a model for development of Virginia's standards.

Common barriers to technology integration are also presented in the literature. Ironically, access to technology is not cited as often as might be expected. In a recent study of computer use in Idaho schools, approximately one third to one half of the teachers in the study never actually used available technology for instructional purposes (Mathews & Guarino, 2000). Similar results were found in an earlier survey of software use in Kentucky, Tennessee, Virginia, and West Virginia, in which 83.6 percent of the respondents indicated *never* using software for instruction (McGraw, Blair & Ross, 1999).

Some of the often-mentioned barriers preventing technology use in classrooms are lack of time for evaluating and selecting software, developing basic skills, and planning for and incorporating technology into

lessons; insufficient, inappropriate, or inconvenient training; lack of administrative and technological support; constraints of schooling, such as the structure of the school day, external testing demands, and the relative isolation many teachers experience (Cuban, Kirkpatrick, & Peck, 2001; Earle, 2002; Mathews & Guarino, 2000; Rogers, 1999). Strategies for overcoming these barriers include comprehensive planning for technology integration that considers adequate and sustainable funding for the purchase and replacement of technology as well as the hiring of support personnel to provide technical assistance. Technical support is often overlooked in planning and budgeting, but is crucial to the success of any technology integration effort (Rogers, 1999; Tiene & Luft, 2001).

Support and professional development can be considered the most critical components for effective integration of technology, but they often receive less attention than hardware, software, and network connectivity (Bailey & Pownell, 1998). Teachers from the Ameritech Classroom of the Future indicated that they owed their success in this technology-rich environment not to the hardware and software but to the technology specialists who supported their integration and facilitation needs. The researchers noted that, however obvious the need for technical support may seem, "this point apparently needs to be made again and again and again" (Tiene & Luft, 2001, p. 26).

Given the accountability requirements in the No Child Left Behind Act of 2001 to disaggregate student assessment data, it is important to note one area in which technology has achieved great impact, and that is in providing greater access to learning resources and the general curriculum for students with special needs. Assistive technology provides support to enable students with disabilities to participate in instruction while creating responses and products that equal or closely resemble those of their peers.

Assistive hardware and software tools may include speech synthesizers, larger monitors, touch screens, scanners with scan-reading software, voice recognition systems, speech output devices, keyboards of various sizes, trackballs, joysticks, and Morse code sip and puff switches (Anderson, 1996). For many children with disabilities, simple access to computer software and word processors with grammar and spell checkers can improve performance by increasing attention, providing immediate feedback on errors, allowing the children to work at individualized levels and paces, and developing their problem-solving skills (Gregg, 1995).

Integration: Needs in Virginia

According to *Technology Counts 2002,* 85 percent of schools in Virginia report that a majority of their teachers use computers for planning or instruction. In addition, 75 percent of schools in Virginia report that a majority of their teachers use the Internet for instruction. However, there is little information about how effectively teachers integrate the use of the Internet into instruction. In fact, the *Technology Counts 2002* report also indicates that lower-level applications of technology for instruction, such as drill-and-practice applications, are most often found in Virginia schools.

In the 1998 *Report to the Commonwealth of Virginia: An Analysis of the Status of Education Technology Availability and Usage in the Public Schools of Virginia*, researchers asked the question, "Is the learning environment designed to achieve high academic performance by students through the effective use of technology?" They found that teachers and students in Virginia were gaining expertise in computer skills but were not yet using technology effectively to improve student learning.

The Virginia Department of Education's *Educational Technology Plan for Virginia* establishes statewide direction for the integration of technology into instruction. Specifically, five areas are identified that will aid in the successful integration of technology throughout the state.

Planning for Integration of Technology into Instruction

Successful integration of technology into instruction requires educators to develop comprehensive plans for that initiative. Integration plans, often a part of divisional or school technology plans, help set strategic direction, establish a plan of action, determine implementation activities, monitor progress and evaluate results. Plans should be based upon divisional teaching and learning objectives. The goal of the plans is to tie software, resources, and technology educational objectives in ways that result in enhanced teaching and learning. Focus should be upon improving all students' mastery of basic and advanced academic skills and concepts. Use of technology in instruction will increase students' motivation and class attendance, improve communication skills and collaboration, expand use of research and learning resources, aid in critical thinking and informed decision making, and encourage inquiry-based learning.

Access and Use of Technological Resources

Instructors need to have sufficient access to and proficiency in using technological resources to support their integration efforts. Depending upon the nature and method of the content being delivered, they should evaluate intended activities to be certain that a sufficient number of computers, instructional software, and other technology are available to successfully accomplish learning objectives. Computers should be connected through networks that are reliable and of sufficient speed and capacity to accommodate students involved in the activity. Instructors should be proficient in managing technology-enhanced learning activities. This includes developing knowledge, skills, and experience with equipment and software, managing technology classrooms, basic troubleshooting, and determining appropriate instructional uses. Instructors can gain knowledge and experience with use of technology through and in-service training, mentoring programs, and on-line professional development. Training should be available, and should be on-going and relevant to instructional needs and learning objectives.

Alignment of Technology with Content Curriculum

For technology to enhance learning it is important that its use supports state Standards of Learning and curriculum content. Teachers should analyze curriculum needs and determine what capabilities of various technologies can be utilized to improve instructional delivery and better meet learning needs of all students. Lessons and activities can then be planned that reflect delivery and learning needs. Among other things, technology has the capability to enhance instruction by assisting in the creation, manipulation, and output of information; providing multimedia products through access to graphics and sound; guiding students through progressively challenging learning activities; gaining classroom-based access to unlimited collections of information; providing virtual access to places, people, and things outside the classroom; and tracking and evaluating student's progress toward meeting learning objectives.

Alternative Methods of Content Delivery

Changing student demographics, economic and social inequality, and the need to provide meaningful educational experiences for all children require consideration of many instructional practices. Teachers should analyze student performance and determine which methodologies are most effective for content to be delivered and what works best for various student populations. Students receive, process, and retain information differently. Technology can be a useful instructional tool to help teachers address these differences. In many instances, direct instruction is most appropriate. In others, computer-aided instruction, tutorials, team collaboration projects, computer-aided research and analysis, creation of student portfolios or multimedia presentations, educational simulations or content-specific

application software might better address learning needs of diverse populations. People often learn better through experience, and interacting with technology can simulate real experiences. Technology can assist in individualizing instruction and providing data to track and evaluate progress toward meeting learning objectives.

Assessment of Effectiveness of Instructional Practices

Integrating technology into instruction is useful only if it results in better instruction and increased student learning. Higher assessment scores are an indicator of student learning and progress, but they also are an indicator of the effectiveness of instructional practices. Using student performance tracking software for information-based decision making, instructors can collect, analyze, and interpret assessment and other data to determine if an instructional practice is effective. This evaluation can help determine if practices should be changed for a group or whether individual students would benefit from a different instructional strategy. Research concerning the appropriateness and effectiveness of instructional strategies, with or without use of technology, is widely available and can be used to create revised lesson plans. The process of evaluating and revising instructional delivery should be done continuously to assure that students are receiving the highest quality of instruction and assistance to meet learning objectives. Through the *Educational Technology Plan for Virginia,* data will be collected on indicators associated with the effective implementation of technology. Activities will be designed to assist schools in meeting their goals for the integration of technology.

Integration: Implementation Plan

CENTRAL ISSUE

Research confirms that students reap the maximum benefit from the use of technology when the infrastructure supports the integration of technology throughout the educational process. Data from various reports indicate a wide range in levels of knowledge and application of technology integration across the commonwealth. Despite recent gains in hardware and software acquisitions, surveys confirm that an inadequate foundation level of hardware and software exists in most schools. Research has indicated that significant and effective integration of technology is hampered by this inadequacy. Integration refers to the appropriate use of specific technologies as highly effective tools in facilitating learning across all levels of cognitive inquiry and development. The issue area will specifically address "how" technology must be seamlessly utilized in teaching and learning, and the technology integration partnerships and site-based collaborative approaches that will be needed to effect appropriate integration. Included is the "foundation level" (critical mass of technologies) that must be in place in schools for integration to occur.

RATIONALE

Finding the most effective methods, software, and hardware for integrating technology must be a collaborative effort representing a broad range of K-12 entities stakeholders, including K-12 faculty, parents, higher education, business and industry, professional organizations, and the Department of Education. Statewide efforts must promote and provide equity in integrating technology by providing foundation levels of modern hardware and software in all schools.

Goals and Targets for Integration

Goal 1 Improve teaching and learning through the appropriate use of technology.

Target 1 Administrators have a vision and plan for technology use and integration.

Direct Benefit to Teaching and Learning

- Teaching and learning are enhanced when administrators communicate a vision and a plan for technology use and integration.

Reality

- Some administrators do not have a vision or a plan for technology use and integration.

Gap

- Technology leadership training for administrators needs to be provided to assist administrators to develop a plan for technology use and the integration of technology into instruction.
- All administrators need to develop and communicate a vision and a plan for technology use and integration.

Progress Measures

- The number of administrators reporting that they have developed and communicated a plan for technology use and the integration of technology into instruction.
- The number of administrators who participate in training opportunities that assist them in developing a plan for technology use and the integration of technology into instruction.

COLLABORATION TO REACH GOAL 1, TARGET 1	
Department of Education-Strategic Direction	
• Provide resources and technical assistance to administrators on technology planning. • Provide training opportunities to administrators focusing on developing plans for technology use and integration. • Continue to provide the Educational Technology Leadership Conference.	
Representative Actions	
School Divisions	**Stakeholders**
• Support technology leadership training for administrators. • Involve administrators in technology plan development. • Provide resources to administrators so that they can develop a vision and a plan. • Support and encourage administrators to attend and make presentations at the Educational Technology Leadership Conference and other state/national/regional conferences.	• Higher education institutions provide technology leadership training. • Sponsor grants that focus on technology leadership training. • Technology vendors provide technology leadership training.

Target 2 Leaders provide support for integration of technology into instruction.

Direct Benefit to Teaching and Learning

- Teaching and learning is enhanced when leaders are strong advocates for technology integration.

Reality

- Some leaders are not strong advocates for technology integration.

Gap

- Technology leadership training needs to be provided to assist leaders to recognize the value of technology to teaching and learning.
- Leaders need to set expectations for appropriate integration of technology into instruction.

Progress Measures

- The number of leaders who participate in training opportunities that focus on the value of technology to teaching and learning.

- The number of leaders reporting that they have set expectations for appropriate integration of technology into instruction.

COLLABORATION TO REACH GOAL 1, TARGET 2	
Department of Education-Strategic Direction	
• Provide resources and technical assistance to help leaders recognize the value of technology in teaching and learning. • Provide training opportunities to leaders focusing on technology integration. • Continue to provide the Educational Technology Leadership Conference.	
Representative Actions	
School Divisions	**Stakeholders**
• Support technology leadership training. • Involve all leaders in technology plan development. • Provide resources to leaders so that they can become strong advocates for technology integration. • Support and encourage leaders to attend and present at the Educational Technology Leadership Conference and other state/national/regional conferences.	• Higher education institutions provide technology leadership training. • Sponsor grants that focus on technology leadership training. • Technology vendors provide technology leadership training.

Target 3 Leaders can effectively evaluate instructional uses of educational technology.

Direct Benefit to Teaching and Learning

- Research indicates that learning is enhanced when technology tools are used appropriately and effectively.

Reality

- Many leaders do not consistently evaluate the degree of technology integration into instruction.

Gap

- Professional development that provides training for leaders on the identification and evaluation of effective uses of technology needs to be developed and implemented.

Progress Measures

- The number of leaders who receive training on how to recognize and evaluate effective uses of technology, particularly its integration into the K-12 curriculum.
- Number and quality of training events that focus on how to recognize and evaluate effective uses of technology.

COLLABORATION TO REACH GOAL 1, TARGET 3
Department of Education-Strategic Direction
• Develop and disseminate a system for assessing the appropriateness and degree of technology integration into the K-12 curriculum, both at the division and school site level. • Research and analyze technology integration strategies that have led to significant student achievement gains and disseminate that information.

Representative Actions	
School Divisions	**Stakeholders**
• Design and conduct training to help principals and teachers identify effective technology integration strategies. • Use a variety of instructional resources and mediums to train leaders to identify effective use of instructional technology. • Conduct periodic observations of classroom instruction using a technology integration observation form to determine levels of technology integration and effective uses of technology.	• Higher education research centers work with local school divisions to develop effective evaluation strategies and tools. • Create a focused, high-quality professional development program that equips leaders with the skills to effectively evaluate technology integration. • Sponsor peer observations in other school divisions. • Expand continuing education programs to include technology leadership training for leaders.

Target 4 Technology integration partnerships are established among educational technology stakeholders.

Direct Benefit to Teaching and Learning

- Collaborative partnerships among educational technology stakeholders are often the most efficient and cost-effective method for providing educators access to up-to-date technology, training based on best practices, and extensive online resources.

Reality

- The annual Virginia Educational Technology Leadership Conference, the MarcoPolo Foundation training in the use of Internet resources in the classroom, the Bill and Melinda Gates Grant to provide leadership training for administrators in promoting the integration of technology, the Virginia Community of Learning, and Virginia's public television stations are examples of partnerships that promote and support technology integration.

Gap

- Both current and new sources for developing local, regional, and state partnerships need to be explored, established, and supported.

Progress Measures

- The number of effective partnerships formed among educational technology stakeholders to focus on improving teaching and learning through integration of technology.

COLLABORATION TO REACH GOAL 1, TARGET 4
Department of Education-Strategic Direction
• Explore, establish, support, and disseminate information about effective partnerships with educational technology stakeholders that focus on improving teaching and learning through integration of technology. • Promote the development of vendor partnerships.

Representative Actions	
School Divisions	**Stakeholders**
• Continue to develop partnerships with universities to pilot new instructional strategies for integrating technology. • Continue to work with the educational services departments of the public television stations so that technology resources and training in the effective use of technology in the classroom are made available to all teachers. • Enhance the relationship with the Tidewater Center for Technology Access to provide more access to adaptive technologies for special education students. • Use federal grant funds to host and co-sponsor regional and statewide technology symposia and training that promote the sharing of instructional strategies and techniques. • Develop curriculum activities that incorporate global communications and cooperative learning.	• Work with the Library of Virginia and public libraries to provide access to electronic educational resources beyond the school day. • Partner with museums to provide access to educational programs and resources for K-12 students. • Participate in collaborative research activities on effective methods of integrating technology.

Target 5 Teachers effectively integrate instructional technology.

Direct Benefit to Teaching and Learning

- Research indicates that learning is enhanced when technology tools are used appropriately and effectively.

Reality

- Many teachers do not integrate technology effectively.

Gap

- Professional development that focuses on training for K-12 teachers on the identification and effective utilization of technology needs to be developed and implemented.

Progress Measures

- Number and quality of training events that focus on how to effectively integrate technology into the K-12 curriculum.
- The number of teachers who receive training on how to effectively integrate technology into the K-12 curriculum.
- A statistically relevant number of learning environments in selected K-12 schools and classrooms has been observed to determine the level of technology integration implementation.

COLLABORATION TO REACH GOAL 1, TARGET 5
Department of Education-Strategic Direction
• Identify or develop and disseminate a system for assessing the level of technology integration in K-12 instruction. • Research and analyze technology integration strategies that have led to significant student achievement gains and disseminate that information. • Provide training opportunities to teachers focusing on the identification and effective use of technology.

Representative Actions	
School Divisions	**Stakeholders**
• Design and conduct training to help teachers identify effective integration strategies. • Conduct peer observations of classroom instruction using a technology integration observation form to determine levels of technology integration and effective uses of technology. • Appoint teams that include lab managers, technology representatives, instructional technologists, library media specialists, and parents to collaborate with teachers on improving and enriching instruction through the use of technology.	• Higher education research centers cooperate with school divisions to develop comprehensive educational technology integration programs. • Create a focused, high-quality professional development program that equips teachers with the skills to utilize effectively, instructional technology for academic achievement. • Sponsor peer observations in other school divisions. • Expand continuing education programs to include technology integration training for teachers.

Target 6 Teachers collaborate to improve and enrich instruction using technology.

Direct Benefit to Teaching and Learning

- Instruction is improved when teachers, library media specialists, and technology specialists collaborate to develop instructional activities that optimize the use of a variety of resources.

Reality

- Many teachers do not use a collaborative approach to plan for and deliver effective, technology-rich instruction.

Gap

- Training, models, time, and support for collaboration need to be provided.

Progress Measures

- The percentage of schools reporting a predominance of teacher lesson plans that reflect a collaborative approach (involving teachers, library media specialists, technology specialists, etc.) to the integration of technology.

COLLABORATION TO REACH GOAL 1, TARGET 6	
Department of Education-Strategic Direction	
• Develop a K-12 site-based model for using a collaborative approach for technology integration. • Identify new examples of successful implementation of collaborative approaches to technology integration.	
Representative Actions	
School Divisions	**Stakeholders**
• Appoint teams that include lab managers, technology representatives, instructional technologists, library media specialists, and parents to collaborate with teachers on improving and enriching instruction through the use of technology. • Explore alternative scheduling arrangements that support collaboration.	• Examine and share models of collaboration for effective technology integration. • Vendors include a technology integration-training program as part of software purchases.

Target 7 Teachers use technology-based intervention strategies to improve student achievement.

Direct Benefit to Teaching and Learning

- Improvements in student learning occur when technology is used as a tool for remediation.

Reality

- Many teachers do not employ effective strategies and lack sufficient technology resources to address individual student needs for remediation.
- Teachers do not know how to use data to modify instruction to meet student needs.

Gap

- Teachers need assistance in identifying and utilizing technology-based interventions to close student achievement gaps.

Progress Measure

- The number of teachers who use technology-based intervention strategies to close student achievement gap.

<table>
<tr><th colspan="2">COLLABORATION TO REACH GOAL 1, TARGET 7</th></tr>
<tr><th colspan="2">Department of Education-Strategic Direction</th></tr>
<tr><td colspan="2">• Collaborate with educational technology stakeholders who develop, implement, and evaluate pilot projects that particularly focus on closing student achievement gaps.
• Evaluate results of technology-based intervention strategies.
• Provide data and disaggregation tools for teachers to modify instruction to meet student needs.</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Identify technology tools for instruction and remediation of the Standards of Learning.
• Develop and disseminate models that demonstrate the use of technology to facilitate differentiated instruction.
• Offer coursework via distance learning to meet unique instructional needs.
• Provide technology-based instructional delivery, support, and management systems that support the development and utilization of intervention strategies.
• Establish a software review and selection process that identifies appropriate software for instruction and remediation.
• Technology-based intervention strategies are implemented in all curriculum areas.</td><td>• Teacher education institutions provide programs that focus on evidence-based strategies that identify and utilize technology-based intervention to close student achievement gaps.
• Parents and community volunteers tutor or assist students using technology resources.
• Vendors collaborate in the development, implementation, and evaluation of pilot projects that focus on closing student achievement gaps.</td></tr>
</table>

Target 8 Teachers understand and model the acceptable use of technology in teaching and learning.

Direct Benefit to Teaching and Learning

- Ethical use of technology resources is an expected practice for all uses of educational technology.
- Evaluation and selection of Internet sites identify resources appropriate for K-12 instruction.

Reality

- Not all teachers understand and model the acceptable use of technology in teaching and learning.
- Not all teachers are aware that state legislation requires each school division to have an Acceptable Use Policy (AUP) on file with the Department of Education.

Gap

- School divisions need to communicate the Acceptable Use Policy to all teachers.
- Teachers need to apply the guidelines as established in the school division's AUP in all teaching and learning activities.

Progress Measures

- Percentage of school divisions reporting that they have communicated their Acceptable Use Policy to staff.
- Percentage of school divisions reporting that teachers are applying the AUP in all teaching and learning activities.

COLLABORATION TO REACH GOAL 1, TARGET 8	
Department of Education-Strategic Direction	
• Continue to provide resources that assist schools with the development of up-to-date AUPs	
Representative Actions	
School Divisions	**Stakeholders**
• Involve students, teachers, administrators, parents, and community members in periodic review of the AUP. • Examine samples of AUPs developed by other school divisions. • Provide in-service training on the impact of the AUP on teaching and learning. • Include AUP compliance as a component of teacher evaluation and observation instruments.	• Businesses, colleges, and universities share their AUPs with school divisions. • Businesses, colleges, universities, and public television stations provide resources, awareness and training on acceptable uses of computer networks.

Target 9 Students routinely use technology in a variety of learning activities across the curriculum.

Direct Benefit to Teaching and Learning

- Students will have basic technology skills.
- Student learning resources are extended beyond the classroom.
- Students will be better prepared to become members of tomorrow's workforce.

Reality

- Many K-12 classroom activities do not incorporate technology.

Gap

- Teachers need to develop technology-based lessons that use a variety of technologies.
- Models of technology-based lesson plans and activities need to be shared and widely publicized.

Progress Measures

- School divisions report the percentage of learning activities that require students to use technology.

COLLABORATION TO REACH GOAL 1, TARGET 9	
Department of Education-Strategic Direction	
• Identify or develop an assessment rubric to measure technology literacy among students. • Develop a system of statistical sampling to determine if Virginia students are proficient in the use of technology.	
Representative Actions	
School Divisions	**Stakeholders**
• Assess whether students are using technology in a variety of activities across the curriculum. • Assess whether students are routinely using a variety of technologies.	• Offer mentoring or summer job programs that involve applications of technology.

Target 10 Students will have information literacy skills.

Direct Benefit to Teaching and Learning

- Students will master information literacy skills (e.g., conduct research to locate, collect, organize, and evaluate information; electronically exchange information, or collaborate with others external to the classroom) and become lifelong consumers of information.

