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ABSTRACT

This report describes the plan for educational technology in Maryland from 1999-2003. The first section introduces the mission of technology in Maryland. Vision and strategy are discussed in the second section, and a summary of technology research is provided in the third section. The fourth section lists guiding principles and outlines rationales, targets, and recommendations for the following objectives: (1) ensure access for all learners; (2) provide ongoing professional development for technology, beginning at the preservice level; (3) integrate the most appropriate and effective technology into all aspects of the education process; (4) involve key stakeholders in the planning, implementation, and evaluation of the plan; (5) ensure adequate funding; and (6) assess the impact of technology. An action plan is presented in the fifth section, and costs are described in the sixth section. Appendices include a review of research on technology in schools, a discussion of integrating technology in specific program areas, a list of references, and a list of members of the Committee on Technology in Education of the Maryland Business Roundtable for Education. (MES)

STATE OF INNOVATION:

The Maryland Plan for Technology in Education 1999-2003

Developed for the Maryland State Board of Education
by the Maryland Business Roundtable for Education Committee on Technology in Education

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STATE OF INNOVATION:

The Maryland Plan for Technology in Education 1999-2003

December 1998

Developed for the Maryland State Board of Education by the MBRT Committee on Technology in Education

EXECUTIVE SUMMARY

In 1995, the State of Maryland began implementation of the Maryland Plan for Technology in Education, a blueprint for effective utilization of technologies in schools statewide. The Plan, developed by a committee representing the state's many constituencies, served as the foundation for development and funding of educational technology programs on both the State and local levels. In 1997, the U.S. Department of Education approved the Maryland Plan, but also made suggestions which prompted the State to reexamine the Plan in light of new data and national goals. The result is this four-year revised Plan. It consists of a vision and strategy, a summary of research, a set of clearly defined objectives, a detailed action plan, and an analysis of costs.

The vision of the Maryland Plan for Technology in Education is:

"Every learner has access to and use of technology in classrooms and schools. Technology supports achievement, enabling learners to be independent, competent and creative thinkers, as well as effective communicators and problem-solvers."

The Plan's strategy is for Maryland to achieve this vision by the year 2003 by realizing six key objectives:

I. Ensure access for all learners.

II. Provide ongoing professional development for technology, beginning at the pre-service level.

III. Integrate the most appropriate and effective technology into all aspects of the education process.

IV. Involve key stakeholders in the planning, implementation, and evaluation of the Plan.

V. Ensure adequate funding.

VI. Assess the impact of technology.

The bulk of existing research indicates that such an investment in technology is both necessary and sound. Studies show that appropriate use of technology in the classroom helps students to better master basic skills, solve problems, and think and work independently and creatively. Students who are comfortable with technologies also collaborate and communicate better in class, and enjoy an advantage in being prepared for the technologies they will encounter in the "real world." Studies also show that technology supports teacher innovation and continual refinement of practice in the classroom. Proper use of technology, however, is key to successful results, and general classroom performance seems a better measure of the effectiveness of technology than standardized tests.

In seeking optimal benefit for schools, the Plan calls for technology to be integrated into education according to the following Guiding Principles: technology must be integrated into all aspects of school instruction, administration and management; it must be easily accessible to students and teachers; technical support staff must be trained and effective; students must learn how to use technology efficiently, effectively, and independently; teachers must be given time, training and support for learning; assistive technologies must be available to children with disabilities; technologies should assist the administration in collecting, managing and reporting data and making decisions; technology must be integrated into K-12 curricula as a tool for achieving outcomes in specific program areas.

Technology is a powerful force in education reform, with tremendous potential for strengthening schools.

For each of its six strategic Objectives, the Plan provides a Rationale, identifies Targets, gives a Summary of Maryland's Progress, and provides a set of Recommendations for ensuring further progress. The Plan then puts forth a comprehensive Action Plan for accomplishing all objectives and the "sub-objectives" that contribute to their success. Elements of the Action Plan are too numerous and detailed to explicate in this Executive Summary, but all provide concrete ways for the State to work productively with constituencies to meet specific objectives and solve problems.

The Plan concludes with an analysis of Costs. The responsibility for funding will not fall solely upon any one entity; technology will continue to be a partnership among federal, state, local, and corporate stakeholders. Nor will this require all "new" money; a strong base of funding has already been committed. The report also includes four Appendices: a Review of Research; Integration of Technology in Specific Program Areas; References; and Committee Members.

THE MISSION OF TECHNOLOGY IN MARYLAND

Maryland leads the nation in many aspects of educational reform. It has instituted statewide standards for school performance, established rigorous requirements for graduation, implemented a state-of-the-art school performance assessment program, provided targeted assistance to low-performing schools, and rewarded schools for making significant progress.

As Maryland follows this course of reform, technology has proven itself to be a tremendous resource for strengthening our schools. Documented results show that technology, properly implemented, can strongly improve both instruction and student learning. Technology can provide access to information and communications resources that expand the learning opportunities of students in resource-poor, low-performing schools. Technological tools can also help teachers to enhance both their classrooms and their approaches. Even the school improvement planning process itself is enhanced by providing site-based school improvement teams with online access to, and analysis of, state and local performance assessment data.

State educational technology plans are highly important, living documents, especially when they result in such wide participation and commitment as in the case in Maryland.

Linda Roberts, Director, Office of Educational Technology, U.S. Department of Education

Moreover, technology resources help to connect children, throughout their years of education, to the "real world" in which they will live and work. Given the large number of information technology-related fields today, a graduate who has learned to be comfortable with these tools has a clear edge in career options. Ultimately, strong economic development in Maryland depends on a workforce with the requisite technological knowledge and skills.

To ensure that Maryland students, teachers, and administrators realize all of the immense benefits of technology in education, the State Superintendent of Schools and the Maryland Business Roundtable for Education formed a Blue Ribbon Committee that first met in July of 1992. Its charge: to develop a vision of technology in Maryland education, and a plan for realizing this vision. The Committee included representatives of all sectors of the education community, the business community, and the broader community of citizens. It took, as its point of departure, the premise that technology will be critical to attaining the needed improvement in Maryland schools.

The Committee's recommendations served as the basis for the Maryland Plan for Technology in Education, which was accepted by the State Board of Education in January of 1995. The Plan included a Vision, five key Strategies, an Action Plan, and a proposed budget. Implementation of the Plan began in the spring of 1995; the first major steps recommended in the Plan were carried out. An Instructional Technology Unit was established at the Maryland State Department of Education. A State Committee on Technology in Education, chaired by the Maryland Business Roundtable for Education and composed of all key stakeholders in the Plan, was established to provide oversight and monitoring. Data on the quantity, quality, and use of technology in Maryland schools were collected and reported.

The Plan served as an impetus for technology program development and funding. At the State level, for example, in the spring of 1996, the Governor and Maryland General Assembly moved strongly in support of technology in education by establishing Maryland Connected for Learning, a statewide effort to wire and equip all Maryland schools and train school staff, enabling all students and teachers to ultimately have access to information and communications resources.

At the local school system level, the plan provided a catalyst for improved planning and use of technology as well as more targeted funding. For example, each local school system in Maryland now has a long-range district technology plan for acquiring and using technology resources. At individual schools, technology plans that include staff development and evaluation are now required as part of all requests for state funding. Local funding for technology has accelerated as well. Local school systems not only provide matching funds for the wiring required in the State program, but also, in most cases, have increased their local spending in such areas such as equipment acquisition and professional development.

In 1997, the State submitted the Maryland Plan for Technology in Education to the U.S. Department of Education (USDE) for review and approval as part of its application for the Technology Literacy Challenge Fund. The Plan was approved and funding made available to supplement state and local spending on technology. As part of the approval process, the USDE provided substantive comments on Maryland's Plan. These suggestions prompted the State Committee on Technology in Education to reexamine the Plan in light of new research and national goals, as well as new data gathered over the past two years on technology in Maryland schools.