Reality

- Few school divisions have incorporated information literacy skills into the curriculum.

Gap

- Training is needed to provide teachers with an understanding of and the ability to incorporate information literacy skills.

Progress Measures

- Scores on an assessment rubric designed to measure information literacy skills among students.

COLLABORATION TO REACH GOAL 1, TARGET 10	
Department of Education-Strategic Direction	
• Develop a rubric to assess information literacy skills among students. • Identify or develop a system of statistical sampling to determine if Virginia's students are proficient in information skills.	
Representative Actions	
School Divisions	**Stakeholders**
• Assess whether students in the school division are attaining a level of information literacy skills that include one or more of the following characteristics: student is able to conduct research to locate, collect, organize, and evaluate information; electronically exchange information, and collaborate with others outside the classroom.	• Public and private agencies sponsor local research projects that involve students. • Higher education research centers collaborate with school divisions to develop systems for assessing level of information literacy skills among students.

Target 11 Student learning and achievement will be enhanced through the effective integration of technology.

Direct Benefit to Teaching and Learning

- Student achievement increases when students participate in technology-facilitated activities that involve peer collaboration, higher-order thinking, and problem-solving skills.
- Students will be better prepared to become members of tomorrow's workforce.

Reality

- Students are not routinely engaged in learning activities in which technology is effectively integrated.

Gap

- Teachers need to develop technology-based lessons that incorporate one or more of the following characteristics: self-directed learning, multidisciplinary activities, peer collaboration and interaction, and higher-order thinking skills to solve real problems.
- Models of lesson plans and activities that effectively integrate technology need to be shared and widely publicized.

Progress Measures

- School divisions report the percentage of students who are routinely engaged in technology facilitated learning activities that incorporate one or more of the following characteristics: self-directed learning, multidisciplinary activities, peer collaboration and interaction, and higher-order thinking skills to solve real problems.

COLLABORATION TO REACH GOAL 1, TARGET 11	
Department of Education-Strategic Direction	
• Provide training to assist teachers in the development of lesson plans that effectively integrate the use of technology. • Identify, collect, and distribute model lesson plans that illustrate the effective integration of technology.	
Representative Actions	
School Divisions	**Stakeholders**
• Assess whether students in the school division are attaining a level of information literacy skills that include one or more of the following characteristics: self-directed learning, multidisciplinary technology-based activities, peer collaboration and interaction, and higher-order thinking skills to solve real problems.	• Create engaging software that simulates reality. • Educational services staff at Virginia's public television station provide training in the development of lessons that effectively integrate technology..

Target 12 Student learning will be enhanced by the use of advanced technologies.

Direct Benefit to Teaching and Learning

- Students are motivated and engaged in learning activities that are relevant and authentic.
- Student learning resources are extended beyond the classroom.
- Students will be better prepared to become members of tomorrow's workforce.

Reality

- Students do not routinely participate in learning activities that are enhanced by the use of advanced technologies.

Gap

- Students and teachers need ready access to advanced technologies.
- Teachers need training in the use of advanced technologies.
- Teachers need training in the development of technology-based lessons that incorporate the use of advanced technologies.

Progress Measures

- Schools report the number and type of advanced technologies available to students and teachers.
- The number of teachers who attend training in the use and curriculum integration of advanced technologies.
- The number of training events that focus on the use and curriculum integration of advanced technologies.

COLLABORATION TO REACH GOAL 1, TARGET 12	
Department of Education-Strategic Direction	
• Provide training in the use and curriculum integration of advanced technologies. • Provide information and technical assistance on advanced technologies. • Promote or coordinate the development of K-12 technology procurement contracts for advanced technologies.	
Representative Actions	
School Divisions	**Stakeholders**
• Target appropriate funding to provide teacher's and student's access to advanced technologies. • Use state and regional contracts or negotiate local contracts for the procurement of advanced technologies. • Provide training for teachers in the use and curriculum integration of advanced technologies. • Submit a proposal for K-12 education grants that provide advanced technologies.	• A variety of entities form partnerships to negotiate for and procure advanced technologies. • Technology providers support training and provide support materials for advanced technologies. • Provide K-12 education grants for the acquisition of advanced technologies.

Target 13 Computer/Technology Standards of Learning (SOL) are fully integrated across all curriculum areas.

Direct Benefit to Teaching and Learning

- Computer/Technology Standards of Learning are best mastered when the student's use of technology is a routine part of their learning activities.

Reality

- Computer/Technology Standards of Learning are not fully integrated across all K-12 curriculum areas.
- The state averages for Computer/Technology Standards of Learning have increased each year. The fifth-grade scores increased from 72.05 in 1998 to 85.04 in 2000. The eighth-grade scores increased from 63.45 in 1998 to 77.91 in 2000.

Gap

- School division and building technology plans should include a strategy for integrating the Computer/Technology Standards of Learning into teaching and learning.
- Lesson plans need to indicate that Computer/Technology Standards of Learning are regularly integrated into content instruction and activities.
- A component of the teacher evaluation instrument should indicate a level of technology integration.

Progress Measures

- The percentage of principals reporting that observations and review of teachers' lesson plans show that Computer/Technology Standards of Learning are being significantly integrated into all curricular areas.
- A recognized and accepted methodology for determining student progress toward computer literacy.

COLLABORATION TO REACH GOAL 1,TARGET 13
Department of Education-Strategic Direction
• Promote full and seamless integration of Computer/Technology Standards of Learning through the development of guidelines promoting integration that are approved by the Board of Education. • Incorporate board-adopted guidelines for the integration of technology into all Standards of Learning resource documents and state sponsored staff development activities.

• Review, update, and modify the Computer/Technology Standards of Learning. • Identify Computer/Technology skill sets as strategies to accomplish instructional goals.

Representative Actions	
School Divisions	**Stakeholders**
• Develop a format for schools to state their technology integration goals in their school improvement plans. • Create and use curriculum maps thatdemonstrate integration of technology into the curriculum. • Teachers develop lesson plans that integrate technology and information-literacy skills and incorporate them into the instructional program. • Promote a consistent integration of technology at all grade levels in a variety of instructional settings. • Develop a matrix of technology integration to infuse instructional technology into all curriculum areas at all grade levels. • Develop and implement instructional models for integrating technology.	• Higher education teacher training programs promote instructional models for integrating computer/technology standards in K-12 instruction. • Professional organizations develop and update national technology standards for students. • Private foundations and commercial portals continue to provide schools with quality resources that promote the development of student Internet literacy skills within the context of academic content areas.

Target 14 Instructional personnel meet *Technology Standards for Instructional Personnel (TSIP)*.

Direct Benefit to Teaching and Learning

- Teachers integrate technology into instruction when they are effective users of technology.
- Student achievement is enhanced when teachers use technology effectively and integrate technology into instruction.

Reality

- Some teachers do not meet the *Technology Standards for Instructional Personnel*.

Gap

- Teachers must meet the *TSIP* requirements in accordance with state law by July 1, 2003.

Progress Measures

- The number of teachers who have not met the *TSIP* requirements by July 1, 2003.

COLLABORATION TO REACH GOAL 1, TARGET 14	
Department of Education-Strategic Direction	
• Monitor compliance of *TSIP* requirements. • Continue to provide training and technical assistance to instructional personnel who need to meet the *TSIP*.	
Representative Actions	
School Divisions	**Stakeholders**
• Monitor compliance of the *TSIP* requirements. • Continue to provide training to instructional personnel who need to meet the *TSIP*.	• Institutions of higher education provide ongoing and in-service *TSIP* training for instructional personnel. • Educational services staffs at Virginia's public television stations continue to provide *TSIP* training.

Target 15 Students meet Computer/Technology Standards of Learning.

Direct Benefit to Teaching and Learning

- Students are proficient in the use of technology.
- Students use technology tools to enhance learning, increase productivity, and promote creativity.
- Students develop positive attitudes towards technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.

Reality

- Some students have not mastered the Computer/Technology Standards of Learning appropriate for their grade level.

Gap

- Teachers need to incorporate the Computer/Technology Standards of Learning into their teaching and learning activities.

Progress Measures

- Number of schools reporting that Computer/Technology Standards of Learning have been incorporated into teaching and learning activities.

<table>
<tr><th colspan="2">COLLABORATION TO REACH GOAL 1, TARGET 15</th></tr>
<tr><th colspan="2">Department of Education-Strategic Direction</th></tr>
<tr><td colspan="2">• Identify or develop and disseminate an instrument for assessing student mastery of the Computer Technology Standards of Learning
• Periodically examine and revise the Computer Technology Standards of Learning.</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Set expectations for student mastery of the Computer Technology Standards of Learning.
• Set expectations for the incorporation of the Computer/Technology Standards of Learning into teaching and learning activities.
• Assess the student mastery of the Computer/Technology Standards of Learning.</td><td>• Provide incentives to students to master the Computer/Technology Standards of Learning.
• Provide internships and work-study programs that require technology skills and application.
• Share expectations for technology skills for employment.</td></tr>
</table>

Goal 2 Improve statewide equity in the implementation of technology-enhanced teaching and learning.

Target 1 Educators and students have sufficient access to technology to support instructional goals.

Direct Benefit to Teaching and Learning

- Research indicates that teaching is enhanced and learning is improved when teachers and students have ready access to a foundation level of technology and a variety of teaching/learning tools.

Reality

- Many classrooms are not currently equipped with a foundation level of technology to facilitate teaching and learning.
- Many school divisions have not made adequate provisions for the timely updating, repair, and replacement of technology resources.

Gap

- Additional computers, software, and other technology resources need to be available to teachers and students to provide for a variety of instructional activities and teaching techniques.

- School divisions need to include a process for upgrading, replacing, and repairing technology resources in their technology plan.

Progress Measures

- The percentage of teachers who have an up-to-date multimedia computer and printer for classroom instruction.
- The percentage of classrooms that have large-screen (computer and multimedia, etc.) projection capability.
- The percentage of schools reporting a computer-to-student ratio of one networked, multimedia computer for every five students.
- The percentage of schools reporting they have an appropriate number of general use computers for specific curriculum areas and grade levels.
- The percentage of teachers and students reporting they have access to sufficient numbers of computers, software, and video resources.
- The percentage of schools reporting they have sufficient quantity and overall quality of instructional software and video resources across all grade levels and subject areas.
- The percentage of schools reporting sufficient numbers of electronic teaching/learning devices such as classroom TV/VCRs (or central media distribution), digital cameras, digital scanners, video recorders, portable keyboarding devices, graphing calculators, computer projection devices, and scientific probes/sensors as computer interfaces.
- The percentage of schools reporting that plans are in place for the systematic upgrading and/or replacement of software and hardware.

<table>
<tr><th colspan="2">COLLABORATION TO REACH GOAL 2, TARGET 1</th></tr>
<tr><th colspan="2">Department of Education-Strategic Direction</th></tr>
<tr><td colspan="2">• Annually identify and disseminate minimum specifications of foundation-level technology resources that facilitate teaching and learning in K-12 schools.
• Identify a cadre of instructional technologists to assist school divisions in implementing technology–enhanced teaching and learning.
• Promote and chronicle collaborative approaches to implementation of technology-enhanced teaching and learning.</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Develop additional computer labs, increase the number of computers in classrooms, and provide mobile laptop labs.
• Upgrade school library software and computer hardware and other technology to provide greater access to educational resources.
• Implement a plan to install a core collection of instructional software on all servers at the school site.
• Upgrade access to the Internet and provide access to other online resources as appropriate</td><td>• Vendors participate in consortiums to allow group purchases of high-ticket technology resources.
• Community members provide grant-writing services.
• Community agencies create parent and community involvement programs that address school technology access needs.</td></tr>
</table>

Target 2 Appropriate technology-based instructional strategies are used for students with unique needs.

Direct Benefit to Teaching and Learning

- Student achievement is improved when assistive technology for special needs students and technology-based instructional alternatives for at-risk students are available.

Reality

- Assistive devices for special needs students are not readily available in all school divisions.
- School divisions lack technology resources for meeting the needs of at-risk students.
- Technology-based strategies for providing general remediation are not currently available in all school divisions.

Gap

- Assistive technology for special needs students and technology-based resources for at-risk students and for remediation need to be available in all school divisions to aid student learning.

Progress Measures

- The percentage of schools reporting that special needs students have access to assistive technologies when needed.
- The percentage of schools reporting that at-risk students have access to technology-based instructional alternatives when needed.
- The percentage of schools reporting that access to technology-based solutions for general remediation is available when needed.

COLLABORATION TO REACH GOAL 2, TARGET 2	
Department of Education-Strategic Direction	
• Identify site-based technology application models and strategies for students with unique needs. • Identify organizations that provide access to adaptive technologies for special needs students.	
Representative Actions	
School Divisions	**Stakeholders**
• Provide adaptive and instructional technology for special needs populations. • Include funding for assistive technology in the budget for special education departments. • Identify and provide specialized instructional resources for at-risk students and for remediation needs.	• Vendors provide information on free or low-cost access to assistive technology. • Professional organizations identify grants that support assistive technology programs. • Community organizations establish a grant in support of assistive technology programs.

Integration: A Vision for the Future

Since the 1998 study *Report to the Commonwealth of Virginia: An Analysis of the Status of Education Technology Availability and Usage in the Public Schools of Virginia*, the commonwealth has made a concerted effort to improve the effectiveness of education technology initiatives in the state, particularly as they relate to integration. Computer/Technology Standards of Learning, adopted in 1995, challenge students to apply technology in their learning, particularly for communication, productivity, management, research, problem solving, and decision making.

A number of school divisions in the commonwealth have been on the leading edge with widespread implementation of portable computing devices. The following scenario describes how integration might be addressed in the future.

Evan has been looking forward to this field trip for weeks, and finds it hard to believe that he is actually on an archeological dig with the famous high-altitude archaeologist Dr. Johan Reinhardt. Dr. Reinhardt, who led the 1996 expedition to the summit of Sara Sara in Peru, uncovered sacrificial Incan "ice mummies." He currently works in the Appalachians and invited Evan's teacher, Mrs. Shumate, to bring her students to learn about archaeology firsthand.

Everyone is pleased when Evan and his partner, Jill, unearth a pottery fragment. Careful not to destroy the fragile artifact, Evan and Jill call to Dr. Reinhardt for assistance. They are excited to see markings on the fragment's

surface. Dr. Reinhardt, puzzled by the strange markings, suggests that Evan and Jill contact an expert in interpreting ancient writings.

Evan gets out his Bluetooth wireless pen and electronic "pad" and begins to draw a picture of the fragment. The pen contains a pressure sensor, which activates a digital camera capable of recording the position of Evan's drawing on the electronic paper. Checking a box labeled e-mail, Evan's pen transmits the drawing to Jill's personal communication device (PCD). Jill's PCD sends the drawing to Dr. Reinhardt's colleague at National Geographic via the Internet.

Mrs. Shumate pauses to think about how unobtrusive technology has become. Educational technologies have changed, and using them effectively no longer requires a fundamental change in behavior.

Integration obviously requires more than simply making hardware available to students. The tools must be used in meaningful ways that are driven by the curriculum. The tools described in the preceding scenario are now commercially available.

Considerations for the Future

When planning for the future, consideration must be given to new trends and technologies that are not yet widely used but may impact schools in the not-so-distant future. The following questions are intended to stimulate such thought, but are not to be considered prescriptive or comprehensive.

- Learning will increasingly occur beyond traditional classrooms. How will your division respond technologically to fundamental changes in the learning environment?
- Many people believe that small, portable, wireless devices will play an important role in education in the future. What capabilities do you believe these devices will have and how will your school division use them?
- New technologies will make it possible to provide customized learning experiences for all learners. How will these applications be used in your division? How will electronic textbooks impact teaching and learning?
- In the future, technology advancements may improve our ability to physically perceive the world around us. In what ways will teaching and learning change?
- Tomorrow's students will become increasingly skilled at manipulating, adapting, generating, and disseminating media. How will this impact instructional media?

Professional Development and Support Programs

This element covers both pre-service and in-service training and professional development. It addresses the collaborative development of materials, courses, certification programs, and various staff development delivery models related to the effective integration of technology in K-12 schools.

Support programs for technology integration are defined in terms of financial assistance and the necessity for site-based instructional technologists.

Goals and Targets for Professional Development and Support Programs

Goal 1 **Establish partnerships for identifying and delivering effective technology training to assist educators as they help students achieve high academic standards.**

Targets

1. **Educator training programs reflect preservice coursework and experiences that include effective approaches to integrating technology into K-12 education.**
2. **A variety of classes, training, and resources pertaining to integrating technology effectively are available for staff development.**
3. **Technology-related staff development offered by various entities is provided in a variety of topics and delivery methods.**
4. **Technology leadership activities are provided to K-12 educational technology stakeholders.**

Goal 2 **Administer grant programs and financial assistance initiatives that support implementation of educational technology integration.**

Targets

1. **Grant programs and alternative sources of funding that support educational technology are administered.**
2. **Teacher education institutions, businesses, organizations and private entities become a partner in the implementation of technology-related grants focusing on technology integration.**

Goal 3 **Establish and maintain instructional technologist positions (including site-based technology resource teachers) in school divisions.**

Targets

1. **Site-based instructional technologists are available to all schools.**
2. **Staff development models and activities that are designed for site-based instructional technologists are available for all K-12 schools.**

Professional Development and Support Programs: A Review of the Literature

The classroom teacher determines the success or failure of any school's efforts to integrate technology, and teacher preparedness influences technology's potential to positively affect student achievement (Sivin-Kachala & Bialo, 1999). For schools to capitalize on their technology investments, it is crucial that teachers understand and feel comfortable using technology in their classrooms and know how to choose and use appropriate technologies that will support teaching and learning.

Unfortunately, a majority of our nation's teachers do not have this knowledge. As recently as 1999, only one-third of teachers reported feeling "well prepared" or "very well prepared" to use computers and the Internet for classroom instruction (National Center for Education Statistics, 2000). Those who reported feeling prepared were more likely to use technology for instructional activities than teachers who felt unprepared. The International Society of Technology in Education has developed technology standards for teachers and administrators that can guide divisions in their professional development programs.

Apparently, schools underestimate the importance of professional development for increasing their return on technology expenditures because many do not budget sufficient funding for training. The U.S. Department of Education (1996) recommends that districts set aside 30 percent of their technology budgets for professional development, but research indicates that expenditures for this vital component fall closer to 10 percent (Zeisler in AEL, 2000a). The recent reauthorization of the Elementary and Secondary Education Act (No Child Left Behind Act, 2001) does more than recommend professional development expenditures. It requires that 25 percent of federal technology funds be spent on professional development.

Most teachers reported spending 32 hours *or less* in technology-related professional development over a *three-year time period* (National Center for Education Statistics, 2000). In this short period of time, teachers do not receive adequate training in either basic technology skills or the more complex skills required for effectively integrating technology into the curriculum.

Too often, the content and scope of this training are flawed. Single-day comprehensive workshops that focus on a single hardware or software application are common but are often ineffective (Beavers, 2001). These "one-size-fits-all" workshops seldom address different levels of proficiency and provide little or no follow-up (Snoeyink & Ertmer, 2001-2002).

While all teachers need a core of basic technology skills, many sources emphasize the importance of training that ties technology use to curricular goals (Beavers, 2001; Garet, Porter, Desimone, Birman, & Yoon, 2001; Johnson & Kardos, 2002; Mulqueen, 2001). Active learning with hands-on participation is often recommended, but regardless of format, training requires substantial support, follow-up, and evaluation. Only 67 percent of teachers report the availability of follow-up training (National Center for Education Statistics, 2000). Results from a national sample of teachers (Garet et al., 2001) indicate that improving professional development depends less on format than on duration, collective participation, and three core features: content knowledge, opportunities for active learning, and alignment with other learning activities.

Most teachers report that some professional development is available; however, these opportunities are not as readily available for administrators. The National Staff Development Center developed guidelines that propose a

constructivist approach to professional development and suggest that teachers and administrators collaborate in such activities as action research, conversations with peers about the basic nature of instruction and keeping journals, and projects that involve family and community members in student learning (as cited in Coley, Cradler, & Engel, 1997). Improving opportunities for training administrators is addressed by the Apple Classroom of Tomorrow™ Teacher Development Center Project. Administrators are encouraged to attend the program with a teacher team, and they must commit to providing release time and daily planning time for teachers as well as time for teachers to reflect on their work. Administrators also increase staff awareness through public acknowledgment of teachers' efforts (as cited in Coley, Cradler, & Engel, 1997).

New teachers also require sustained, school-based professional development (Johnson & Kardos, 2002). Many of the nation's teacher training institutions provide very limited basic technology skills and integration training; but regardless of the level of technology proficiency of new teacher candidates, they will be unlikely to integrate technology into practice if they do not see it being used in their schools (National Council for Accreditation of Teacher Education, 1997). This powerful socializing aspect of schools and schooling is corroborated by Jones (2001), who adds that the first place all teachers look for technology help is their peers.

Jones (2001) further notes that technology can support the follow-up to training demonstrated to be so critical to professional development. Teachers can develop technology integration skills by participating in online discussion forums, e-mail correspondence, mailing lists, and chat rooms. Online professional development communities allow teachers to collaborate with colleagues, technology professionals, and teacher education faculty outside of class-time at their own convenience. These online models of training and support can be adapted to address the needs and issues of local divisions and replicated through the use of relatively simple telecommunications tools such as e-mail and mailing lists.

The Enhancing Education Through Technology Act of 2001 supports professional development for teachers, to help them integrate technology with curriculum and instruction and use technology as a tool to access additional and ongoing training and research. The Milken report (1999) also calls for providing Virginia teachers with expanded opportunities to improve their technology skills and to learn to use technology to achieve instructional goals. Research shows that the time spent training teachers in technology correlates to increased student performance (Sivin-Kachala & Bialo, 1999).