This revised four-year Plan is the result of that reexamination. The original strategies have remained the same; there have, however, been revisions in key areas. These include:

- A vision that provides a clearer emphasis on student learning as the desired result of the use of technology.
- An update of the most recent research on the impact of technology on learning.
- A more comprehensive description of how technology can be integrated most successfully into specific program areas.
- Specific targets or benchmarks for each strategy.
- A summary of progress toward targets.
- Revised cost projections based on the most recent data gathered from each Maryland school.

What follows, on the subsequent pages, is the refined *Maryland Plan for Technology in Education*.

The vision of the Maryland Plan for Technology in Education is simple and clear:

"Every learner has access to and use of technology in classrooms and schools. Technology supports achievement, enabling learners to be independent, competent and creative thinkers, as well as effective communicators and problem-solvers."

Maryland intends to achieve this vision by the year 2003. At that time, every learner in the state will have access to information and communications resources in all instructional areas of school buildings. Maryland will be recognized as a leader in developing and integrating technology throughout the curriculum, enabling learners to:

- Understand, use and evaluate current technologies for a variety of purposes and situations
- Engage in challenging and thought-provoking tasks
- Participate in meaningful communication within and outside of school
- Obtain, evaluate, analyze, synthesize and report information accurately and effectively
- Develop and collaborate on projects important for their own learning and the learning of others
- Use "real-world" data to analyze and solve problems
- Reach a deeper understanding of concepts and apply this knowledge in meaningful tasks
- Foster and stretch their imagination and creativity
- Connect their classroom experiences with situations and experiences in the outside world
- Prepare to use technology independently throughout their education and their careers

At the same time, the Plan's vision calls for teachers and administrators, through ongoing professional development and support, to have the knowledge and skills to use technology most productively, and to design programs in which technology is integral to instruction. These programs will meet the present and future needs of all Maryland's school customers: students, parents, teachers, administrators, employers, higher education institutions, and communities. Educational goals will be clear, performance-based and focused on excellence. Activities will be exciting, engaging and conducive to active learning for all students.

Schools will have ample funding through multiple sources. Spending will be cost-effective and administered in a carefully planned, equitable manner.

Schools, once they are committed to integrating technology across the curriculum, will keep families and the community informed and involved through a variety of educational programs and partnerships. By design, the technological infrastructure will be seamless and easily accessible to all users. It will serve current standards while also being open and flexible enough to accommodate future use.

STRATEGY

The Committee's strategy to realize the vision has six objectives. Maryland must:

I. Ensure access for all learners.

Targets 1999 - 2003:

- A high-capacity computer for every five students.
- A connection to a local area network (LAN) from every instructional and administrative area of each school.
- High-speed Internet access from every instructional area of each school.
- Technology that accommodates diverse learning needs and disabilities in every school.
- Information and communications resources available to the school and to the community outside of school hours.
- A technological infrastructure that is standards-based and provides easy accessibility and use.

II. Provide ongoing professional development for technology, beginning at the pre-service level.

Targets 1999 - 2003:

- 100% of teachers will:
  -Operate a computer independently and perform basic functions in software applications.
  -Carry out basic Internet routines independently, such as find locations and information using a web browser or send and receive e-mail.
  -Integrate applications of technology into student learning activities and help students to use the technology appropriately.
  -Have access to computer workstations in each instructional area for administrative and instructional purposes.
- Professional development will be supported throughout educators' (teachers, administrators, library media specialists, support staff) careers through activities that are individualized, flexible, appropriate, and varied in formats and delivery models.
- Easily accessible support and assistance for technical and curriculum integration issues and problems will be provided.

III. Integrate the most appropriate and effective technology into all aspects of the education process.

Targets 1999 - 2003:

- Technology will be integrated into learning activities across the K-16 curriculum to support knowledge and skill acquisition, effective communication and problem-solving.
- Technology will support administrative functions in all schools, especially collecting, analyzing and reporting data; managing information; and analyzing, processing and reporting assessment results in a timely manner.

IV. Involve key stakeholders in the planning, implementation, and evaluation of the Plan.

Targets 1999 - 2003:

- Key stakeholders will be involved in ongoing monitoring, evaluation, and revision of the Plan over time.
- Key partnerships will be established to support implementation of strategies and activities in the Plan
- Ongoing communication will continue to inform key stakeholders of the importance of technology and the successes of the Plan.

V. Ensure adequate funding.

Targets 1999 - 2003:

- Sufficient funding will be secured to:
  -Wire all instructional and administrative areas in each public school and pay telecommunications costs for Internet access.
  -Reach a ratio of five students for every high-capacity computer.
  -Enable every Maryland teacher to possess a minimum level of competency for integrating technology into the teaching/learning process (30% of hardware expenditures will support professional development).
  -Provide sufficient and ongoing staff support.

VI. Assess the impact of technology.

Targets 1999 - 2003.

- Achievement of all targets in the Plan will be tracked and documented by the year 2003.
- Learners will demonstrate the knowledge and proficiencies identified in Maryland's Learning Outcomes & Core Learning Goals, especially the knowledge and skills related to technology identified in Skills for Success.

Do educational technologies work? It's a question asked by many, and a fair one. But it is also akin to asking, "Do books work?" The answer is complex. While it may be tempting to take stacks of research reports and say, "This many say 'technology works', this many say it doesn't, and this many suggest the results are inconclusive," such a scorecard approach does not give policymakers the information they need for thoughtful analysis and strategic planning.

In looking at the research on technology, a number of caveats must be taken into account. Technology itself keeps changing, and new educational opportunities appear as hardware and software continue to evolve. Technologies are often used in classroom settings which rarely provide optimal conditions for their use. Moreover, situations vary; one study's results with one set of students cannot be generalized across grade levels, students, subject matter, types of technologies, and applications. Also, the role played by the teacher is a key variable in the implementation and effectiveness of technology. And finally, technology's impact on teachers and their practice should be considered as important as its effect on students; after all, students move on but teachers remain to influence further generations of learners.

Clearly, measuring the success of technology in schools requires that we be clear about what results we seek and how we define effectiveness. While much research remains to be done to provide a better understanding of the role of technology in the quality of education (both teaching and learning), the body of evidence to date suggests that new technologies provide powerful vehicles for educational improvement. It would be wrong to wait until tomorrow for documentation in all areas if the delay would deny today's students the many important opportunities technology can now offer. Some of the important lessons we have already learned from research about technology are:

Technology has a far-reaching impact on students' lives.

When properly used, technologies improve education. Numerous studies show improvements in student performance, student motivation, teacher satisfaction, and other important educational results stemming from use of technologies. There are many cases in which technology-rich schools report significant improvements in student motivation, academic outcomes, improved problem-solving or collaboration, and other areas; in such studies, technology has been shown to be a key variable. According to the research, test scores alone do not accurately assess the contributions of technology, since it affects such a broad range of student skills and student-teacher interactions. Studies also show that good implementation — proper equipment, technical knowledge of teachers, classroom access — is crucial to the successful application of technology in schools.

Basic skills, the area of greatest immediate concern to policy makers, has the most research available. Most of these studies, however, deal with computer-based instruction (CBI) or computer-assisted instruction (CAI) built around the "drill and practice" models of developing isolated skills. Also, many studies consider older software programs developed prior to 1990. Still, the existing findings provide much of value. The research suggests that students usually learn more (and in less time) in classes in which they receive computer-based instruction; that students enjoy their classes more when they receive computer help in them; and that such students also have more positive attitudes toward computers in general. Research has also shown writing achievement to be a key skill in which technology has provided positive benefits. Computers have not, however, had a positive effect in every area in which they were studied.

Technology may offer the most promise as a tool for acquiring advanced skills and for supporting new models of teaching and learning, although research in this area is less extensive and data are more difficult to aggregate and compare. Studies have already shown, however, that technology can be a catalyst for fundamental shifts in teaching. Teachers who report having changed their instructional practice from the traditional "fact transmission" model to the "knowledge construction" model are the very same teachers who have most thoroughly employed computers in their teaching. The correlation appears to be powerful.