Support Programs

As is true with the introduction of any new and complex technology to an endeavor, it has been necessary to create a support system in schools to manage, operate, and effectively use computer networks. Support is provided at the division, school, and classroom levels. Integration of technology into instruction can occur only when adequate technological support is readily available. There are three separate facets of educational technology support in schools. The first is administrative; the second is technical; and the third is instructional. Listed below are major job responsibilities for each area of support.

Technology Administrators
Technology administrators manage programs and provide educational technology leadership in their school divisions and often work with colleagues on regional issues. They develop and implement technology plans, design policies, write and manage grants, manage budgets and purchasing, perform technical support and supervise employees. They often have advanced educational and administrative degrees and usually have been teachers.

Technical Support
Technical support consists mainly of centralized and school-based (occasional regional sharing) support for information networks. This may include selection, configuration, installation, operation, repair, maintenance, software installation, troubleshooting, security management, and creation and upgrade of servers, computers, and networks. Technical support staff also are often involved with data collection, Web site management, program development, telephony, management of student and financial systems, maintenance of computerized devices, and operation of distance learning networks. Information technology specialists often lack educational certification but possess specific technical skills and certifications.

Instructional Technologists
Instructional technologists work with teachers, other staff members, and students to enhance instruction through the use of technology in the classroom. These support people help teachers integrate technology into classrooms, train teachers to use technology and electronic software effectively, help with curriculum and content development that utilizes educational technology resources, aid with classroom management, co-teach using technology, create training aids, participate in selection of appropriate educational software to augment class content, and assist students with technology-related activities or projects. They are experienced, licensed educators who possess a combination of good academic and technical knowledge.

Although most American schools have personnel assigned to educational technology administrative duties, there have been no guidelines established by the United States Department of Education concerning the appropriate level of staffing. Several states have established technical support guidelines, which vary widely. Only three states have established guidelines for the number of instructional technologists needed in schools. Business methodology development organizations have established technical support guidelines for businesses.

According to information provided by school divisions on the 2000-2001 Capacity Survey and a targeted staffing survey done in fall 2002, the overall average full-time equivalent (FTE) for all support personnel is .48 per 100 computers and .39 per 100 computers for technical personnel. This ratio of personnel to computers is often used in information technology analysis of technology staffing patterns. Although the formulas used by many methodology development organizations like the Gartner Group are complex, in business the number of computers is thought to be a good indicator of the size of the network and the subsequent number of staff personnel required to maintain and operate the system. The Gartner Group and other such organizations recommend that there should be from 1.0 FTE per 50 computers to 1.0 FTE per 100 computers, depending on the work of the business, to adequately support its systems. According to the Consortium for School Networking (CoSN), data gathered by International Data Corporation disclosed that most businesses actually have a ratio of 1 FTE per 50 computers. It is unclear whether this model can be directly applied to schools, but it is unlikely that many schools could afford to support such a ratio. The disparity between businesses and schools is markedly different. When business computers are not useable, many workers become unproductive and make no money for their companies; teachers can and are

expected to use other methods to teach children when networks or computers are not working. While the FTE-to-computer approach works for purely technical support, there is no comparable business methodology for staffing for administrative and instructional technologists.

Many states have recognized the need for technology staffing in their Educational Technology Plans (as has Virginia) and have provided guidelines for staffing responsibilities. Generally, these guidelines have addressed the reasons for the staffing and the value of adequate staffing to support technical and instructional needs. Many do not have state board of education approval or recommended staffing levels. A review of state guidelines revealed that few states have substantively addressed the issue of technology staffing. The Massachusetts Department of Education, in its Local Plan Benchmark Standards for the year 2003 established a goal of 1 technical FTE per 100-200 computers and a goal of at least 0.5 FTE instructional technologists to support every 30 to 60 users integrating technology into the curriculum. Maryland has established a ratio of 1 technical support person for 300 computers in its 2002 technology plan. Michigan, through a federal grant, developed the Michigan Technology Staffing Guidelines document that provides a rationale for technology staffing, establishes job responsibilities, and includes a worksheet and formula to assist school districts to determine local needs. This is an excellent planning document for local assessment of technical and instructional staffing needs, but it does not establish specific recommended levels. Texas uses a version of the StaR Chart. The CEO Forum School Technology and Readiness (STaR Chart) characterizes school readiness in four stages: early, developing, advanced, or target. Texas established the following technical support guidelines: early - no support, developing – 1:750, advanced – 1:500, and target – 1:350. The state of Washington has adopted the ISTE (International Society for Technology in Education) Technology Support Index. Oregon has established a technical support staff ratio of 1 to 100/250 users. California proposes adequate staffing as 1 per 300 in newer schools and up to 1:50 in older schools. North Carolina has set staffing ratios at many levels with the major ones being: 1 technology administrator per district, 1 technology coordinator for every 10 schools, 1 technical facilitator per school, and 1 technical support per approximately 100 computers. As can be seen from the research, each state has adopted staffing recommendations that are deemed reasonable by that state.

The International Society for Technology in Education (ISTE), a national and internationally recognized group devoted to the promotion of educational technology in education, has created a rubric called the Technology Support Index. While the index is intended to help school divisions determine many support categories beyond the guidelines, it is a good model for structuring the guidelines. The index characterizes the level of technology capability into four stages. These broad stages of technological capability in schools are emergent (beginning support capability), islands (isolated areas of effective support), integrated (very good support provided in most areas), and exemplary (excellent support in most areas). The Technology Support Index rubric defines each stage and then assigns an FTE staffing range to each. Again, the index provides staffing ratios only for information technology technicians and does not address other computerized devices commonly used in schools. Ratios included in the index are: emergent-level computer to staff ratios exceed 250 to 1, island-level ratios are between 150 to 1 and 250 to 1, integrated-level ratios are between 75 to 1 and 150 to 1, and exemplary-level ratios are less than 75 to 1.

Professional Development and Support Programs: Needs in Virginia

The *Technology Counts 2002* report identifies that Virginia as one of 27 states that require the completion of technology training for teachers to qualify for licensure. Teachers are also required to have technology training as part of their recertification process. Despite this emphasis on technology training, *Technology Counts 2002* reports that only 14 percent of schools in Virginia claim that the majority of their teachers are at the beginning level in the use of technology. There is little information about the quantity and quality of professional development offered to improve the use of technology by Virginia educators.

Additional data must be collected through the implementation of this technology plan to determine the professional development needed to continue building the capacity of educators in Virginia. Professional development is critical to ensure the effective use of technology to improve student learning.

Support Programs

According to a survey in the fall of 2002, Virginia school divisions reporting had an average of 1.6 members serving in a technology director or specialist category. In some instances, there was a full-time director and staff of one or more individuals, but in many smaller divisions, technology administration is just one of many school-wide administrative duties. Seventy-five percent of divisions reported having one or less administrative personnel. The average number of information technology staff personnel reported on the survey was 8.09. These staff members provide support for all technical issues at the central office, individual schools, and classrooms teachers. More than 40 percent of divisions reported three or less information technology staff members. The survey also showed an average of 8.02 instructional technologist positions in each division. Many larger schools do have staff assigned to assist teachers with technology, but most smaller schools have no one assigned to this task. Many schools do have additional curriculum support personnel who work with teachers on instructional improvement, but a great many do not have experience in the effective use of technology, and therefore are not able to focus on instructional improvement through appropriate application of technology.

Professional Development and Support Programs: Implementation Plan

CENTRAL ISSUE

Staff development for educational technology stakeholders continues to be a critical issue (if not the top priority in educational technology utilization) related to the effective use of technology in teaching and learning. The availability of staff development opportunities, materials, and resources varies widely among school divisions. Site-based support systems for technology integration are evolving, but inequities among school systems are dramatic.

RATIONALE

Large investments in educational technology hardware and software will not produce significant results in student achievement and learning unless adequate, consistent, and high-quality staff development and training resources are available to all school divisions and teacher training programs. Support systems for technology integration at the school level have proven critical to the follow-up on investments in hardware, software, and staff development.

Goals and Targets for Professional Development

Goal 1 Establish partnerships for identifying and delivering effective technology training to assist educators as they help students achieve high academic standards.

Target 1 Educator training programs reflect coursework and experiences that include effective approaches to integrating technology into K-12 education.

Direct Benefit to Teaching and Learning

- Teachers are better prepared to appropriately and effectively use technology in teaching and learning.

Reality

- Pre-service programs vary in the quality and depth of technology integration experiences.

Gap

- Teacher education programs need more consistency with regard to experiences in integrating technology into K-12 education.

Progress Measures

- The percentage of teacher education graduates who meet the Virginia Technology Standards for Instructional Personnel.
- The number of teacher training programs that include effective technology integration in course work and pre-service experiences.

<table>
<tr><th colspan="2">COLLABORATION TO REACH GOAL 1, TARGET 1</th></tr>
<tr><th colspan="2">Department of Education – Strategic Direction</th></tr>
<tr><td colspan="2">• Collaborate with institutions of higher education to identify and incorporate best practices and technology innovations in their teacher education programs.
• Promote collaboration between instructional technology leadership and teachers in institutions of higher education to promote training for technology integration.</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Partner with teacher training institutions to provide practical experiences in technology for preservice teachers.
• Collaborate with teacher preparation institutions to evaluate effectiveness of preservice technology training programs.</td><td>• Teacher education faculty models the use of digital content in instruction.
• Teacher education institutions require new teachers to demonstrate proficiency in the use of education-related electronic information, video resources, computer hardware, software, and related technologies prior to starting student teaching and internship experiences.
• Teacher education institutions place student teachers in technology-enriched environments.
• Teacher education institutions include administrator technology leadership training as part of education administration programs.</td></tr>
</table>

Target 2 A variety of classes, training, and resources pertaining to integrating technology effectively are available for staff development.

Direct Benefit to Teaching and Learning

- Instruction improves when teachers use modern teaching tools and methods. All educators will have a better understanding of how technology can assist with student information and provide "decision support" benefits.

Reality

- Not all in-service classes and training materials reflect best practices for integrating technology into instruction.
- Access to training opportunities for integrating technology and managing student data is not equitable for all K-12 teachers and administrators.
- The number of educators who complete educational technology certification programs is relatively small.

Gap

- Improvements are needed in the consistency and quality of technology training materials and classes, and in statewide equity in training opportunities.

Progress Measures

- The number of educational technology classes and certification programs available to educators.
- The number of distinctly different, technology-related, staff development activities, and training materials available to educators.
- The quality and availability of staff development activities and training materials as determined by peer assessment.
- The number of K-12 educators from each school division who successfully complete educational technology courses and certification programs.

<table>
<tr><th colspan="2">COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 2</th></tr>
<tr><th colspan="2">Department of Education-Strategic Direction</th></tr>
<tr><td colspan="2">• Collaborate with institutions of higher education to address the needs for staff development on the effective use of educational technology in K-12 schools.
• Work with institutions of higher education to develop a clearinghouse to disseminate information on professional development opportunities, resources, and contact information.
• Sponsor a state-level conference for the purpose of coordinating the efforts of educational technology stakeholders to share effective practices and innovations in technology integration.
• Provide additional opportunities (using a variety of delivery methods) for stakeholders to share effective practices and innovations in technology integration.
• Develop a Web-based data clearinghouse for instructional resources</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Offer CEUs for technology course work.
• Use grant funds to reimburse staff for credits toward graduate degrees, licensure, or license renewal.
• Contract with local colleges and universities to offer coursework consistent with the TSIP and/or ISTE standards.
• Provide training on technology integration topics at various levels for specific audiences.
• Provide technology training for substitutes.
• Offer technology-training classes for parents.
• All school administrators participate in staff development sessions on curriculum</td><td>• Provide technology proficiency in real-world settings to better prepare teachers to meet the instructional needs of children using technology.
• Incorporate use of digital content in methodology coursework.
• Revise or develop programs that prepare educational technology coordinators and facilitators, and school/division administrators to provide effective leadership in the use of technology for learning and information management.
• Conduct and share research on effective staff</td></tr>
</table>

development sessions on curriculum integration of technology. • Promote sharing of best practices for integration strategies at state and regional conferences, division principals' meetings, and building-level faculty meetings. • Use local educational TV cable channels and/or satellite broadcasts to share best practices in the integration of technology.	development models and practices. • Professional organizations provide membership with examples of best practices in technology integration. • Educational services staff at the public television stations provide training in effective utilization of technology and resources. • Share business model of uses of technology to provide services.

Target 3 Technology-related staff development offered by various entities is provided in a wide variety of topics and delivery methods.

Direct Benefit to Teaching and Learning

- Teachers stay current with modern technology teaching and learning tools and methods, and have a wide range of staff development opportunities that fit their learning styles and time preferences.

Reality

- Not all educators have equal access to high-quality technology training materials and staff development options based on best practices.
- Not all school divisions support significant participation in state, regional, or national technology conferences and in-service activities.

Gap

- Improvements are needed to provide consistent quality in technology training materials and classes, and statewide equity in training opportunities.

Progress Measures

- Number of technology-related staff development activities offered or supported
  - by and among school divisions.
  - by professional organizations.
  - by business and industry.
  - by public broadcasting entities.
  - by the Virginia Department of Education.
- Quality and availability of technology-related staff development activities as measured by peer assessment.

COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 3	
Department of Education –Strategic Direction	
• Provide appropriate resources for staff development activities that are conducted by educational technology stakeholders. • Offer opportunities to promote various models of staff development.	
Representative Actions	
School Divisions	**Stakeholders**
• Attend training opportunities offered by the VDOE, including MarcoPolo Internet Content for the Classroom train-the-trainers training. • Explore virtual training opportunities (anywhere, anytime training, etc.). • Offer technology integration lesson plan development training. • Offer training support for assistive technology. • Provide ongoing professional development in new and emerging	• Provide support for developing virtual professional development for school divisions. • Assist educators in learning how to use advanced communication technologies for their professional productivity and administrative effectiveness.

technologies at all levels. • Offer beginning, intermediate, and advanced level training**.**	

Target 4 Technology leadership activities are provided to K-12 educational technology stakeholders.

Direct Benefit to Teaching and Learning

- Positive technology leadership fosters effective technology integration that results in improved student achievement.

Reality

- Many school divisions do not take advantage of DOE-sponsored training.
- Statewide technology leadership activities are not specifically provided for special populations such as school division administrative leaders, building-level principals, and technology resource teachers.

Gap

- There is a need for greater participation in technology professional development opportunities by K-12 instructional leaders.
- Targeted technology leadership staff development is needed for school division leaders, building-level principals, and site-based technology resource teachers.

Progress Measures

- The number of annual technology leadership activities, i.e., Educational Technology Leadership Conference, leadership activities conducted for K-12 administrators, technology resource teachers, and coordinators/directors of instructional technology.
- The number of K-12 instructional leaders participating in technology professional development activities.
- The quality and availability of technology leadership activities as determined by peer assessment.
- Participation of school divisions in DOE-sponsored training.

COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 4	
Department of Education-Strategic Direction	
• Conduct an annual educational technology leadership conference. • Collaborate with educational stakeholders to conduct staff development for K-12 administrators and technology leaders.	
Representative Actions	
School Divisions	**Stakeholder**
• Encourage teachers to participate in high-quality technology leadership training programs, such as the National Teacher Training Institutes and the MarcoPolo train-the-trainers program. • Require teachers to design individualized training programs. • Ensure that school improvement plans include leadership staff development**.**	• Offer seminars, workshops, and training in technology leadership. • Provide National Teacher Training Institutes

Goal 2 Administer grant programs and financial assistance initiatives that support implementation of educational technology integration.

Target 1 Grant programs and alternative sources of funding that support educational technology are administered.

Direct Benefit to Teaching and Learning

- Additional resources are available to help achieve a foundation level of technology resources for all school divisions.

Reality

- Not all school divisions have the resources and personnel to take advantage of available grant programs and alternative sources of funding.
- A general listing of available grant opportunities and alternative sources of funding is not available.

Gap

- School divisions need technical assistance in grant writing, as well as help in exploring and utilizing alternative sources of funding.
- A general listing of available grant programs and alternative sources of funding is needed.

Progress Measures

- Number of school divisions that participate in grant programs and take advantage of alternative sources of funding.
- Number of grant opportunities and alternative sources of funding that are identified and publicized.

<table>
<tr><th colspan="2">COLLABORATIVE STRATEGIES TO MEET GOAL 2, TARGET 1</th></tr>
<tr><th colspan="2">Department of Education-Strategic Direction</th></tr>
<tr><td colspan="2">• Provide technical assistance for state and/or federal technology grant programs.
• Provide up-to-date E-rate information and related consultation services to educational stakeholders.
• Compile and post grant opportunities on the DOE Web pages.</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Submit proposals for technology grants.
• Take advantage of Elementary Secondary and Elementary Act (ESEA) flexibility provisions.
• Use Title VI, Title II, Part A, Title I grant funds, lease/purchase agreements to fund the local technology plan and address technology needs more effectively.
• Fully participate in the Web-based SOL Technology Initiative funding.
• Utilize Virginia Satellite Education Network) VSEN course offerings</td><td>• Teacher education institutions, profit and non-profit businesses, and private entities become a consortium partner in the implementation of the Title II, Part D: Enhancing Education Through Technology Program, Bill and Melinda Gates Administrator Technology Training Grant, Virginia Initiative for Technology and Administrative Leadership (VITAL), and other technology-related grants.</td></tr>
</table>

Target 2 Teacher education institutions, businesses, organizations, and private entities become a partner in the implementation of technology-related grants focusing on technology integration.

Direct Benefit to Teaching and Learning

- School divisions will have assistance in developing a foundation level of technology software/hardware and the connectivity infrastructure to fully utilize technology resources.

Reality

- Not all school divisions have resources to effectively administer and implement state financial assistance programs at the local level.
- Not all school divisions have foundation level technology resources that include modern connectivity infrastructures.

Gap

- Assistance is needed to effectively implement technology funding.
- Consistent funding resources are needed to help school divisions achieve foundation levels of technology resources, maintain and replace current technology resources, and establish modern connectivity infrastructures.

Progress Measures

- The number of entities that implement partnership grants focusing on technology integration.

COLLABORATIVE STRATEGIES TO REACH GOAL 2,TARGET 2	
Department of Education-Strategic Direction	
• Broker opportunities for the formation of consortia focused on promoting technology integration. • Participate as an active partner in consortia where appropriate.	
Representative Actions	
School Divisions	**Stakeholders**
• Maximize use of local options for the development of partnerships targeting technology-related grants that focus on technology integration.	• Serve as fiscal agent for projects.

Goal 3 Establish and maintain instructional technologists (including site-based technology resource teachers) in school divisions.

Target 1 Site-based instructional technologists are available to all schools.

Direct Benefit to Teaching and Learning

- The degree of technology integration increases when on-demand instructional technology assistance is available.

Reality

- A majority of school divisions do not have adequate financial and human resources to establish and maintain effective site-based technology integration support to all schools.
- A range (i.e., effectiveness and quality) of site-based support models for technology integration exists in Virginia school divisions.

Gap

- Guidelines and implementation models are needed to assist with establishing site-based instructional technologists in all schools.

Progress Measure

- Number of school divisions that have site-based instructional technologists in all schools.
- Number of site-based technology support models that are identified and publicized.

COLLABORATIVE STRATIGES TO REACH GOAL 3, TARGET 1	
Department of Education-Strategic Direction	
• Identify and communicate effective models of K-12 site-based technology support. • Establish guidelines and standards for K-12 site-based instructional technologists.	
Representative Actions	
School Divisions	**Stakeholders**
• Form "technology mentoring teams". • Develop peer-coaching programs. • Adopt local guidelines for site-based instructional technologists.	• Offer utilization support to Virginia public television stations**.**

Target 2 Staff development models and activities that are specifically designed for site-based instructional technologists are available for all K-12 schools.

Direct Benefit to Teaching and Learning

- Staff development for building-level instructional technologists creates mentors and trainers for site-based technology integration support when and where it is needed.

Reality

- Specific training needs for most site-based instructional technologists are not being effectively addressed.

Gap

- Targeted training and specialty resource materials are needed for instructional technologies.

Progress Measures

- Number of staff development activities that are conducted for site-based instructional technologists.
- Quality of staff development activities for site-based instructional technologists as determined by peer assessment.
- Number of staff development models for site-based instructional technologists that are identified and publicized.

COLLABORATIVE STRATEGIES TO REACH GOAL 3, TARGET 2	
Department of Education-Strategic Direction	
• Identify and communicate staff development models and activities for site-based instructional technologists. • Develop and sponsor staff development activities for site-based instructional technologists**.**	
Representative Actions	
School Divisions	**Stakeholders**
• Offer training on emerging technologies and their applications in K-12 instructional programs. • Ensure that building-level technology plans include training programs for instructional technologists	• Content area professional associations offer pre- or post-conference technology training workshops

Professional Development and Support: A Vision for the Future

Professional development has been a major component of the commonwealth's technology initiatives in recent years. The Technology Literacy Challenge Fund 1996-2002, for example, was distributed to districts with the understanding that at least 50 percent of the funds be allocated for professional development. In April 2001, the Bill and Melinda Gates Foundation awarded more than $3.6 million to implement the commonwealth's plan to provide a three-year professional development program for principals and superintendents. These and similar programs reflect the commonwealth's commitment to quality and sustained professional development for educators. There is little doubt that professional development will continue to be an important component of Virginia's technology plan. How professional development will be provided and accessed, however, will likely change. Consider the following scenario.

Last March, Chris attended a two-day workshop about Virginia's new online community of professional practice, known as the Professional Educators Online Community (PEOC). The PEOC workshop provided hands-on experience with Web-based tools such as videoconferencing, shared workspaces, document management, and the customizable PEOC interface.

Chris frequently uses the multimedia training resources and finds the step-by-step graphics, audio files, and animations especially helpful. The system regularly notifies her of new information and resources related to her topics. Today she received notification of a new article on data-based decision making, the central topic of her Personal Professional Development Plan this year. In the past, she felt overwhelmed by trying to read and keep up with several mailing lists; now the PEOC search-and-remind feature provides a "digest" that she finds easier to manage.

The PEOC monthly WebCasts feature specialists on topics identified by educators across the state. If Chris misses a videoconference, an auto-reminder notifies her to retrieve the archived event for viewing.

Although she is a good typist, Chris much prefers a (broadband) videoconference where she can simply speak and not worry about trying to read and respond through the keyboard. Chris uses the online calendar to schedule a conference with her study group at least once a week. She knows that Robert on the Eastern Shore enjoys a videoconference, but the others are more comfortable with a phone call or chatting online. Regardless, they all have found PEOC to be their preferred medium for professional development. Her group includes David, who is visually impaired. He uses a microphone and voice-recognition software to communicate. It was four months before Chris realized her colleague wasn't typing!

Chris and her study group colleagues share a common goal: to improve their students' performance in fifth-grade science as measured by the Standards of Learning test. They have been studying the test data to develop intervention strategies. This study group has provided much-needed support for these teachers who are dispersed across the commonwealth, yet share the same challenges in their classrooms.

When in her classroom, Chris likes to track the strategies she is implementing. She quickly records notes, reflections, and other data on her PDA. Later she uploads them to the PEOC. The system instantly recognizes her and allows her to enter shared workspaces with appropriate cohorts, where they can create and edit documents, collaborate online, and share graphics and other media files. She wishes the PEOC lesson plan database, student tracking software, and the templates for other school management activities had been available when she was a beginning teacher.

The key to Chris's success is that she effectively uses technology to fully participate in a community of professional practice. She no longer feels isolated because she is able to draw on the vast experiences and knowledge of experts from higher education, the Department of Education, content specialists, and her K-12 colleagues around the state. The PEOC enables her to manage her own professional development and provides a forum for communication and resource sharing.

As the role of teachers continues to change to reflect a more student-centered approach to learning, teacher professional development must also change. Professional development must be designed to provide ongoing

training and continuous engagement in a nurturing community of professional practice. The technologies needed to create such an online community of practice exist today.

Additionally, the support programs for each division's technology system must include an appropriate level of instructional technologists to support integration. These instructional technologists must be supported by quality professional development offered specifically to address their needs.

Considerations for the Future

When planning, consideration must be given to new trends and technologies that are not yet widely used but may impact schools in the not-so-distant future. The following questions are intended to stimulate such thought but are not to be considered prescriptive or comprehensive.

- Computer-based tutors/mentors will be more sophisticated in the future. How can these intelligent mentors be used to support your professional development activities?
- Teachers will have unprecedented access to information about their students in the future. In what ways can the availability of such information be used to improve teaching?
- How can teachers use new media and digital tools to guide their own professional development?
- Computer-based simulated teachers will be viable in the future. In what ways are they most likely to be used successfully?
- In the future, the responsibilities of the teachers will become segmented into specialized areas of expertise including evaluator, media developer, subject matter expert, counselor, and manager. What aspects of these roles can be automated?

Connectivity

This component embraces concerns such as the development of state and school division electronic infrastructures that include data, voice, and video networks, and the supporting software and hardware that would allow all computer users to have equitable access to local, state, and worldwide educational resources. Also covered are network connectivity standards and common protocols, network security, Internet usage, Intranets, and hardware/software guidelines, as well as leadership and resources related to technology infrastructure procurement and maintenance.

Goals and Targets for Connectivity

Goal 1 Ensure that all public schools have access to integrated instructional and administrative services across interoperable high-speed networks.

Targets

1. **Every instructional and administrative area in every school has a sufficient number of network connections to support the high bandwidth requirements of current and future instructional and administrative applications.**
2. **Each school division connects all school facilities through a wide area network with sufficient bandwidth to accommodate instructional and administrative needs.**
3. **Each school local area network has reliable high-speed access to the Internet, capable of supporting instructional and administrative applications and initiatives.**
4. **An integrated suite of instructional and administrative applications supported by a standards-based enterprise architecture for K-12 schools is in place.**

Goal 2 Ensure sufficient support for ongoing, reliable network operations.

Targets

1. **Adequate support personnel are in place to operate and support K-12 school technology infrastructure.**
2. **Support personnel for K-12 school infrastructure have appropriate technical skills.**
3. **School systems have customer support systems in place to address technical problems in a timely and efficient manner.**
4. **School divisions plan for the total cost of ownership (TCO) associated with K-12 technology.**

Goal 3 Provide leadership and resources to promote efficient procurement of infrastructure including the identification and procurement of emerging technologies.

Targets

1. **K-12 school technology procurement process is efficient and cost effective.**
2. **School divisions are regularly informed about emerging technologies for instruction and administration.**

Goal 4 Ensure that school divisions have in place network security, filtering, and disaster recovery plans.

Targets

1. **Policies, procedures, and technologies are in place to ensure that computing resources are secure and recoverable.**
2. **School divisions maintain an up-to-date Acceptable Use Policy (AUP) and effectively use network filtering solutions.**
3. **School divisions have appropriate and effective network and data security policies and systems.**

Connectivity: A Review of the Literature

Increased use of the World Wide Web for commerce, government, and education has truly created a global market for goods, services, and even people. Now, more than ever, graduates must compete with their peers around the world.

A 2002 report from the U.S. Department of Commerce highlighted the growing use of the Internet by all Americans, whatever their race, gender, age, income, or education. From August 2000 to September 2001, the number of Americans online (143 million) surpassed 50 percent of the population—an increase of 26 million users in 13 months. Children and teenagers use computers and the Internet more than any other age group, with 90 percent (48 million) of all children between the ages of 5 and 17 reporting using computers and 58.5 percent of those using the Internet. By the age of 10, children are more likely to use the Internet than adults of any age beyond 25. These figures have clear implications for the future importance of being online.

According to the U.S. Department of Commerce (2002), by making Internet access available, schools have dramatically reduced the "digital divide"—the inequities of access among groups of race, gender, and age. In this study, children and young adults of all age groups reported using the Internet "outside home" nearly as often as "at home," with the most prevalent use "outside home" being at school. Black and Hispanic children still have significantly lower access to computers and the Internet at home than do whites, Asian-Americans, and Pacific Islanders. However, current levels of computer and Internet use at school by black and Hispanic children show no significant differences when compared with other ethnic groups. Students from lower-income families, too, have similar access to computers and the Internet at school, as do students from families with higher incomes.

Virginia ranks third nationally in the percentage of information technology jobs, and fifteenth in computer and Internet use in schools (Atkinson, 2002). This gap supports the Milken (1999) recommendation that Virginia continue to invest in infrastructure and connectivity to reach underserved schools and classrooms. Likewise, the Enhancing Education Through Technology Act of 2001 requires states to ensure equitable access to technology for all students, and encourages and supports initiatives designed to expand technology access for disadvantaged students and high-need schools.

While many schools have worked hard to achieve a 5:1 student-to-computer ratio, advances in computing hardware since this national goal was announced (U.S. Department of Education, 1996) provide novel strategies for increasing access that are not tied to the "modern multimedia computer" of just a few years ago. More important than simply reaching a ratio goal is providing sufficient access to computing hardware and software needed to reach student achievement goals. Greater power in ever-smaller computing devices makes some small, affordable units viable options for achieving or even beating the 5:1 goal. Many states and districts have established a goal of one-to-one computing.

Some tools for providing access include notebook (also called laptop) computers and the scaled-down relatives of notebooks called network appliances. Smaller handheld computers, often called personal digital assistants (PDAs), and graphing calculators can support a variety of peripherals, such as small keyboards, cameras, and probes, for taking measurements such as salinity, temperature, and pressure readings. Purchased in classroom sets, stored on portable carts, and capable of wireless transmission, many of these devices provide on-demand computing access to students at critical points in instruction.

Several states, school districts, and universities are experimenting with laptop initiatives to provide greater access to computing power for teachers and students. Projects such as the Maine Association for Middle Level Education (http://www.mamleonline.org/tech.html) seek to increase access to learning materials and extend learning possibilities beyond the walls of the school and after the last bell has rung. In a review of a similar initiative, Rockman (2000) found that students with laptops demonstrated significantly greater access to technology in terms of hardware and Internet use than students without laptops. In addition, students with laptops scored significantly higher on an essay writing task; however, the reviewers had difficulty demonstrating differences in standardized test scores. Teachers, perhaps, benefited most from access to laptops—the researchers noted significant changes in teaching strategies and learning activities for their students.

Beyond the current focus on providing computers and basic Internet access to students and teachers, what does the next decade hold in store? What priorities are emerging for current and future generations of students? One immediate answer is broadband access.

Broadband simply refers to the capacity of a telecommunications service—either wired or wireless—to transmit large data sets and simultaneous data streams (e.g., video or audio-visual media) almost instantaneously (Web-Based Education Commission, 2000). Of the 94 percent of schools that reported being connected to the Internet (Meyer, 2001), more than 30 percent have slow connections, such as 56K frame-relay or even slower dial-up connections. The dramatic rise in Internet use and the increasing complexity of Web-based data and applications demand more capacity to transmit voice, video, and data quickly and reliably across the globe.

Broadband access will support the potential of networked technologies to provide rich content and educational resources, such as digital libraries with HDTV-quality video, CD-quality audio available on demand, and virtual libraries that provide remote access to scientific instruments (Web-Based Education Commission, 2000). While many of the nation's classrooms already use Web-based resources for

instruction, these are primarily text- and graphic-based resources. The ability to more readily transmit voice and video data will approximate face-to-face interactions and will allow all participants—students, teachers, and content experts—to have more natural interactions. Broadband access will deliver more sophisticated information and resources, such as real-time transmissions from remote instruments located deep within the ocean. It will better support the creation of new learning environments that use simulation and virtual reality—technologies that hold the potential to create complex, stimulating environments that were heretofore inaccessible or even impossible. In addition, these richer networked environments will allow users to capitalize more effectively on diverse learning styles and preferences and become more engaged in learning and less encumbered by technology.

Reliable, affordable broadband access will support the realization of the "promise of the Internet" (Web-Based Education Commission, 2000). This promise includes centering learning on the student, focusing on the strengths and needs of individual learners, and making lifelong learning a practical reality. Clarke and Hermens (2001) list positive attributes of what they call "e-learning." E-learning is scalable at less cost than traditional education. There is greater access to e-learning—every Internet connection is a classroom. Finally, e-learning is timely; information and knowledge can be updated more cost effectively than more traditional forms of instruction. Schools, colleges, and even businesses contribute to the realization of this promise by investing in online education that supports instruction and training.

At least a dozen states (Carr, 2000) have established or are developing virtual high schools. Online education found an early niche with students seeking advanced subjects not offered by their home campuses and remedial courses that allow greater time and flexibility in processing and completing coursework, with students who had schedule conflicts in or after school, and students with physical disabilities or medical needs (Harris, 2000). It is estimated that only 60 percent of traditional high schools offer Advanced Placement (AP) courses, with the average being only five AP courses per school (Rourke, 2001). Virtual high schools already extend access to as many as 10 AP courses from a single provider. The online movement continues to blossom, with several schools offering full curricula that are often for sale across state lines; and the Enhancing Education Through Technology Act of 2001 supports the further development of such efforts.

Online education may also address other problems. Rourke (2001) reports that online education may be one strategy for handling growing student enrollments, overcrowded schools and outdated buildings, and teacher shortages. Julie Young (as cited in Rourke, 2001) principal of the Florida Virtual School, one of the nation's most successful online schools, also sees teacher retention and renewed enthusiasm as a by-product of online learning.

To realize the potential of broadband access and the new and emerging technologies it will support, school leaders must become competent in technology planning and managing funding demands. Indeed, many states and funding agents tie appropriations to the existence of a well-developed technology plan (Brush, 1998). Technology planning has become an integral part of annual budgeting, training, data gathering, and assessment of school performance (Cartwright, 1996; U. S. Department of Commerce, 1996;

AEL, 2000a). However, contrary to traditional budgeting practices in many school districts, a technology plan should span more than one year and have enough flexibility to accommodate new and emerging technologies and teaching strategies, as well as changes supported by evaluation data.

The business world typically considers technology a tool to increase productivity. Businesses use complex calculations to determine the "total cost of ownership" of their technology expenditures. Total cost of ownership, or TCO, refers to the costs associated with new equipment beyond the purchase price. It includes costs of software, supplies, upgrades, and infrastructure needs, as well as the human costs of support personnel and professional development. These costs are offset by the anticipated increases in productivity and generation of revenue-bearing products and services over the life span of a piece of equipment.

Schools, too, must consider the TCO of their technology expenditures. However, calculations used by businesses often do not translate well for schools, nor do calculations transfer well from district to district. A study by the International Data Corporation in 1997 (as reported in Consortium for School Networking, 1999) calculated the total cost of ownership for a school with 75 computers at $2,251 per year *per computer,* while costs for a comparably-sized business were $4,517. Differences were attributed to less expensive hardware and software, fewer support personnel for schools, and a projected life span of five years for school computers compared to three years for business computers. The factors that influence a district's cost calculations include support personnel, age and number of computers, number of platforms and software applications, as well as the type of network.

According to the Web-Based Education Commission (2000), new technologies can increase productivity in schools by streamlining administrative procedures, reducing expenditures on resources that require physical storage and quickly become outdated, and by delivering instruction, assessment, and even teacher training online. The report warns, though, that productivity gains in business took three decades to emerge and similar educational gains will require schools to explore new funding models. As the commission reports, "it makes little sense to use 30-year bonds to purchase equipment that should be replaced in three years" (Web-Based Education Commission, 2000, p. 120).

An important concept, then, is interoperability. Defined as "the ability of a product to co-exist in a multiple vendor environment and operate with other products" (University of New Hampshire, 2002, http://www.iol.uhn.edu/testsuites/main.html), interoperability is key to capitalizing on existing technology while defining and identifying complimentary components to support seamless integration. Standards defining maximum utilization of technology will address long-term issues and provide benchmark parameters for future purchases.

The pervasive use of networked technologies and the ease with which data can be created and shared pose problems that have implications for schools. It is not only easier to obtain and reuse materials found on the Internet or in digital resources, it is also easier to misuse them and to find inappropriate or even harmful material. A recent survey (National Public Radio, 2000) indicated that many Americans have concerns about use of the Internet. Most respondents (85 percent) worry about the possibility of dangerous

strangers contacting children, and 84 percent have concerns about the availability of pornography on the Internet. This last fear may be justified, as the survey reports that 24 percent of children between the ages of 10 and 17 say they have seen a pornographic Web site. A later report by the U.S. Department of Commerce (2002) found that, even though 68.3 percent of respondents indicated they were more concerned about children viewing inappropriate information on the Internet than on television, this has not resulted in lower levels of Internet use at home.

Educators must also be mindful of privacy issues and security to prevent unauthorized individuals from obtaining and altering student data (Olivia, 1999; Owens & Cohen, 1998). Administrators and teachers must be aware of how students are using the school's technology and must monitor what students publish (Burke, 2000). Schools must also respond to policies and legislation that dictate requirements to maintain accreditation (Anderson, 1996); provide access to all students by following requirements of the Americans with Disabilities Act (Consortium for School Networking, 1999); and uphold copyright and intellectual property rights of content creators, as specified in the Copyright Act of 1976 and the Digital Millennium Copyright Act of 1998.

Decisions regarding technology use must reflect local policy and community needs, while also acknowledging the potential of educational technology to prepare students to work and live in an information age. Many schools have harnessed the Internet and other technologies to support instruction and help their students practice acceptable and responsible use. The most popular approaches include teaching and monitoring strategies, Acceptable Use Policies (AUPs), and filtering software (Burke, 2000; Mason, 1997; Pownell & Bailey, 1999).

An Acceptable Use Policy (AUP) is a set of guidelines governing use of the Internet for school activities (Anderson, 1996; Rockman, 1998; Truett, Scherlen, Tashner, & Lowe, 1997). AUPs are often district initiatives and may require students and their parents or guardians to sign letters of agreement. AUPs vary greatly, but most districts agree the primary purpose of the policy is to support research and instruction. Most AUPs stem from existing policies regarding codes of behavior and use of traditional resources, such as books, magazines, television, and radio (AEL, 2000a).

The Virginia Department of Education provides an extensive resource to help divisions develop effective AUPs. This Web site, http://www.pen.k12.va.us/VDOE/Technology/AUP/home.shtml, is often recommended as a model of helpful information.

No one strategy can solve all use problems and no school should rely solely on a technology solution. Training for parents, teachers, and students will help reduce the number and severity of problems encountered during use of technology and the Internet (Burke, 2000).

Connectivity: Needs in Virginia

The Commonwealth of Virginia has made great progress over the past four years in school Internet connectivity. In 1998, there was a state average of one Internet-connected computer for every 9.7 students per the *Report to the Commonwealth of Virginia: An Analysis of the Status of Education*

Technology Availability and Usage in the Public Schools of Virginia, by the Milken Exchange on Education Technology, North Central Regional Education Laboratory, and SRI International. *Technology Counts 2002* reported that this ratio was reduced to one Internet-connected computer for every 6.3 students.

The speed of Internet connectivity varies across the commonwealth. The 2002 Department of Education Technology Survey indicated that 71percent of schools have a high-speed Internet connection. There is, however, disparity in high-speed connectivity. Of the eight regions of the state designated as superintendent study groups, the connectivity ranges from a low of 41 percent of the schools with high-speed connections in one region to 92 percent with high-speed connections in another. There is also a disparity in connectivity speed between large and small schools. Only 51 percent of schools with 300 students or less have high-speed Internet access. Of the schools with 1,000 students or more, 91 percent have high-speed Internet access. With the implementation of the Web-based Standards of Learning Technology Initiative, guidelines for minimum connectivity requirements have been established to assist schools in ensuring that adequate connection speeds can be attained; however, bandwidth management is also an important issue when considering connectivity. Schools must learn to partition bandwidth for maximum performance. For example, during online testing the start time can be staggered to avoid a one-time surge in activity.

The 1999 Virginia Department of Education survey of Internet connectivity found that 91percent of the schools in the commonwealth are connected to a wide area network. Data about the capacity of the schools' local area networks or the school divisions' wide area network are scant. To build this capacity, the Virginia legislature appropriated funds in March 2002 for the advancement of technology in schools. Through this initiative, 57 of the 132 school districts in the state have certified that their high schools have Internet-ready local area networks; high-speed, broadband capabilities for instructional, remedial, and testing needs; and a student-to-computer ratio of 5:1.

Technical support of the school computers and network infrastructures is vital to ensuring consistency and reliability in technology use. The 2002 Technology Survey indicated that Virginia schools have less than one (.88) full-time technical support position for every 200 computers. This compares to reports from business of a 1:50 ratio (Consortium for School Networking, 1999). No information is available about the qualifications of the technical support staff in schools, the nature of the support provided, or how school divisions make maximum use of the support staff they have.

The activities proposed in the *Educational Technology Plan for Virginia* will be designed to assist schools to meet their goals for connectivity.

Connectivity: Implementation Plan

CENTRAL ISSUE

All public schools and school division offices in Virginia do not have the same level of connectivity to local and outside resources. Infrastructures vary widely from school division to school division, and even among schools in the same division. Technology infrastructure support, security, and maintenance have become one of the most critical areas in educational technology. Statewide data,

voice, and video connectivity among all educational entities and government need to be standardized and expanded.

RATIONALE

All schools need to be connected to robust, high-speed, wide area networks capable of providing voice, video, and data communication, with equal access to local, state, and worldwide resources. The maintenance and support of technology infrastructures include the need for consistent funding streams to support technical personnel, replacement schedules, and other key maintenance issues**.**

Goal 1 Ensure that all public schools have access to integrated instructional and administrative services across interoperable high-speed networks.

Target 1

Every instructional and administrative area in every school has a sufficient number of network connections to support the high bandwidth requirements of current and future instructional and administrative applications.

Direct Benefit to Teaching and Learning

- Offices, classrooms, and libraries with connections to appropriate educational resources through a local area network with sufficient bandwidth are technology-rich teaching and learning environments.

Reality

- The 2000 High School Capacity Survey showed that there are only 1.48 ports per classroom in high schools. The survey also indicated that student-to-Internet computer ratio in high school classrooms is 15:1—the Virginia General Assembly has established a goal of 5:1.

Gap

- Schools need to connect every instructional and administrative area to a local area network. Many schools need to increase connectivity speed and bandwidth, and many classrooms need four additional ports (for 5:1 multimedia, networked computer connectivity).

Progress Measures

- The percentage of schools reporting that every instructional and administrative area has sufficient connections to a local area network (LAN) with adequate bandwidth to support current and future instructional and administrative applications.

- The percentage of schools reporting that every instructional area has a student-to-computer (networked multimedia and Internet connected) ratio of 5:1.

<table>
<tr><th colspan="2">COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 1</th></tr>
<tr><th colspan="2">Department of Education – Strategic Direction</th></tr>
<tr><td colspan="2">• Promote statewide legislative technology initiatives to assist schools to improve and upgrade school facilities.
• Establish architectural guidelines/standards for schools to upgrade infrastructure to allow for sufficient connections and improved network performance.
• Provide information related to networking infrastructure issues.
• Provide information and consultation services related to Universal Services Act (E-rate) issues.</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Participate in the Web-based SOL Technology Initiative to develop a standards-based infrastructure in high schools that can be replicated at middle and elementary schools.</td><td>• Vendors provide professional consulting services</td></tr>
</table>

• Require all schools to comply with state and local standards for wiring and electrical infrastructure installations and upgrades. • Establish a 5:1 ratio of multimedia, networked computers to students. • Establish a ratio of computers to students of 1:1 in grades 3-12 and 1:3 in Grades 1-2. • Upgrade and/or replace network computers on a three-year cycle.	

Target 2 Each school division connects all school facilities through a wide area network with sufficient bandwidth to accommodate instructional and administrative needs.

Direct Benefit to Teaching and Learning

- Schools with connections to educational resources through a wide area network with sufficient bandwidth are technology-rich teaching and learning environments.

Reality

- The 2002 Technology Survey showed that 71percent of schools report connection to a wide area network with T1 speed or greater.

Gap

- All schools need to have sufficient wide area network connectivity to support access by an increased number of students, teachers, and administrators to administrative and instructional applications.

Progress Measures

- Percentage of schools that have a connection to a wide area network that accommodates instructional and administrative applications.

COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 2	
Department of Education – Strategic Direction	
• Establish architectural guidelines or standards for school divisions for wide area networks. • Provide information related to wide area network issues. • Provide information and consultation services related to Universal Services Act (E-rate) issues. • Provide information and consultation on Internet and connectivity issues.	
Representative Actions	
School Divisions	**Stakeholders**
• Participate in the Web-based SOL Technology Initiative to develop school division wide area network connectivity that will support increasing bandwidth needs. • Follow state and local standards for designing and supporting wide area networks. • Establish and maintain a wide area network connecting all schools at either 1Gigabyte Ethernet over private fiber or T-1 over leased lines.	• Vendors support and participate in school network management training projects and activities. • Municipal offices implement use of network management and monitoring tools. • Municipal purchasing agency examines cost alternatives to wired carriers.

Target 3 Each school local area network has reliable high-speed access to the Internet, capable of supporting instructional and administrative applications and initiatives.

Direct Benefit to Teaching and Learning

- A robust local area network infrastructure enables teachers, students, and administrators to readily access local, state, and worldwide educational resources.

Reality

- The 2000 High School Capacity Survey results show that most computers in high schools communicate at low speeds. Most high school networks use low-speed local area network technology.

Gap

- All schools need to have sufficiently robust local area networks to support ready access to the Internet as well as network-based educational resources and applications.

Progress Measures

- The percentage of schools reporting that they have reliable high-speed access to the Internet, capable of supporting statewide network applications as well as providing access to worldwide educational resources.

<table>
<tr><th colspan="2">COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 3</th></tr>
<tr><th colspan="2">Department of Education –Strategic Direction</th></tr>
<tr><td colspan="2">• Establish architectural guidelines or standards to assist schools to plan for an Internet connection that provides sufficient bandwidth to support instructional and administrative needs.
• Provide information and consultation services related to Universal Services Act (E-rate) Internet access.</td></tr>
<tr><th colspan="2">Representative Action</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Participate in the Web-based SOL Technology Initiative to develop high-speed local area networks in high schools that can be replicated in middle and elementary schools.
• Follow industry standards for designing and supporting local area networks in all schools.
• Lease two (TI) lines to the Internet that can be shared by all schools over the wide area network. Seek to significantly upgrade Internet service in the next budget year.</td><td>• Vendors encourage a planned obsolescence program for local area network infrastructure and network components within Virginia Architectural Guidelines.
• Vendors create and publish standards for core technologies.
• Infrastructure entities support Web-based statewide network applications.</td></tr>
</table>

Target 4 An integrated suite of instructional and administrative applications supported by a standards-based enterprise architecture for K-12 schools is in place.

Direct Benefit to Teaching and Learning

- Universal access to worldwide educational information and resources enriches the teaching and learning environment.
- Teachers and administrators can focus on instruction and spend less time on administrative tasks.
- Teachers and administrators have ready access to information that supports instructional decision making.

Reality

- The 2000 High School Capacity survey indicated that nonstandard or proprietary technology is in use in some high schools.

Gap

- All school divisions need to use technology that is standards-based and supportable.

Progress Measures

- Percentage of school divisions that report use of standards-based technology for instruction and administration.

COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 4	
Department of Education – Strategic Direction	
• Collaborate with other entities to develop standards-based application and technology architectural guidelines that meet the needs of K-12 schools. • Provide information and guidance to school divisions regarding technology infrastructure.	
Representative Actions	
School Divisions	**Stakeholders**
• Participate in the Web-based SOL Technology Initiative to build a standards-based technical architecture for high schools that can be replicated in middle and elementary schools. • Adopt new applications that can be readily integrated and address current and future needs.	• Provide technical support for development of standards-based application architectural guidelines in schools. • Establish a reliable and technology standards-based architecture for network connectivity • Provide cost-effective training opportunities on integrating applications and technology.

Goal 2 Ensure sufficient support for ongoing, reliable network operations.

Target 1 Adequate support personnel are in place to operate and support K-12 school technology infrastructure.

Direct Benefit to Teaching and Learning

- Adequate support services promote the consistent and reliable operation of the K-12 school technology infrastructure.

Reality

- The 2002 Technology Survey showed that each school has .57 FTEs (technical staff) dedicated to technology support, and that one technician may support up to 318 computers.

Gap

- K-12 technology personnel generally support four times the number of computers, as do their business counterparts. Additional support personnel are needed to correct this disparity.

Progress Measures

- The percentages of school divisions reporting they have an adequate number of support personnel to efficiently operate and maintain their technology infrastructure.

COLLABORATIVE STRATEGIES TO REACH GOAL 2, TARGET 1
Department of Education –Strategic Direction
• Develop recommendations to guide school divisions in providing an adequate number of technical support personnel. • Promote legislative initiatives supporting ensuring an adequate number of school technology support personnel. • Collect and share best practices as they relate to adequate technology support staffing.

Representative Actions	
School Divisions	**Stakeholders**
• Allocate funding for an appropriate ratio of equipment to desktop support staff in division technology budget. • Develop or offer technician training programs. • Train teachers to identify and fix minor technical problems. • Share technical staff among divisions.	• Vendors permit and encourage use of desktop support technology. • Municipalities budget for certified outsource providers. • Municipalities establish standards-based infrastructure. • Community members volunteer to assist with school technology needs. • Supplement existing technical administrative personnel with staff. • Vendors participate in programs that train students.

Target 2 Support personnel for K-12 school infrastructure have appropriate technical skills.

Direct Benefit to Teaching and Learning

- Appropriately skilled support personnel will be able to maintain a technology infrastructure that responds to complex connectivity and usage demands.

Reality

- Evidence suggests that some technical support personnel may not have appropriate skills to support the K-12 school technology infrastructure.

Gap

- All technical support personnel need to have the skills needed to support K-12 school technology infrastructure.

Progress Measures

- The percentage of school divisions reporting that support personnel for their technology infrastructure are appropriately skilled to meet the demands of the position.

COLLABORATIVE STRATEGIES TO REACH GOAL 2, TARGET 2	
Department of Education – Strategic Direction	
• Share best practices for defining and providing appropriately skilled technology support personnel. • Identify and promote innovative technical training opportunities. • Provide information on programs that lead to certification in industry-standard technology for K-12 technology support personnel.	
Representative Actions	
School Divisions	**Stakeholders**
• Target appropriate funding per technical support employee for additional training in division technology budget. • Provide resources and support for division technology support personnel to obtain industry standard certification. • Include training programs for technology support personnel in school division technology plan.	• Technology providers make training resources available. • Community colleges offer training for K-12 technology end users. • Technology providers use training-of-trainers model to add support personnel. • Technology providers standardize infrastructure components. • Technology providers train IT staff to understand the nature of educational technology needs**.**

Target 3 School systems have customer support systems in place to address technical problems in a timely and efficient manner.

Direct Benefit to Teaching and Learning

- Expedient K-12 network problem resolution reduces interruption of educational technology activities.

Reality

- Evidence suggests that some school divisions may not have reliable procedures in place for technical problem resolution.

Gap

- All school divisions need to develop reliable procedures for technical problem resolution.

Progress Measures

- The percentage of school divisions reporting they have fully developed procedures in place to expedite technical problem resolution.

COLLABORATIVE STRATEGIES TO REACH GOAL 2, TARGET 4	
Department of Education –Strategic Action	
• Identify and publicize guidelines, procedures and models for technical problem resolution.	
Representative Actions	
School Divisions	**Stakeholders**
• Create and deploy an intranet/Web-based service request system for technical difficulties. • Participate in collaborative agreements for sharing specialized technology personnel with other school divisions or entities. • Include development of procedures for technical problem resolution in technology plans.	• Software developers offer Web-based solutions geared toward the K-12 environment. • Technology providers use Help Desk applications geared toward the K-12 environment. • Technology providers develop and maintain a knowledge base of information resources geared toward K-12 technology personnel.

Target 4 School divisions plan for the total cost of ownership (TCO) associated with K-12 technology.

Direct Benefit to Teaching and Learning

- Technology investments are fully supported and utilized when the total costs of ownership and operation are understood.

Reality

- A total cost of ownership for the overall K-12 educational technology infrastructure is not fully understood by all stakeholders.

Gap

- Total cost of ownership information for the overall K-12 technology infrastructure needs to be identified, understood, and communicated to all stakeholders, and incorporated into planning at all levels of K-12 education.

Progress Measures

- Number of activities conducted to identify and promote awareness of total cost of ownership for K-12 technology (costs to include hardware, software, operations, administration, end-user operations, and downtime).
- Number of school divisions that conduct total cost of ownership analysis as reflected in technology plans.

COLLABORATIVE STRATEGIES TO REACH GOAL 2, TARGET 4	
Department of Education – Strategic Action	
• Identify and publicize resources for determining and measuring the TCO of K-12 technology. • Conduct activities to promote an understanding of the TCO for K-12 technology investments.	
Representative Actions	
School Divisions	**Stakeholders**
• Include total cost of ownership studies and strategies in school division technology planning.	• Technology providers support training and provide support materials on total cost of ownership. • Municipalities use total cost of ownership structures in conjunction with obsolescence planning.

Goal 3 Provide leadership and resources to promote efficient procurement of infrastructure including the identification and procurement of emerging technologies.

Target 1 K-12 school technology procurement process is efficient and cost effective.

Direct Benefit to Teaching and Learning

- Efficient and cost-effective technology procurement can result in significant savings for school divisions.

Reality

- A limited number of resources exist to assist school divisions in the acquisition of K-12 technology.

Gap

- Develop additional procurement resources, customized for K-12 education needs.

Progress Measures

- Number of resources (i.e., templates and guidelines) that schools may use in the technology procurement process that have been identified or developed and publicized.

COLLABORATIVE STRATEGIES TO REACH GOAL 3, TARGET 1	
Department of Education – Strategic Direction	
• Identify templates and guidelines that K-12 school divisions can use for their technology procurement process. • Promote and coordinate the development of K-12 technology procurement contracts for hardware, software/courseware, consulting services, and maintenance.	
Representative Actions	
School Divisions	**Stakeholders**
• Use state and regional contracts or negotiate local contracts. • Establish guidelines and specifications for hardware and software purchases. • Provide online resource of purchasing information for frequently purchased technology items.	• Municipalities encourage use of electronic procurement systems. • Municipalities share efficient practices for procurement procedures. • A variety of entities form partnerships to negotiate for and procure goods and services.

Target 2 School divisions are regularly informed about emerging technologies for instruction and administration.

Direct Benefit to Teaching and Learning

- Educational technology stakeholders need timely information to make critical decisions about using emerging technologies for teaching and learning.

Reality

- Information about emerging technologies is not always well researched, timely, or widely distributed to K-12 stakeholders.

Gap

- Current information about educational technologies needs to be carefully researched and publicized to K-12 stakeholders.

Progress Measures

- Number of activities conducted for educational technology stakeholders that explain and explore emerging technologies for instruction and administration.
- Number of pilot studies in K-12 schools using emerging technologies.
- Percentage of surveyed educational technology stakeholders who indicate awareness and/or understanding of emerging technologies for instruction and administration.

<table>
<tr><th colspan="2">COLLABORATIVE STRATEGIES TO REACH GOAL 3, TARGET 2</th></tr>
<tr><th colspan="2">Department of Education – Strategic Action</th></tr>
<tr><td colspan="2">• Conduct activities that provide information about emerging technologies for instructional and administrative applications.
• Conduct and promote demonstrations of the applications of emerging technologies in education.
• Identify and publicize school use of emerging technologies.</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Investigate mechanism for central distribution of video-on-demand (instructional and informational programming) across a video network.
• Plan regular meetings of administrative and technology instructional support staff featuring new technologies and models of technology integration.</td><td>• Teacher education institutions provide research resources.
• Professional organizations communicate demonstrated results for technology investments.
• Institute a technology adoption process to facilitate incorporation of new technologies into statewide standards.</td></tr>
</table>

Goal 4 Ensure that school divisions have in place network security, filtering, and disaster recovery plans.

Target 1 Policies, procedures, and technologies are in place to ensure that computing resources are secure and recoverable.

Direct Benefit to Teaching and Learning

- K-12 technology resources are protected from unauthorized use or misuse and the loss of data due to catastrophe or hardware/software failure.

Reality

- All schools divisions have some form of security for technology resources as well as varied data backup systems; however, these procedures may not meet acceptable IT industry standards.

Gap

- School systems need to constantly upgrade their security and data backup procedures for technology resources in the face of constantly changing threats to valuable technology resources and data integrity.

Progress Measures

- Percentage of school divisions reporting they have conducted a formal risk assessment.
- Percentage of school divisions reporting they have assessed risk and threats to their school computing resources.
- Percentage of school divisions reporting they have implemented security technologies such as firewall and virus protection software.
- Percentage of school divisions reporting they have developed disaster recovery plans for their technology resources.

<table>
<tr><th colspan="2">COLLABORATIVE STRATEGIES TO REACH GOAL 4, TARGET 1</th></tr>
<tr><th colspan="2">Department of Education –Strategic Direction</th></tr>
<tr><td colspan="2">• Identify resources that will assist school divisions in the assessing and developing of security and disaster recovery procedures.
• Identify model disaster recovery plans for school division data and resources</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• All school division networks will utilize both firewall and virus protection software with daily extensive taped backup every day to provide recovery of data if necessary.</td><td>• Technology providers conduct periodic security audits.
• Businesses share policies and procedures that could be used as models for security plans.
• Technology providers and businesses volunteer to assist with the development of security procedures.</td></tr>
</table>

Target 2 School divisions maintain an up-to-date Acceptable Use Policy (AUP) and effectively use network filtering solutions.

Direct Benefit to Teaching and Learning

- Ethical use of technology resources is an expected practice for all users of educational technology.
- The effective use of filtering solutions promotes a safe and appropriate teaching and learning environment.

Reality

- As required by state legislation, each school division has an installed filtering solution as part of its AUP.

Gap

- School divisions need to file updated AUPs with the Department of Education every two years.
- School divisions need to continually review and evaluate the effectiveness of their filtering solutions.

Progress Measures

- Number of school divisions reporting that they have updated their AUP.
- Number of activities conducted statewide that provide information about appropriate uses of K-12 network filtering solutions.

COLLABORATIVE STRATEGIES TO REACH GOAL 4, TARGET2	
Department of Education – Strategic Direction	
• Continue to provide resources that assist schools with the development of up-to-date AUPs. • Identify emerging network-filtering solutions for K-12 schools. • Interpret current state and federal laws and policies and disseminate explanatory material to school divisions. • Promote technology initiatives to assist school divisions to implement filtering legislation.	
Representative Strategies	
School Divisions	**Stakeholders**
• Involve students, teachers, administrators, parents, and community members in the periodic review of the AUP. • File updated AUP with the Department of Education every two years. • Update and utilize appropriate school division network filtering solutions.	• Businesses, colleges, and universities volunteer to review school division AUP. • Information technology providers offer technological solutions to AUP infringements. • Technology providers work to offer customized filtering solutions. • Businesses offer their solutions as a model. • Businesses offer solutions to the challenges of providing secure e-mail services to the K-12 environment.

Target 3 School divisions have appropriate and effective network and data security policies and systems.

Direct Benefit to Teaching and Learning

- Access to confidential student, staff, and vital administrative data supports instructional decisions and design.

Reality

- Few school divisions have a well-defined security policy for computer and network equipment (hardware, software, and data).

Gap

- School divisions need to invest time and expertise into the development of a well-conceived, comprehensive, and customized security policy.

Progress Measures

- The number of school divisions reporting that they have a policy that effectively secures sensitive information, critical systems, and computer equipment and software.

COLLABORATIVE STRATEGIES TO REACH GOAL 4, TARGET 3	
Department of Education –Strategic Direction	
• Provide guidance to school decision makers with information relating to privacy and confidentially of data. • Provide training on issues related to electronic data security. • Identify and publicize examples of security policies and systems	
Representative Actions	
School Divisions	**Stakeholders**
• .Develop and communicate policy to students, teachers, administrators, parents, and community members. • Identify personnel responsible for activities that relate to the use of the network. • Plan for overall coordination of relationship of network to other regional	• Share security policy. • Serve on committees to develop or review school division security policy.

and state networks. • Acquire blocking software designed to limit students' access to specific types of information.	

Connectivity: A Vision for the Future

Virginia's Public Education Network (VA.PEN) was established more than 10 years ago as a telecommunications system accessed mainly by modem for grades K-12. Virginia was one of the first states in the nation to create such an infrastructure to link its schools with one another and the world. Today, this innovation continues with the Web-based Standards of Learning Technology Initiative, a large-scale project to improve student achievement through the use of statewide computer resources and the Internet. This initiative creates an Internet-ready local area network capability in each school and assures high-speed, high-bandwidth capabilities for instructional, remedial, and testing needs. The Internet2 K20 Initiative brings together Internet2 member institutions, primary and secondary schools, colleges and universities, libraries, and museums to place new technologies—advanced networking tools, applications, middleware, and content—into the hands of innovators, across all educational sectors in the United States, as quickly and as "connectedly" as possible (UCAID, 2002). Some agencies of the commonwealth have opted to connect to Internet2 via Net.Work.Virginia (NWV). In early 2002, the Jason Project, a program based on real-time scientific investigations, was delivered to fourth- and ninth-graders via satellite and Internet2. The success of the pilot highlights the potential of advanced network technologies to provide meaningful experiences for learners. The following scenario describes other experiences that might occur via Interent2.

Angela awakes early and rushes downstairs for breakfast. Her dad has promised to drop her off at her school so she can begin work before her lab partner arrives.

At their school in far southwest Virginia, Angela and Juan are studying human influences on ocean systems in one of 30 natural laboratories of the Neptune Project. These laboratories, located on the sea floor just off the coasts of Washington, Oregon, and British Columbia, are connected by 3,000 kilometers of fiber optic/power cable that transmit continuous real-time data and imagery.

This morning, Angela and Juan will drive a robotic vehicle along the ocean floor, thanks to their Internet 2 connection. They will capture images to help them determine how their study site has changed since their last visit more than six months ago. They will discuss these images with their lab partners, Joy and Aaron, who attend school in Maine, before enhancing the images with image processing software to reveal more detail.

Their data will contribute to a robust archive that will be built over the 25-year life of the Neptune Project. It will be used by scientists, researchers, teachers, and students around the world to expand our understanding of human influences on ocean systems.

The Neptune Project, based at the University of Washington, is slated to begin in 2005. This project will provide learners with unprecedented opportunities to interact with real-time data and imagery that will enable them, alongside scientists from around the world, to construct a deeper understanding of dynamic earth and marine systems. It represents only one type of activity that will be possible with the broadband access available to Virginia's schools.

Considerations for the Future

When planning, consideration must be given to new trends and technologies that are not yet widely used but may impact schools in the not-so-distant future. The following questions are intended to stimulate such thought but are not to be considered prescriptive or comprehensive.

- Real-time, broadcast-quality video conferencing will be commonplace in the future. How will your division maximize the improved quality afforded by broadband connectivity?
- Tele-immersion will enable students to interact with real and virtual objects in a shared space with other students who are physically situated in another part of the world. Describe some learning experiences that could be effectively addressed through tele-immersion.
- New technology features are becoming commonplace on mobile telephones. What learning applications do you believe could be delivered using this widely available technology?
- Interoperability among various devices will provide unprecedented communication options. In what ways can this connectivity be used to support a distributed learning model?
- In the future, accurate real-time language translation will occur routinely. How will this impact teaching and learning?

Educational Applications

This element includes issues that relate to the instructional and administrative educational applications that will make use of the infrastructure "highway" which is referenced in the issue area, "Connectivity." A major area includes Virginia's Web-based SOL Technology Initiative as well as other Web-based informational resources and necessary data collection systems that will be developed and supported by the Virginia Department of Education. Focus areas will include appropriate use and stakeholder sharing of networked educational courses, applications, and instructional resources that support the Virginia Standards of Learning using the supporting functions and delivery systems of distributed/distance learning technologies to include the Virginia Satellite Education Network (VSEN).

Goals and Targets for Educational Applications

Goal 1 Improve teaching and learning through the appropriate use of network-accessible educational applications.

Targets

1. **Teaching and learning resources that effectively support the Virginia Standards of Learning (SOL) have been identified, communicated, and developed.**

Goal 2 Promote and develop Web-based applications, services and resources.

Targets

1. **All schools are participating successfully in the Virginia Web-based SOL Technology Initiative.**
2. **School divisions use Web-based applications for state data collection, warehousing, and reporting.**
3. **Use of a common set of data definitions allows standard communication and interpretation of student information.**
4. **Every school has an efficient automated library media center connected to the Internet and networked to appropriate learning areas.**
5. **School divisions have strategies for providing community access to school-based technology and applications.**

Goal 3 Offer digital learning opportunities at state and local levels.

Targets

1. **Web-based courses and staff development activities are provided.**
2. **Schools are able to receive digital television broadcast signals and effectively utilize the enhanced capabilities.**

Educational Applications: A Review of the Literature

The education and training sector holds the potential to become one of the largest sectors in the world economy. Global expenditures in education and training are reported by Merrill Lynch (as cited in Gunasekaran, McNeil & Shaul, 2002) to top $2 trillion, with one-third of this expended in North America. A variety of educational applications—both networked and stand-alone—is available to practitioners for supporting teaching, learning, and school management.

With the growing market for educational applications, schools should consider interoperability as they make software purchases. To help schools increase their purchasing power by leveraging software investments and reducing redundant or proprietary data formats, the Schools Interoperability Framework (SIF) (http://www.sifinfo.org) is an industry-driven effort designed to promote greater interoperability between software for instruction and management. School software purchasing agents should consider the standard formats, naming conventions, and rules of interaction among software applications promoted by SIF to increase the return on their software investment.

While word processing applications and other productivity-based software are the instructional applications most commonly used in classrooms (McGraw, Blair & Ross, 1999; National Center for Education Statistics, 2000), digital content in the form of interactive media holds potential to create high-quality learning environments. These media enable greater user control of content and navigation, increased collaboration, and unique assessment opportunities that provide relevant and personalized feedback (Cairncross & Mannion, 2001). Hill and Hannafin (2001) suggest that access to easily manipulated resources encourage educators to move to a resource-based approach to learning. As these researchers note, digital resources are more easily stored, cataloged, and retrieved; they are more dynamic; and users often can extract meaningful data from them. Digital resources may also support different learning needs, and because resource-based learning does not imply any particular form of learning or learning process, it is easily aligned with various epistemologies, teaching styles, and learning preferences.

Simulations, more than virtual environments, have found a modest user base. While neither has yet reached widespread use in providing and supporting instruction, early projects in the distribution of media-intensive content over broadband technologies hold great promise for creating compelling learning environments and activities that promote student learning. The Internet2 K20 Initiative seeks to leverage the capacity of broadband technologies to facilitate teaching, learning, and access to educational opportunities. The initiative supports collaborative efforts with K-12 schools, colleges and universities, libraries, and museums (and their government and corporate partners). Current projects include Research Channel, which streams high-definition-television-quality, research-based content from leading research institutions; Neptune, a network of undersea laboratories that provides students with real-time remote access to vehicles, sensors, and data instruments on the ocean floor; and the Animation Research Lab and Digital Animation Library at the University of Washington, which brings together computer scientists, artists, musicians, architects, and writers to create new algorithms, systems, and tools for animation that will be accessible from a digital repository (Fox, 2001).

Projects such as these answer the call by the Web-Based Education Commission (2000) for compelling online content. The commission warns that without demand for such content, it may not be feasible for online content developers to stay in business. The result could be a market dominated by a few companies with limited choice and little innovation in design. Schools with technology-savvy faculties could generate a demand for compelling online content, but unless a critical mass of schools create this demand while the already-dwindling online content market still has enough players, it may come too late.

Educational Applications: Needs in Virginia

The use of technology for educational applications has moved forward in the commonwealth. A new online testing program to measure student progress on the state's academic standards is being developed for implementation in the 2004-2005 school year. The Virginia Department of Education has increased its use of Web-based applications to support schools. Most curriculum support materials can be accessed through the Web. In addition, products to assist schools in the use of student achievement data are available. There also have been efforts made to coordinate the collection of data from schools through Web-based reporting. Currently, all of the state's major data collections are submitted online.

Other projects across the commonwealth use technology to expand the learning opportunities available to students. *Technology Counts 2002* states that 19 percent of Virginia schools subscribe to some form of online curriculum. An example of this is the use of two-way interactive audio and video technology in many high schools to provide students with advanced mathematics, science, social studies, and English courses not directly available on the campus. The 2002 Virginia Department of Education Technology Survey indicated that 184 schools have digital videoconferencing capability.

While progress has been made in the availability and use of educational applications of technology, the activities supporting the *Educational Technology Plan for Virginia* are designed to move the state forward in this area.

Educational Applications: Implementation Plan

CENTRAL ISSUE

All public schools and school divisions in Virginia do not have the same level of educational application support (administrative and instructional) at either the divisional and/or individual school level.

RATIONALE

All schools need access to the same level of informational, administrative, and instructional resources and educational applications to support the Virginia Standards of Learning, to improve the delivery of essential services, and to increase student learning and achievement.

Goal 1 Improve teaching and learning through the appropriate use of network-accessible educational applications.

Target 1 Teaching and learning resources that effectively support the Virginia Standards of Learning (SOL) have been identified, communicated, and developed.

Direct Benefit to Teaching and Learning

- Teachers and administrators will have ready access to SOL resource materials.
- Information regarding the quality of resources will be shared.

Reality

- Not all educators are aware of SOL resources that have been identified and developed.
- Not all resources are available through online delivery methods.

Gap

- An online delivery method that can be easily accessed by all technology stakeholders and will allow reference to SOL resource materials as well as information pertaining to the quality of educational resources needs to be developed.

Progress Measures

- Quality and quantity of updated and online software reviews from professional evaluation sources.
- Quality and quantity of updated and online items in Virginia's Public Television Instructional Video Resource Database.
- Number and quality of updated software evaluations posted to statewide Web site by school divisions.
- Percentage of school-based performance evaluations that indicate teachers are significantly integrating technology-based resources to support the Virginia Standards of Learning.

<table>
<tr><th colspan="2">COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 1</th></tr>
<tr><th colspan="2">Department of Education – Strategic Direction</th></tr>
<tr><td colspan="2">• Identify and deliver high-quality, SOL-aligned content-based lessons or classes over the Internet and via satellite.
• Coordinate school division's participation in instructional software evaluation and distribute findings via the Department of Education Web site.
• Promote evaluation of software to determine correlation with the Virginia SOL.
• Post Web-based links to emerging technology resources that enhance effective teaching and learning.</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Provide staff development and training opportunities that address the identification, evaluation, SOL correlation, and selection processes for technology-based materials including those for remediation.
• Create and maintain an electronic curriculum guide that ties instructional media materials to the SOL and local curriculum.
• Use TSIP certification, technology-use surveys, and classroom observations to assess that teaching and learning resources have been identified and utilized.
• Provide access to a full range of digital</td><td>• Content professional organizations encourage members to use and submit information to online instructional video resource database created by educational stakeholders.
• Public broadcasting stations provide appropriate teacher training (such as National Teacher Training Institute, NTTI) so that teachers can most effectively utilize broadcast media from public television.
• Public entities provide support for the educational services department of public television stations to allow additional education specialists to work with school divisions to</td></tr>
</table>

content to supplement printed textbook and other analog learning resources. • Provide online access to the core curriculum in the form of e-learning courses for secondary students, where appropriate.	provide services that identify, communicate, and implement available resources that correlate with the SOL. • Content professional organizations as well as consortia develop electronic training programs that support integration.

Goal 2 Promote and develop Web-based applications, services, and resources.

Target 1 All schools are participating successfully in the Virginia Web-based SOL Technology Initiative.

Direct Benefit to Teaching and Learning

- All schools have a robust infrastructure capable of supporting Internet-based applications for instruction, remediation, and testing.

Reality

- Of 133 school divisions, 18.9 percent do not meet the Stage 1 High School Readiness Certification (VDOE, n.d.); 73 percent are not Stage II Ready

Gap

- Many schools need an infrastructure capable of supporting Internet-based instructional activities and online testing.

Progress Measures

- Percentage of high schools where the network infrastructure is in place to support applications of the Virginia Web-based SOL Technology Initiative
- Percentage of middle and elementary schools where the network infrastructure is in place to support applications of the Virginia Web-based SOL Technology Initiative
- Number of times DOE Web-based SOL instructional or remediation application resources are accessed or downloaded
- The number of schools reporting successful operation of Web-based SOL online testing applications

COLLABORATIVE STRATEGIES TO REACH GOAL 2, TARGET 1	
Department of Education –Strategic Direction	
• Develop, implement, and evaluate applications of the Virginia Web-based SOL Technology Initiative for K-12 schools. • Provide intervention strategies to schools having difficulty meeting the goals of the Web-based SOL Technology Initiative for K-12 schools. • Develop a clearinghouse for sharing instructional and remedial materials.	
Representative Actions	
School Divisions	**Stakeholders**
• School division computer-based and Web-based instructional materials committees conduct regular needs assessments and identify materials to correlate with local instructional needs and the SOL. • Share information about materials found to be effective for instruction and remediation via a common database. • Ensure all schools are "certified" to participate in the Web-based SOL Technology Initiative**.**	• Public television stations share information and resources that effectively support instruction and remediation. • Businesses provide technical expertise and support to assist school divisions to make sound infrastructure and hardware selection decisions. • Technology providers become a partner in the Web-based Initiative.

Target 2 School divisions use Web-based applications for state data collection, warehousing, and reporting.

Direct Benefit to Teaching and Learning

- Efficient services are supplied to school divisions to simplify and/or reduce reporting requirements.

Reality

- Information is not readily available to school divisions and other appropriate stakeholders.

Gap

- Data warehousing capability and data collection systems need to be developed to provide efficient services to educational stakeholders.

Progress Measures

- Number of Web-based information resources, data collection, warehousing, and reporting systems available to school systems.
- Utilization data and surveys indicating that Web-based resources are frequently utilized and reduce or simplify data reporting requirements for school divisions.
- Degree of access to appropriate DOE Web-based resources by all educational technology stakeholders.

<table>
<tr><th colspan="2">COLLABORATIVE STRATEGIES TO REACH GOAL 2, TARGET 2</th></tr>
<tr><th colspan="2">Department of Education – Strategic Direction</th></tr>
<tr><td colspan="2">• Develop appropriate Web-based resources for state data collection, warehousing, and reporting to simplify or reduce data reporting processes for school divisions.
• Identify and publicize Web-based resources for local data collection, warehousing, and reporting.</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Provide all administrators and curriculum supervisors appropriate training to maximize the utilization and analysis of Web-based data and information available from local and DOE sources.</td><td>• Businesses present models of currently developed business applications.
• Businesses share best practices.
• Research institutions provide information and technical support to assist school divisions in developing and analyzing data collections so that they can make sound decisions regarding technology planning.</td></tr>
</table>

Target 3 Use of a common set of data definitions allows standard communication and interpretation of student information.

Direct Benefit to Teaching and Learning

- DOE and school divisions are able to send and receive data reports using common protocols. Information is available and accessible for planning and instruction.

Reality

- Information cannot always be transmitted electronically in a standard communication format using commonly defined terms.

Gap

- Standard student information data definitions need to be adopted.

Progress Measures

- Number of school divisions reporting that they can communicate with state-operated data collection and data warehouse applications pertaining to transmitting and referencing student information.
- Number of state-operated Web-based applications that have a common set of data definitions for communicating with school divisions.

COLLABORATIVE STRATEGIES TO REACH GOAL 2, TARGET 3	
Department of Education – Strategic Direction	
• Identify and communicate a common set of data definitions for student information systems.	
Representative Actions	
School Divisions	**Stakeholders**
• Implement student information and other intranet systems that use a common set of data definitions.	• Adopt a common protocol for communicating data. • Provide and develop interoperable student management systems. • Adopt practice of using common data definitions.

Target 4 Every school has an efficient automated library media center connected to the Internet and networked to appropriate learning areas.

Direct Benefit to Teaching and Learning

- Students and teachers will have online access to carefully selected resources through the library media center.

Reality

- Many schools have up-to-date library media centers with access to carefully selected electronic resources. Not all school learning areas are connected to the library media center. Not all school library media centers are connected to the Internet.

Gap

- School library media centers need to be updated to include connectivity to all learning areas in the school.

Progress Measures

- The percentage of schools reporting an up-to-date library media center with the following characteristics: automated card catalog, automated circulation system, access to an electronic reference system and the Internet.
- The percentage of schools reporting that their library media centers are networked to all appropriate learning areas and the Internet.
- The percentage of schools reporting that plans are in place for the systematic upgrade and replacement of library media center software and hardware.

COLLABORATIVE STRATEGIES TO REACH GOAL 2, TARGET 4	
Department of Education – Strategic Direction	
• Identify and communicate minimum technology specifications for school-based library media services.	
Representative Actions	
School Divisions	**Stakeholders**
• Identify a procedure for regular library media center equipment and software upgrades, replacements, and expansions as part of the school division's technology plan. • Provide video resources for distribution across the school division's wide area network.	• Vendors provide home access to school resources. • Libraries and museums share access to information databases. • Information entities provide access to other collections and resources

Target 5 School divisions have strategies for providing community access to school-based technology and applications.

Direct Benefit to Teaching and Learning

- Enhances parent and community involvement in teaching and learning.

Reality

- A wide disparity exists in technology resource sharing.

Gap

- Schools need to develop strategies to increase ongoing parent and community involvement through access to school-based technology resources.

Progress Measures

- The percentage of schools reporting they have strategies for increasing the availability of school-based technology to parents and students.
- The percentage of schools reporting that school-based technology resources are available for Web-based access by parents and the community.

<table>
<tr><th colspan="2">COLLABORATIVE STRATEGIES TO MEET GOAL 2, TARGET 5</th></tr>
<tr><th colspan="2">Department of Education – Strategic Direction</th></tr>
<tr><td colspan="2">• Identify and communicate school division approaches to providing availability of school-based technology for the community.</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School divisions</th><th>Stakeholders</th></tr>
<tr><td>• Offer online staff development courses and necessary and desirable seminars/workshops for school personnel, parents, and the community.
• Offer job-related technology skills and computer literacy training to the community using division's technology facilities.
• Use technology to provide students and parents with individual education plans, remedial resources, continuous feedback on how well students are meeting their learning goals, and opportunities for virtual student performance assessments.</td><td>• Seek partnerships to provide low-cost or free Internet access from home for students who cannot afford it.
• Create partnerships to provide technology literacy training in a variety of formats and delivery systems.
• Give employees access to school’s Web site for announcements.
• Create policies and procedures for gathering and accessing information on students.</td></tr>
</table>

Goal 3 Offer digital learning opportunities at state and local levels.

Target 1 Web-based courses and staff development activities are provided.

Direct Benefit to Teaching and Learning

- Educational technology stakeholders have equitable access to courseware and staff development.

Reality

- A wide inconsistency exists regarding statewide student and educator’s access to courseware and staff development.

Gap

- Student courses and staff development need to be designed for distributed/distance learning. Up-to-date distributed/distance learning technologies are needed for the delivery of student courses and staff development.

Progress Measures

- The variety of K-12 staff development activities delivered via satellite, Web-based digital content, public television, and two-way interactive video using state and educational technology stakeholder facilities.
- Amount of participation by educational technology stakeholders in staff development delivered through distributed/distance learning technologies as shown by utilization surveys.
- The percentage of schools utilizing distributed/distance learning technologies for staff development.
- Models of staff development using distributed/distance learning technologies that are shared with educational technology stakeholders.
- Quality and availability of staff development activities using distributed/distance-learning technologies as determined by peer assessment.

COLLABORATIVE STRATEGIES TO REACH GOAL 3, TARGET 1	
Department of Education – Strategic Direction	
• Utilize teleconferencing, distributed/distance learning, and Web-based delivery for statewide staff development activities. • Support and publicize courses and staff development activities and models conducted by other educational entities and stakeholders that utilize distributed/distance-learning technologies. • Develop and utilize online evaluation tools for Web-based courses and staff development. • Virginia Virtual provides unified distributed/distance learning services**.**	
Representative Actions	
School divisions	**Stakeholders**
• Establish teleconferencing and distance/distributed learning capability for all schools. • Explore, procure, and/or develop a wide-range of e-learning opportunities for students and staff development**.**	• Vendors provide content specialists to assist in the development of electronic courseware. • Vendors participate in and support the development of student courseware. • Teacher education institutions conduct online demonstrations focusing on technology integration and educational uses of products.

Target 2 Schools are able to receive digital television broadcast signals and effectively utilize the enhanced capabilities.

Direct Benefit to Teaching and Learning

- Schools can receive a wider variety of programming formats and resources.

Reality

- Some schools cannot receive broadcast signals in digital format.

Gap

- All schools need the capability to receive broadcast resources in digital format.

Progress Measures

- Number of schools reporting that they can receive a digital public television broadcast signal in all appropriate learning areas.
- Number and variety of informational and programming services available to K-12 schools.

COLLABORATIVE STRATEGIES TO REACH GOAL 3, TARGET 2
Department of Education – Strategic Direction
• Provide information and guidance to schools for migration from analog to digital broadcast reception capability. • Explore and utilize the expanded programming services that digital broadcast will provide.

Representative Actions	
School Divisions	**Stakeholders**
• Develop an implementation plan to provide each classroom with access to digital public television broadcast signals. • Develop a division plan for the utilization of public television digital broadcast informational and programming services.	• Enable schools to receive digital signals and to utilize the expanded services provided by multiple channel capabilities. • Public television stations provide guidance and technical assistance in purchasing and installing equipment.

Educational Applications: A Vision for the Future

The Virginia Department of Education's Office of Teleproduction Services provides a range of video, multimedia, and distance learning services for classroom instruction, professional development, support of other state agencies, and the public. The following scenario describes a possible evolution in these services based on digital teleportation technology.

It is Monday night and Krista is at her grandmother's house for dinner. She can't remember when this family tradition began, but she enjoys it. Her grandfather asks her about school and she tells him she is studying Ronald Reagan's presidency. Her dad smiles and says that Ronald Reagan was a candidate in the first presidential election in which he could vote. Krista shares her excitement about tomorrow; she will have an opportunity to hear Ronald Reagan speak. When her grandfather and dad look puzzled, she explains.

Krista's class will go to the seminar room, where a digital teleportation system will bring Ronald Reagan to the classroom to present his first inaugural address. Krista describes digital teleportation as the transmission of a life-size image to a distant location. It can be a live person or, as in this case, an archived video of an important event. Krista says it isn't like watching a video; the background is removed so the people look like they are actually in the room. The speaker becomes a participant in the classroom. Mrs. Marchio, the school's media specialist, prefers digital teleportation because the hologram-like images appear to look directly at participants and have none of the jerkiness and interruption in sound and video that often occur in videoconferencing.

Krista's mom, dad, and grandparents look at one another in amazement. Krista adds that many teachers in her school use the system. Mr. Caldwell likes to use it when he teaches public speaking because the speakers' gestures are lifelike. Krista adds that live events are also brought to her school through digital teleportation. Two weeks ago, the governor teleported to her school to present the Governor's Award for Outstanding Improvement. Next semester, a teacher in France will be teleported to the school to teach French, and Mr. McCormick, the American history teacher, will teach American history to students in France.

Krista tells her family that digital teleportation isn't just for bridging the distance between people. The Hermitage Museum in St. Petersburg, Russia, teleported Faberge objects from their permanent collection. These include jewelry, photograph frames, snuff boxes, cigarette cases, clocks, handles for walking sticks, and of course, the famed Easter eggs—Krista's favorites. She remembered the Faberge eggs she saw during last year's field trip to the Virginia Museum of Fine Art in Richmond. She is glad her school now has the Hermitage Faberge objects available in the media center. She might develop her research project around the eggs and use the visuals during her presentation.

Digital teleportation is currently possible and is enabling schools in North Richland Hills, Texas, and Salford, Manchester, in the United Kingdom to work collaboratively in a seeming "face-to-face" environment. Digital teleportation has the potential to overcome some of the inherent limitations of distance education environments that exist in schools today.

Considerations for the Future

When planning, consideration must be given to new trends and technologies that are not yet widely used but may impact schools in the not-so-distant future. The following questions are intended to stimulate such thought, but are not to be considered prescriptive or comprehensive.

- Increasingly sophisticated computer-based modeling environments will enable students to observe and interact with complex concepts that are impossible to observe naturally. Describe how these modeling environments might be used in your division. What concepts or experiences would benefit from this approach?
- Multisensory robots can be programmed to perform a variety of tasks while interacting with their environment. In what way do you see robots being used in education?
- With advances in digital media tools and the Internet, creative expression can now be much more participatory. Describe a collaborative activity that promotes students' creative expression.
- Biometrics systems will be used in many settings as our need for national security increases. In what ways can biometric authentication be applied in education?
- Tiny computers embedded in information appliances will be tailored for specific tasks, resulting in a tight coupling between learning the task to be performed and learning to use the technology. What kind of information appliances do you envision in schools in the future?

Accountability

This element addresses the value of technology to teaching and learning environments as well as K-12 student data management and decision support. It includes the assessment of technology literacy among Virginia's public school students, instructional personnel, and support staff. The development and review of technology plans that are consistent with the state technology plan are addressed.

Goals and Targets for Accountability

Goal 1 Assess the value that information technology (IT) adds to teaching and learning environments.

Targets

1. **Identify elements of technology integration that benefit the teaching and learning environment.**
2. **Readiness to integrate technology into teaching and learning has been assessed for each school.**
3. **Instructional technology integration has been assessed in schools and classrooms.**
4. **Technology-rich environments and effective technology-based instructional strategies support student learning.**

Goal 2 Provide appropriate decision support capabilities for all stakeholders.

Targets

1. **Information systems provide comprehensive information about student learning progress.**
2. **Information systems interface to provide staff members the ability to use appropriate and effective data to make decisions.**

Goal 3 Assess information technology (IT) literacy.

Targets

1. **All students are technology literate.**
2. **All instructional personnel are technology literate.**
3. **All support staff members are technology literate.**
4. **Students meet expectations for technology utilization pertaining to their subject or grade level as described by school division technology plans.**

Goal 4 Ensure that local technology plans are consistent with the state technology plan.

Targets

1. **School divisions will have technology plans that are consistent with the components of the state technology plan. All schools will have technology plans that are consistent with the components of their division technology plan.**
2. **All schools and school divisions will evaluate annually the progress and effectiveness of their technology plans.**

Accountability: A Review of the Literature

The No Child Left Behind Act of 2001 requires states to develop high standards for learning; to align curriculum, instruction, professional development, and resources so students have the opportunity to achieve them, and to develop high-quality academic assessments that measure student progress toward achieving the standards. It also places new emphasis on accountability, holding schools, districts, and states responsible for improving student performance.

In addition to enhancing teaching and learning, technology offers support for activities commonly associated with school accountability and management, such as student assessment, teacher and program evaluation, and data-based decision making to support school improvement efforts. Given the pervasiveness of technology in society, it would be difficult for schools to justify *not* integrating technology into their efforts. It is important, however, for practitioners to justify their choices of technologies and strategies for integration and evaluation, and to measure the outcomes from those decisions.

Research continues to confirm the value of technology to improve teaching and learning (Sivin-Kachala & Biaco, 1999); however, assessing the impact of technology on learning can be difficult. Because technology is so pervasive, isolating its effects in an educational system can be a daunting task that requires sophisticated statistical analyses.

Hawkes and Cambre (2001) relate the difficulties of determining the effects of educational technology. They describe such common impact indicators as measures of stakeholder involvement, technology competency, equity, student and teacher roles, climate of learning, teacher collaboration, and school-agency collaboration. Other indicators often described include improved attendance, increased excitement and motivation, engagement in problem solving, improved self-esteem, style of student presentations, and increased student acceptance of responsibility for their own learning (Hawkes and Cambre, 2001; Sivin-Kachala & Biaco, 1999). Although standardized assessments are also reported as impact indicators, these researchers emphasize previous findings (Dede, 1998) that they may be inappropriate because they do not measure the full impact of technology.

Other areas significantly impacted by technology use are presented by Whitehead (2000), who names quantity of student writing, quality of student writing, cooperative learning, integrated learning, application of learning styles, cross-age tutoring, teacher communication, parent-school communication, school-community relations, and students as global learners. Note that this list does not include standardized measures of achievement, yet student performance on such measures is on the minds of many administrators and policymakers. In their study of technology's impact on student achievement, Sivin-Kachala and Biaco (1999) found that its effectiveness "depends on a match between the goals of instruction, characteristics of the learners, the design of the software and technology integration implementation decisions made by educators" (p. 2).

Most states have instituted accountability systems to measure progress in standards-based reforms. The preferred mode for measuring student and school performance is testing (Clarke, Madaus, Pedulla, & Shore, 2000). The recent reauthorization of the Elementary and Secondary Education Act significantly increases the amount of standardized testing that will occur in the nation's schools (No Child Left Behind Act, 2001). The Council for Chief State School Officers (as cited in Russell & Haney, 2000) reported in 1998 that 48 states use statewide tests to assess

student performance. These tests are used to determine whether to promote students and grant degrees, and to identify, sanction, or reward low- and high-performing schools. Policymakers view large-scale assessments as a major determinant in what happens in schools and classrooms (Pellegrino, Chudowsky & Glaser, 2001; Tapper, 1997) and set as their goal the attainment of the highest possible scores from their constituents. Teachers, on the other hand, seek different types of information from assessments and are more concerned with determining the levels of students' understanding to help them achieve desired learning outcomes (Tapper, 1997).

Large-scale assessments serve the purpose of informing administrators, policymakers, and the public on a limited set of indicators. They provide a cost-efficient sampling of a system's progress toward achieving curriculum standards. Several states have begun to explore the use of technology in assessment, particularly the potential of online testing (Hambrick, 2002).

The continuum of teachers that pass through as they learn to integrate technology in their classrooms (Dwyer, Ringstaff & Sandholtz, 1991) seems to be mirrored by other stakeholder groups as they implement online testing (Hambrick, 2002). Developments in four early-adopter states—Georgia, Oregon, South Dakota, and Virginia—indicate that these early ventures typically replicate familiar multiple-choice, paper-and-pencil tests. Replication of traditional activities is a hallmark of early stages of technology integration. Although some technology-based solutions are available for online administration and scoring of writing assessments, most states have yet to explore the potential of technology for creating unique learning and assessment environments.

The National Online Assessment Conference (AEL, 2000b) identified issues states may face when deploying large-scale testing. Four major issues are access, equity, infrastructure, and security.

Access. While many schools have reduced their student-to-computer ratio to approach 5:1, this ratio is inadequate for large-scale testing, which would optimally require a 1:1 ratio. Even schools with a 1:1 ratio could have many computers that may not meet the performance requirements of online assessment instruction and remediation.

Equity. Tests must be designed to measure curriculum standards, but variations in presentation may affect the validity and reliability of results. Factors such as display size and resolution impact how much information students see and may create disparate testing environments. Differences in computer platforms and processor speeds also impact the rate and quantity of testing information that can be displayed.

Infrastructure. While many schools are connected to the Internet, there are no standards governing how many computers are connected and what their access speeds may be. If entire schools or districts access a network at the same time, connection speed will slow, and may erode test reliability.

Security. Test items and student's scores must be kept secure, and schools must be able consistently to identify students who are taking the tests and track students who leave, enter, or re-enter the system.

Researchers argue that, in addition to creating technical barriers, the practice of replicating existing measures will have little impact on classroom practice because existing large-scale assessment formats do not provide the depth of analysis afforded by classroom assessments, which focus more on curriculum and instruction. Most current large-scale tests do not provide sufficient information to identify why students do not perform well or to modify classroom instruction to improve student achievement (Pellegrino, Chudowsky & Glaser, 2001). These

tests are not structured to identify differences in students' levels of understanding, such as the organization of knowledge, problem representations, strategy use, metacognitive skills, and contributions to collaborative problem solving. Black and Wiliam (1998) corroborate that these tests have limited application in instruction because they provide overall summaries of achievement rather than helpful diagnoses.

Classroom-based formative assessments have been recognized as fundamental for implementing standards-based instruction by groups such as the National Research Council and the National Council of Teachers of Mathematics (Pellegrino, Baxter & Glaser, 1999). Formative assessments help teachers determine the effectiveness of the instruction as well as the level of student understanding, and can help teachers select the most appropriate teaching strategies to increase student's performance. Students, too, benefit from formative assessments by learning which skills and knowledge they have or have not mastered. Students benefit most when they receive feedback about the quality of their work and suggestions for improvement—input readily available from formative classroom-based assessments (Pellegrino, Chudowsky & Glaser, 2001).

In a study of classroom practice, McMillan and Nash (2000) found that teachers often use a variety of assessments and criteria to assess fairly students. Teachers use multiple measures and methods individualized to their students and based on their own experiences as well as the nature of the learning objectives. These researchers suggest that the influence of teachers' values supports the rationale for using assessments and grading practices that are most consistent with their own philosophies of teaching and learning. Technology-based tools may be vehicles for generating classroom-based formative assessments and for providing summative results necessary for decisions by administrators and policymakers.

Some technology-based assessment approaches include the use of electronic portfolios, multimedia presentations, and simulations, although few of these are widely used. Electronic portfolios can document student and teacher activities and progress (Penta, 1998; Wiedmer, 1998), but rarely provide data that are easily formatted for summative decisions. Simulations can provide open-ended learning and assessment environments (Barron et al. 1995) that draw on the social nature of learning. These approaches tend to require particular assessment supports, such as the rubrics for assessing multimedia presentations that were developed by the Challenge 2000 Multimedia Project (Penuel, Means & Simkins, 2000).

Most promising are the efforts of groups such as the National Center for Research on Evaluation, Standards, and Student Testing (CRESST) (Chung & Baker, 1997) and others (Daniels & Johnson-Ferguson, 2001; Fickes, 1998)—that are developing technology-supported processes for generating, storing, and analyzing school-based data to provide both formative information for classroom practice and summative results for determining school performance. For example, CRESST's Quality School Portfolio (http://qsp.cse.ucla.edu/) is described as both a product and a process. It includes a database program to help schools gather data from a variety of sources, then disaggregate and use the data for several types of reports. The system also includes a resource kit of research-based tools to help schools gather data on factors such as safety and security, parental involvement, professional development programs, and technology and innovation efforts. This system presents ways technology can support data-based decision making and help schools sort and analyze a vast quantity of data to impact student achievement.

Accountability: Needs in Virginia

The Commonwealth of Virginia is one of 37 states that have student technology standards. The computer/technology standards by the end of grades 5 and 8 identify technology skills for improving student learning through the integration of technology across the curriculum. In grades 9 through 12, technology continues to be integrated across the curriculum. The goal is for students in these grades to achieve a higher lever of mastery in applying technology in their learning. The state is exploring ways to assess the integration of technology skills into teaching and learning, and the ways technology supports school improvement efforts in Virginia. More research needs to be conducted on the use of technology to monitor student learning. Little empirical evidence exists about the current uses of evaluation, assessment, and analysis of the data to integrate technology more effectively. However, anecdotal evidence suggests that schools are using data to make decisions resulting in positive changes. Tools and resources that support data-driven decision making are available to Virginia's schools.

Significant work has been done to develop online assessments of state standards, which will be fully implemented in high schools during the 2004-2005 school year. Implementation of online assessments for middle and elementary students will occur in succeeding years. The first-generation online assessments are designed to replicate paper-and-pencil formats. The activities associated with this *Educational Technology Plan for Virginia* are intended to facilitate the use of technology to evaluate, assess, and analyze student learning progress in all areas.

Accountability: Implementation Plan

CENTRAL ISSUE

The value of technology must be better understood as it relates to improving teaching and learning practices and to its role in the effective and efficient management of information, particularly decision-support functions. Virginia will need to ensure that its public school graduates are technologically literate.

RATIONALE

Accountability regarding the use of educational technologies is being demanded by all funding and governing sources. Information about the impact of educational technologies on teaching methods, student achievement, and the learning environment is not adequate in most areas. The cost of providing educational technologies in sufficient quantities (critical mass, etc.) will demand precise reporting on the overall cost benefit.

Goal 1 Assess the value that information technology (IT) adds to teaching and learning environments.

Target 1 Identify elements of technology integration that benefit the teaching and learning environment.

Direct Benefit to Teaching and Learning

- Teaching and learning is enhanced when teachers include the elements of technology integration in their instruction.

Reality

- Few school divisions have identified the elements of technology integration.

Gap

- A model to identify elements of technology integration needs to be developed and shared.

Progress Measures

- Percentage of schools that have assessed their teaching and learning environment for the presence of the elements of technology integration.

COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 1	
Department of Education – Strategic Direction	
• Create a standard definition of technology integration**.** • Identify and communicate the elements of technology integration. • Provide training for assessing the presence of the elements of technology integration that benefit the teaching and learning environment.	
Representative Actions	
School Divisions	**Stakeholders**
• Identify and customize a system for assessing the presence of the elements of technology integration that benefit the teaching and learning environment.	• Share and distribute systems currently in use for assessing the presence of the elements of technology integration.

Target 2 Readiness to integrate technology into teaching and learning has been assessed for each school.

Direct Benefit to Teaching and Learning

- All K-12 schools will be ready for technology integration.

Reality

- Schools are in various stages of determining their readiness to integrate technology into teaching and learning.

Gap

- All schools need to complete a Readiness to Integrate Technology assessment.

Progress Measures

- The percentage of schools that have been assessed for readiness to integrate technology into teaching and learning (i.e., have created school-site technology readiness profiles).

COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 2	
Department of Education – Strategic Direction	
• Identify a process and assessment tool (i.e., rubric) to document readiness to integrate technology. • Collect and disseminate information on school-site readiness to integrate technology into teaching and learning for each K-12 school.	
Representative Actions	
School Divisions	**Stakeholders**
• Develop or identify a technology readiness profile, and implement a system to determine school-site readiness to integrate technology into teaching and learning for all K-12 schools.	• Support conditions that enable schools to reach a level of readiness. • Share readiness assessment instruments. • Assist with establishing conditions of readiness with resources and training.

Target 3 Instructional technology integration has been assessed in schools and classrooms.

Direct Benefit to Teaching and Learning

- School divisions will be able to recognize whether technology is enhancing or changing teaching and learning.

Reality

- Few divisions have developed guidelines for teachers and administrators to assess the level of technology integration implementation.

Gap

- Guidelines or models for assessing the level of technology integration implementation need to be developed and shared.

Progress Measures

- A statistically relevant number of learning environments in selected K-12 schools and classrooms have been assessed (observed) to determine the level of technology integration implementation.

COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 3	
Department of Education – Strategic Direction	
• Develop a system for assessing instructional practices on the level of technology integration in teaching and learning.	
Representative Actions	
School Divisions	**Stakeholders**
• Identify and customize a system for assessing instructional practices on the integration of instructional technology.	• Share and distribute systems in use. • Provide tools that assess level of integration.

Target 4 Technology-rich environments and effective technology-based instructional strategies support student learning.

Direct Benefit to Teaching and Learning

- There is a measurable increase in student's academic achievement.

Reality

- Not enough information exists on how technology can be used to promote high academic achievement.

Gap

- Research is needed to identify best practices related to technology's role in achieving high academic standards.

Progress Measures

- Number of correlation studies to assess positive relationships between students' SOL test scores and technology-rich school environments.

COLLABORATIVE STRATEGIES TO REACH GOAL 1, TARGET 4	
Department of Education – Strategic Direction	
• Identify and distribute instructional technology best practices that support student learning.	
Representative Actions	
School Divisions	**Stakeholders**
• Conduct pilot studies to assess the relationship between students' SOL test scores and technology-rich school environments	• Teacher education institutions share results of research correlation studies of the relationship between content, technology, and achievement.

Target 1 Information Technology (IT) provides comprehensive information about student learning progress.

Direct Benefit to Teaching and Learning

- Information Technology can provide the necessary information for educational stakeholders to make critical and timely decisions about the learning progress.

Reality

- Information Technology software that provides information about the learning and achievement of students is not being used to its maximum potential.

Gap

- In-service training needs to be developed to help school division personnel use appropriate software to interpret student data in making decisions about learning progress.

Progress Measures

- The percentage of school divisions reporting that Information Technology (IT) provides timely and in-depth information about the learning progress of students to educational stakeholders.

<table>
<tr><th colspan="2">COLLABORATIVE STRATEGIES TO MEET GOAL 2, TARGET 1</th></tr>
<tr><th colspan="2">Department of Education – Strategic Direction</th></tr>
<tr><td colspan="2">• Identify successful models of gathering, reporting, and analyzing comprehensive information about student learning progress.</td></tr>
<tr><th colspan="2">Representative Actions</th></tr>
<tr><th>School Divisions</th><th>Stakeholders</th></tr>
<tr><td>• Assess the value of Information Technology to the school division as it relates to the decision management aspects of student learning progress</td><td>• Software developers create tools that help schools make decisions about teaching and learning.
• Teacher education institutions develop and offer training on data-based decision making.</td></tr>
</table>

Target 2 Information systems interface to provide staff the ability to use appropriate and effective data to make decisions.

Direct Benefit to Teaching and Learning

- School divisions are able to utilize fully and have confidence in Information Technology to support management systems and provide decision-support value.

Reality

- Information Technology is not fully utilized by all schools systems to assist educators through decision support.

Gap

- There is a need for training on how to utilize the decision-support value of information technology systems.

Progress Measures

- The percentage of school divisions reporting that Information Technology has been used to automate appropriate management functions and applications (central and site-based) and the decision support value has been assessed and fully utilized.

<table>
<tr><th>COLLABROATIVE STRATEGIES TO MEET GOAL 2, TARGET 2</th></tr>
<tr><th>Department of Education – Strategic Action</th></tr>
<tr><td>• Identify successful models for interfacing systems to gather, report, and analyze information.
• Identify and publicize successful K-12 Information Technology decision support models</td></tr>
</table>

Representative Actions	
School Divisions	**Stakeholders**
• Determine how to assess the decision support value of Information Technology in the school division.	• Teacher education institutions share examples of using data for program and curriculum development.

Goal 3: Assess Information Technology (IT) literacy.

Target 1 All students are Information Technology literate.

Direct Benefit to Teaching and Learning

- Students will be effective users of technology for personal use and lifelong learning.

Reality

- The pass rate for the fifth grade 2002 computer/technology test was 86 percent. The pass rate for the eighth grade 2002 Computer/Technology Test was 76 percent. (VDOE, 2002).

Gap

- In-service training is needed to assist teachers in developing lessons that incorporate the Computer/Technology Standards of Learning.

Progress Measures

- The percentage of principals reporting that observations and teachers' lesson plans indicate Computer/Technology Standards of Learning are being seamlessly integrated into appropriate curriculum areas.

COLLABORATIVE STRATEGIES TO MEET GOAL 3, TARGET 1	
Department of Education – Strategic Actions	
• Identify or develop an assessment rubric to measure student's Information Technology literacy. • Develop a system of statistical sampling to determine if Virginia students are fluent in Information Technology.	
Representative Actions	
School Divisions	**Stakeholders**
• Assess whether Computer/Technology Standards of Learning are being integrated into the K-12 curriculum. • School divisions align curriculum with Computer/Technology Standards of Learning	• Correlate software to the Standards of Learning. • Use technology to develop curriculum resources and materials that correlate with the state standards**.**

Target 2 All instructional personnel are Information Technology literate.

Direct Benefit to Teaching and Learning

- Teachers will be effective users of technology to fulfill their professional responsibilities.

Reality

- Each division has its own definition and means of assessing Information Technology literacy for its instructional personnel.
- Teachers are at various levels of proficiency.

Gap

- Identification and assessment tools for Information Technology literacy of instructional personnel need to be developed and shared.

Progress Measures

- Percentage of divisions that have such an identification and assessment tool in place.

COLLABORATIVE STRATEGIES TO MEET GOAL 3, TARGET 2	
Department of Education- Strategic Actions	
• Identify or develop assessment rubrics to measure instructional personnel Information Technology literacy. • Develop a system of statistical sampling to determine if Virginia instructional personnel are fluent in Information Technology. • Research and identify technology standards for administrative personnel. • Assess technology literacy of administrative personnel.	
Representative Actions	
School Divisions	**Stakeholders**
• Identify and customize a system for assessing the Information Technology literacy of all instructional personnel.	• Share and distribute systems in use..

Target 3 All paraprofessionals and support staff are Information Technology literate.

Direct Benefit to Teaching and Learning

- Paraprofessionals and support personnel will be effective users of technology to fulfill their job-related responsibilities.

Reality

- Training is not being consistently provided to all paraprofessionals and support staff.

Gap

- Models of support staff training in appropriate technology need to be developed and shared.

Progress Measures

- Percentage of schools providing comprehensive training for all paraprofessionals and support staff.

COLLABORATIVE STRATEGIES TO MEET GOAL 3, TARGET 3	
Department of Education – Strategic Action	
• Identify or develop an assessment rubric to measure paraprofessional and support staff Information Technology literacy. • Develop a system of statistical sampling to determine if paraprofessionals and support staff are technology information literate. • Identify and publicize best practices for determining staff information literacy**.**	
Representative Actions	
School Divisions	**Stakeholders**
• Identify and customize system for assessing Information Technology literacy of all paraprofessionals and support staff.	• Share systems in use.

Target 4 Students meet expectations for technology utilization pertaining to their subject and grade level as described by school division technology plans.

Direct Benefit to Teaching and Learning

- Students will utilize technology as a learning tool within the context of their subject and grade level.

Reality

- Not all school divisions have clearly defined student technology literacy expectations by subject and grade level.

Gap

- Models of student technology utilization by subject and grade level need to be developed or identified and shared.

Progress Measures

- Results of school division assessment of grade and subject technology utilization competencies and skills.

COLLABORATIVE STRATEGIES TO REACH GOAL 3, TARGET 4	
Department of Education – Strategic Direction	
• Identify and communicate successful models of K-12 technology utilization competencies and skills by subject and grade level	
Representative Actions	
School Divisions	**Stakeholders**
• Implement (or update) a system of technology utilization competencies by subject and grade level allowing students to meet the minimum levels of the Virginia Computer/Technology Standards of Learning as well as gaining a high degree of information technology literacy before graduation.	• Provide schools with a list of desired workplace technology skills.

Goal 4 Ensure that local technology plans are consistent with the state technology plan.

Target 1 School divisions will have technology plans that are consistent with the components of the state technology plan. All schools will have technology plans that are consistent with the components of their division technology plan.

Direct Benefit to Teaching and Learning

- All state and local technology plans will contain current status information using standard technology issue descriptors, a needs assessment that relates to the collaboratively developed targets of the *Educational Technology Plan for Virginia*, and a systemic assessment of technology integration implementation.

Reality

- Many technology plans do not contain clear, consistent, and comparable information on the current status of common educational technology resources (i.e., using as a reference "standard technology issue descriptors"), a clear needs assessment of statewide targets for educational technology, or an assessment system to gauge ongoing technology integration implementation.

Gap

- Standard technology issue descriptors and targets need to be developed and updated at the state level to allow for clear, consistent, and comparable reporting and data collection at school division levels. Models for assessing technology integration implementation need to be identified and shared with all educational stakeholders.

Progress Measures

- Number of school division and school technology plans that contain information on the current status of technology that is accurate and can be aggregated, a needs assessment related to statewide targets (objectives), and a systematic assessment plan to gauge the progress toward meeting technology planning objectives

COLLABORATIVE STRATEGIES TO REACH GOAL 4, TARGET 1	
Department of Education – Strategic Action	
• Identify and publicize components of the plan. • Monitor, assess, and update the goals and targets of the *Educational Technology Plan for Virginia*.	
Representative Actions	
School Divisions	**Stakeholders**
• Keep technology-related infrastructure/implementation information current using commonly defined (statewide usage) standard technology issue descriptors that relate to the planning targets outlined in the *Educational Technology Plan for Virginia*. • Ensure that technology plans contain a clear and updated needs assessment and a system for assessing the implementation of technology planning objectives.	• Public entities relate local activities and initiatives to the school division technology plan. • Public and private entities participate in developing school division technology plans.

Target 2 All schools and school divisions will evaluate annually the progress and effectiveness of their technology plans.

Direct Benefit to Teaching and Learning

- Educational technology stakeholders will be able to determine the effectiveness (as related to teaching and learning) of educational technology investments.

Reality

- Evaluation components of most technology plans need refinement and additional research and development, particularly as relates to determining the effectiveness of technology integration implementation.

Gap

- Models for gauging the effectiveness of educational technology investments on teaching and learning need to be developed, tested, and then widely distributed to K-12 educational technology stakeholders.

Progress Measures

- Number of K-12 school division and school technology plans that contain a systematic plan for evaluating the effectiveness of technology integration implementation on teaching and learning.

COLLABORATIVE STRATEGIES TO REACH GOAL 4, TARGET 2	
Department of Education – Strategic Action	
• Identify evaluation models for determining the progress and effectiveness of technology plans. • Review and evaluate every two years submitted plans to support progress toward meeting targets.	
Representative Actions	
School Divisions	**Stakeholders**
• Ensure that school and division technology plans include systems for evaluating the effectiveness of technology integration implementation on teaching and learning.	• Teacher education institutions and content professional organizations sponsor and support research and development projects and/or programs. • Public and private entities conduct independent review of technology plans. • Community members serve on technology plan review and evaluation teams.

Accountability: A Vision for the Future

The statewide Web-Based Standards of Learning Technology Initiative is an ambitious effort to design and create an online Web-based delivery system to support the state's Standards of Learning testing, instruction, and remediation in all Virginia high schools. Virginia, which is only one of a handful of states venturing into the online testing arena, has consistently looked to technology for help in improving the effectiveness of classroom instruction. Teachers and administrators use data disaggregation tools to organize and examine test data in ways that enable them to make better decisions. The following is a scenario that focuses on how schools might extend these technologies to support data-based decision making.

Dr. Lorraine Givens is preparing a presentation for the PTO meeting. She plans to demonstrate students' progress toward mastering the Standards of Learning in reading. From the computer on her desk, she logs on to the Department of Education Web site and downloads her school's SOL reading test scores from the last three years. Using these data files, she can disaggregate the scores of special populations then use a spreadsheet to graph changes. The school's overall scores have been improving, which Dr. Givens attributes in part to a comprehensive reform model adopted two years ago; the model integrates reading across the curriculum. There is still work to do, however, especially with younger boys.

Dr. Givens compares the results from these state-administered tests to indicators of progress from the Learning Management System (LMS), the district's integrated planning, mapping, delivery, and assessment system. The No Child Left Behind Act of 2001 requirement to track instructional improvement prompted the district to purchase the LMS last year. On the LMS, Dr. Givens has a high-level view of the lessons taught and how they correspond to the SOLs.

Using an online lesson-planning tool, teachers in her elementary school have generated and refined successful lessons linked to high-quality instructional resources known as learning objects. Learning objects are digital resources that can be reused and combined in various ways to support learning, and offer clear advantages over traditional textbooks. The great advantage of using the online planning tool is that teachers must align and link lesson plans and the resources that support them to appropriate standards and assessments.

With coaching and by working in small groups over a period of several weeks, teachers learned to use the LMS to track how well individuals and groups of students performed on both classroom and statewide assessments of SOL. The teachers can target lessons that don't seem to provide the results they want. They now feel confident to revise their instructional strategies to reach the desired results. Working collaboratively, the teachers have generated a bank of lesson ideas that work, and they can inject their own creativity so teaching remains enjoyable to them.

A few years ago, the idea of using actual performance data seemed completely foreign to her faculty. They rarely used more than intuition to make decisions about their teaching strategies. The results from high-stakes tests often came too late and meant little when the students had gone on to another semester or even a new grade. Now her teachers really do know what to do and have the data to back up their decisions.

Considerations for the Future

When planning, consideration must be given to new trends and technologies that are not yet widely used but may impact schools in the not-so-distant future. The following questions are intended to stimulate such thought, but are not to be considered prescriptive or comprehensive.

- Intelligent assessments will make it possible to create a test matched to the individual needs and preferences of each learner. Describe how these assessments might look in practice.
- A variety of questioning and response formats are made possible by new media, such as video and voice recognition. Describe how these new formats might result in improvements in assessment.
- In what ways can technology support large-scale computerized testing that moves beyond replicating traditional paper-and-pencil-based tests?
- Technology advancements will continue to redefine the skills valued by society. What skills do you believe will be valued in the future and how will they be assessed?

- Distance-based and distributed learning pose special challenges for assessment. How will advances in technology address these challenges?

References

AEL. (2000a). Principal connections: A guide to technology leadership. [Computer Software]. Charleston, WV: AEL.

AEL. (2000b). Proceedings from the National Online Assessment Conference. Washington, DC.

American Association of School Librarians. (1998). *Information power. The nine information literacy standards for student learning.* Retrieved March 29, 2002, from http://www.ala.org/aasl/ip_nine.html

Anderson, L. (1996). *Guidebook for developing an effective instructional technology plan, Version 2.0.* Mississippi State, MS: Mississippi State University.

Association of College & Research Libraries. (1989). *American Library Association Presidential Committee on Information Literacy.* Washington, DC: American Library Association. Retrieved March 29, 2002, from http://www.ala.org/acrl/nili/ilit1st.html

Atkinson, R. (2002). *The 2002 state new economy index: Benchmarking economic transformation in the states.* Washington, DC: The Progressive Policy Institute.

Bailey, G., & Pownell, D. (1998). Technology staff-development and support programs: Applying Abraham Maslow's Hierarchy of Needs. *Learning & Leading With Technology*, 26(3), 47-51, 64.

Barron, B., Vye, N., Zech, L., Schwartz, Bransford, J., Goldman, S., et al. (1995). Creating contexts for community-based problem solving: The Jasper Challenge Series. In C. Hedley, P. Antonacci & M. Rabinowitz (Eds.), *Thinking and literacy: The mind at work.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Beavers, D. (2001). Outside the workshop box. *Principal Leadership, 1*(9), 43-46.

Black, P., & Wiliam, D. (1998). Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan.* Retrieved March 11, 2002, from http://www.pdkintl.org/kappan/kbla9810.htm

Brush, T. (1998, April 13-17). *Technology planning and implementation in public schools: A five-state comparison.* Paper presented at the meeting of the American Educational Research Association, San Diego, CA. (ERIC Document Reproduction Service No. ED419528)

Burke, J. (2000). *Rights, risks and responsibilities: Students and the Internet.* Atlanta, GA: Southern Regional Education Board.

Cairncross, S., & Mannion, M. (2001). Interactive multimedia and learning: Realizing the benefits. *Innovations in Education and Teaching International, 38*(2), 156-164.

Carr, S. (2000, August 31). More states create virtual high schools, with virtual universities' help. *The Chronicle of Higher Education.* Retrieved April 15, 2002, from http://chronicle.com/free/2000/08/2000083101u.htm

Cartwright, P. G. (1996). Planning for academic computing: Important trends and issues. *Change, 28*(4), 57-59. Retrieved September 5, 2001, from http://contract.kent.edu/change/articles/julaug96.html

CEO Forum. (1999, February). *Professional development: A link to better learning. Year two report.* Washington, DC: Author. Retrieved September 5, 2001, from http://www.ceoforum.org/reports.cfm?RID=2

Chung, G. K., & Baker, E. L. (1997). *Year 1 technology studies: Implications for technology in assessment.* Los Angeles, CA: National Center for Research on Evaluation, Standards, and Student Teaching. (ERIC Document Reproduction Service No. ED418099)

Clarke, M., Madaus, G., Pedulla, J., & Shore, A. (2000). *An agenda for research on educational testing. NBETPP Statements, Volume 1, Number 1.* Chestnut Hill, MA: National Board on Educational Testing and Public Policy. (ERIC Document Reproduction Service No. ED456137)

Clarke, T., & Hermens, A. (2001). Corporate developments and strategic alliances in e-learning. *Education + Training, 43*(4), 256-267.

Coley, R. J., Cradler, J., & Engel, P. K. (1997). *Computers and classrooms: The status of technology in U.S. schools.* Princeton, NJ: Educational Testing Service. Retrieved September 5, 2001, from http://www.ets.org/research/pic/compclass.html

Consortium for School Networking. (1999). *Taking TCO to the classroom. A school administrator's guide to planning for the total cost of new technology.* Washington, DC: Consortium for School Networking. Retrieved September 5, 2001, from http://www.cosn.org/tco/

Conyers, J. G., Kappel, T., & Rooney, J. (1999). How technology can transform a school. *Educational Leadership, 56*(5). 82-85

Cuban, L., & Kirkpatrick, H. (1998). Computers make kids smarter—right? *TECHNOS, 7*(2), 26-31.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal, 38*(4), 813-834.

Daniels, R. & Johnson-Ferguson, V. (2001). Using data to help students achieve. *Principal Leadership, 1*(9), pp. 58-60.

Davis, R. (2002, June).Virginia Public School Authority Educational Technology Funding. Paper presented at a meeting of the Senate Finance Committee Subcommittee on Education, Richmond, VA.

Dede, C. (1998) The scaling-up process for technology-based educational innovations. In C. Dede (Ed.) *Learning with Technology. 1998 ASCD Yearbook.* Alexandria, VA: Association for Supervision and Curriculum Development, 199-215. (ERIC Document Reproduction Service No. ED416857)

Dwyer, D. C., Ringstaff, C., & Sandholtz, J. H. (1991). Changes in teachers' beliefs and practices in technology-rich classrooms. *Educational Leadership, 48*(8), 45-52.

Earle, R. S. (2002). The integration of instructional technology into public education: Promises and challenges. *Educational Technology, 42*(1), 5-13.

Enhancing Education Through Technology Act of 2001, P. L. 107-110, §§ 2402 – 2441, 115 Stat. 1425, 20 U.S.C. § 6301 et seq.

Fickes, M. (1998). Data-driven decision making: Sheree Speakman believes that data management techniques can improve teaching and learning in your district. *School Planning and Management, 37*(4), pp. 54-57.

Fox, L. (2001). Internet2: Putting new technologies to work in the schools. *INSIGHT, 1*(1), 47-64.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915-945.

Gregg, S. (1995). ADHD—Building academic success. *Policy Briefs.* Charleston, WV: AEL, Inc.

Gunasekaran, A., McNeil, R. D., & Shaul, D. (2002). E-learning: Research and applications. *Industrial and Commercial Training, 34*(2), 44-53.

Hambrick, K. A. (2002). *Critical issues in online, large-scale assessment: An exploratory study to identify and refine the issues.* Unpublished doctoral dissertation, Capella University, Minneapolis, Minnesota.

Hawkes, M., & Cambre, M. (2001). Identifying the effects. *Principal Leadership, 1*(9), 48-51.

Harris, L. (2000). *Patterns of promise.* Charleston, WV: AEL.

Hill, J. R., & Hannafin, M. J. (2001). Teaching and learning in digital environments: The resurgence of resource-based learning. *Educational Technology Research and Development, 49*(3), 37-52.

Holland, L., & Moore-Steward, M. (2000). A different divide: Preparing tech-savvy leaders. *Leadership, 30*(1), 37-38.

Honey, M., Culp, K. M., & Carrigg, F. (1999). Perspectives on technology and education research: Lessons from the past and present. *Report from The Secretary's Conference on Educational Technology.* Washington, DC: U.S. Department of Education. Retrieved September 5, 2001, from http://www.ed.gov/Technology/TechConf/1999/whitepapers/paper1.html

Hooper, S., & Rieber, L.P. (1995). Teaching with technology. In A. Ornstein (Ed.), *Teaching: Theory into Practice*, (pp. 154-170). Needham Heights, MA: Allyn & Bacon.

International Society for Technology in Education. (2000). *National Educational Technology Standards for Students: Connecting curriculum and technology.* Eugene, OR: Author.

Johnson, S. M. & Kardos, S. M. (2002). Keeping new teachers in mind. *Educational Leadership, 59*(6) 12-16. Retrieved March 26, 2002, from http://www.ascd.org/readingroom/edlead/0203/johnson.html

Jones, B. F., Valdez, G., Nowakowski, J., & Rasmussen, C. (1995). *Plugging in: Choosing and using educational technology.* Oak Brook, IL: North Central Regional Educational Laboratory.

Jones, C. A. (2001). Preparing teachers to use technology. *Principal Leadership, 1*(9), 35-39.

Jukes, I. & McCain, T. (n.d.) *Living on the future edge*. Retrieved October 15, 2002, from www.tcpd.org/mccain/handouts/FutureEdge.pdf

Mason, M. G. (1997). Sex, kids, and the public library. *American Libraries, 28*(6), 104-105.

Mathews, J. G. & Guarino, A. J. (2000). Predicting teacher computer use: A path analysis. *International Journal of Instructional Media, 27*(4), 385-392.

McGraw, T. M., Blair, B. C., & Ross, J. D. (1999). *Educational software use: Results of a 1999 regional survey.* Charleston, WV: AEL.

McMillan, J. H., & Nash, S. (2000, April 25-27). *Teacher classroom assessment and grading practices decision making.* Paper presented at the meeting of the National Council on Measurement in Education, New Orleans, LA. (ERIC Document Reproduction Service No. ED447195)

Meyer, L. (2001, May 10). New challenges. *Education Week, 20*(35), 49-64.

Milken Exchange, SRI International, and North Central Regional Educational Laboratory (1998). *Report to the Commonwealth of Virginia: An analysis of the status of education technology availability and usage in the public schools of Virginia* Retrieved May 14, 2002, from http://www.mff.org/pubs/ME156.pdf

Milken Family Foundation. (1999, March 1). *Report on the status of education technology availability and usage in the public schools of Virginia*. Retrieved March 29, 2002, from http://www.mff.org/publications/publications.taf?page=156

Mulqueen, W. E. (2001). Technology in the classroom: Lessons learned through professional development. *Education, 122*(2), 248-255.

National Center for Education Statistics. (2000). *Teacher's tools for the 21st century: A report on teachers' use of technology.* Washington, DC: U.S. Department of Education.

National Council for Accreditation of Teacher Education. (1997). *Technology and the new professional teacher: Preparing for the 21st century classroom.* Washington, DC: NCATE. Retrieved April 3, 2002, from http://www.ncate.org/accred/projects/tech/tech-21.htm

National Public Radio. (2000). *Survey shows widespread enthusiasm for high technology.* Washington, DC: Author. Retrieved October 13, 2000, from http://www.npr.org/programs/specials/poll/technology

No Child Left Behind Act of 2001, P. L. 107-110, 115 Stat. 1425, 20 U.S.C. § 6301 et seq. .

Olivia, M. (1999). Developing an open system for the assessment of technology in education: The data gathering agent. *Calico Journal,* 497-508.

Olson, J. K., & Clough, M. P. (2001). Technology's tendency to undermine serious study: A cautionary note. *The Clearing House, 75*(1), 8-13.

Owens, T., & Cohen, C. (1998, January 15-16). Technology for learning: The present and future in the United States. *Proceedings of IT@EDU98, Ho Chi Minh City, Vietnam.* (ERIC Document Reproduction Service No. ED417702)

Panel on Educational Technology. (1997, March). *Report to the President on the use of technology to strengthen K-12 education in the United States.* Retrieved October 13, 2000, from http://www.whitehouse.gov/WH/EOP/OSTP/NSTC/PCAST/k-12ed.html

Pellegrino, J. W., Baxter, G. P., & Glaser, R. (1999). Addressing the "two disciplines" problem: Linking theories of cognition and learning with assessment and instructional practice. *Review of Research in Education, 24, 307-353.*

Pellegrino, J. W., Chudowsky, N., & Glaser, R. (Eds.). (2001). *Knowing what students know: The science and design of educational assessment.* Washington, DC: National Academy Press.

Penta, M. (1998, April 13-17). *Is it time to circle the Wagons? Lessons learned in pioneering electronic portfolios.* Presented at the meeting of the American Educational Research Association, San Diego, CA. (ERIC Document Reproduction Service No. ED434911)

Penuel, W. R., Means, B., & Simkins, M. (2000). The multimedia challenge. *Educational Leadership, 58*(2), 34-38.

Pierson, M. E. (2001). Technology integration practice as a function of pedagogical expertise. *Journal of Research on Computing in Education, 33*(4), 413-430.

Pownell, D., & Bailey, G. (1999). Electronic fences or free-range students: Should schools use Internet filtering software? *Learning & Leading with Technology, 27*(1), 50-57.

Rafferty, C. D. (1999). Literacy in the Information Age. *Educational Leadership, 57*(2), 22-25.

Rockman, S. (1998). *Leader's guide to education technology.* Washington, DC: Edvancenet. Retrieved October 13, 2000, from http://www.edvancenet.org/ax/metacontent_fs.html?res*guide

Rockman, S. (2000). *A more complex picture: Laptop use and impact in the context of changing home and school access.* San Francisco, CA: Author. Retrieved April 3, 2002, from http://rockman.com/projects/laptop/

Rogers, P. L. (1999). *Barriers to adopting emerging technologies in education.* Richmond, VA: Virginia Commonwealth University. (ERIC Document Reproduction Service No. ED429556)

Rourke, J. R. (2001). Online learning: Fad or fate? *Principal Leadership, 1*(9), 8-14.

Russell, M., & Haney, W. (2000). The gap between testing and technology in schools. *NBETPP statements, 1*(2*).* (ERIC Document Reproduction Service No. ED456138)

Schwab, R., & Foa, L. (2001). Integrating technologies throughout our schools. *Phi Delta Kappan, 82*(8), 620.

Sheingold, K., & Hadley, M. (1990). *Accomplished teachers: Integrating computers into classroom practice.* Washington, DC: Office of Educational Research and Improvement. (ERIC Document Reproduction Service No. ED322900)

Sivin-Kachala, J., & Bialo, E. (1999). *Research report on the effectiveness of technology in schools* (6th Edition). Washington, DC: Software and Information Industry Association.

Snoeyink, R. & Ertmer, P. A. (2001-2002). Thrust into technology: How veteran teachers respond. Journal of Educational Technology Systems, 30(1), 85-111.

Tapper, R. (1997). *The problem of high stakes assessment in public education.* (ERIC Document Reproduction Service No. ED430021)

Technology counts. (2001). *Education Week, 20*(35).

Technology counts. (2002). *Education Week, 21*(35).

Thornburg, D. (1999). Technology in K-12 education: Envisioning a new future. *Paper presented at the Forum on Technology in Education.* Washington, DC: U.S. Department of Education. Retrieved October 13, 2001, from http://www.air.org/forum/wpapers.htm

Tiene, D., & Luft, P. (2001). Teaching in a technology-rich classroom. *Educational Technology, 41*(4), 23-31.

Truett, C., Scherlen, A., Tashner, J., & Lowe K. (1997). Responsible Internet use. *Learning and leading with technology, 24*(6), 52-55.

UCAID (University Corporation for Advanced Internet Development). (2002). *About the initiative: Internet2 K20 Initiative*. Retrieved October 15, 2002, from http://k20.internet2.edu/abouttheinitiative/index.shtml

University of New Hampshire. (2002). *Test suite overview*. Durham, NH: Author. Retrieved June 7, 2002, from http://www.iol.uhn.edu/testsuites/main.html

U.S. Department of Commerce. (1996). *Lessons learned from the Telecommunications and lInformation Infrastructure Assistance Program.* Washington, DC: Author. Retrieved October 13, 2000, from http://www.ntia.doc.gov/otiahome/top/publicationmedia/lessons/lessons.htm

U.S. Department of Commerce. (2002). *A nation online: How Americans are expanding their use of the Internet.* Washington, DC: Author. Retrieved March 29, 2002, from http://www.ntia.doc.gov/ntiahome/dn/nationonline_020502.htm

U.S. Department of Education. (1996). *Getting America's students ready for the 21st Century: Meeting the technology literacy challenge.* Washington, DC: Author. Retrieved October 13, 2000, from http://www.ed.gov/Technology/Plan/NatTechPlan.

Virginia Department of Education. (n.d.). *Divisions with stage 1 high school readiness certification*. Richmond, VA: Author. Retrieved October 17, 2002, from http://www.pen.k12.va.us/VDOE/Technology/soltech/stage1.html

Virginia Department of Education. (1996). *Six-year educational technology plan for Virginia*. Richmond, VA: Author.

Virginia Department of Education. (1999). *Key questions about Internet connectivity in Virginia schools*. Richmond, VA: Author.

Virginia Department of Education. (2000). *High school technology capacity*. Richmond, VA: Author.

Virginia Department of Education. (2000-2001). *Technology capacity in support of instruction in Virginia's public schools 2000-2001 school year*. Richmond, VA: Author.

Virginia Department of Education. (2002). *Statewide passing rates*. Richmond, VA: Author. Retrieved October 17, 2002, from http://www.pen.k12.va.us/VDOE/Assessment/2002SOLpassrates.html