Technology has a far-reaching impact on students' lives. More and more national research is showing how profoundly the use of technology affects the attitudes and abilities of American students. One of the largest studies, the Apple Classrooms of Tomorrow (ACOT) research program, looked at classrooms in which every teacher and every student had access to a computer both at school and at home. ACOT's findings were striking. Test scores indicated that despite time spent learning to use technology, students performed well, and some performed significantly better. Students wrote more and with greater effectiveness and fluidity. Some classes completed entire units of study far more quickly than in previous years. Students collaborated more than in traditional classrooms, communicated more effectively about complex processes, and began to routinely use technology to express themselves. They became more socially aware, more confident, and increasingly independent learners and self-starters. Moreover, this comfort with technology helped all students, including those at risk for failure and those with disabilities.

National research has also shown technology to have benefits as an assessment tool, providing information on demand about students' progress and new ways for families to be involved in their children's education. Technology in schools also helps students to develop the very skills that our society's technologies require. It gives students the "real world" contexts, tools, and collaborative opportunities to work and thrive as historians, technicians, scientists, service providers, economists, entrepreneurs, and politicians in the information age.

Quality, not "distance," is what counts. Most studies suggest that there is no significant difference in outcome (grades, test scores, retention, job performance) between being taught face-to-face and being taught at a distance (e.g., via computer). The absence of face-to-face contact is not in itself detrimental to the learning process. What makes any course of instruction good or poor is how well it is designed and delivered, not the simple fact of physical proximity or distance. In our view, education, like business, will increasingly see a blend of face-to-face and distance techniques to form more varied and effective communication.

As we have said, much more research must be done to assess the vast and varied impact of technology in schools. The research so far, however, makes a compelling case for schools to invest in technology. For explanation of the body of research in greater detail, please see Appendix A.

Bringing the immense benefits of technology to Maryland's students means much more than simply providing access. It means integrating technology into the curriculum in a manner conducive to optimal student achievement. Toward this end, the Maryland Plan for Technology in Education is built upon a core set of Guiding Principles which, in turn, serve as the basis for our objectives, targets and recommendations.

Students must learn how to use technology efficiently, effectively, and independently.

Guiding Principles

- Technology must be integrated into all aspects of the school system and learning process: school instruction, administration and management.
- Technology must be easily accessible to all students and teachers while they are in the classroom or library media center. This equipment and software must be fully accessible to students with disabilities.
- Teachers must be given time, training, and support to learn how to apply technology as a teaching tool and as a resource for professional growth.
- Technical support staff must be trained and assigned to ensure that technology-based systems work properly and smoothly, and that support is provided to teachers and administrative personnel.
- Students must learn how to use technology efficiently, effectively, and independently to gain appropriate information, to solve problems, and to communicate with others. They must learn to apply ethical behavior to their use of technology, adhering to copyright laws and citing sources properly.
- Assistive technology devices and/or services must be available to children with disabilities, if required, to increase, maintain or improve their functional capabilities.
- Technology applications for administration and assessment should include:
  - collecting school, local and state education data
  - managing information and budgets
  - analyzing, processing and reporting assessment activities
  - using data for decision-making.
- Technology must be integrated into the K-12 curriculum as a component in achieving outcomes in specific disciplines and program areas. In addition, students must be shown how to make connections among various disciplines, through the use of various technologies.

(For details about integrating technology into specific program areas , please see Appendix B.)

Objectives, Targets and Recommendations

I. Ensure Access for All Learners.

Rationale:

All Maryland students, regardless of learning styles, abilities, achievement levels or economic status, need a reasonable amount of time working with a sufficiently powerful computer if technology is to significantly improve their academic performance. They need to be connected, through technology, with their peers and teachers in the local school environment in order to collaborate, share resources and exchange information.

Further, in order for Maryland's students to fully participate in today's world economy, they must be able to utilize the vast resources of the global telecommunications network. Networks should be developed to allow access and interaction from all locations within school buildings and local school systems as well as throughout the state.

Targets 1999 - 2003:

- A high-capacity computer for every five students.
- A connection to a local area network (LAN) from every instructional and administrative area of each school.
- High-speed Internet access from every instructional area of each school.
- Technology that accommodates diverse learning needs and disabilities in every school.
- Information and communications resources available in the community or school outside of school hours.
- A technological infrastructure that is standards-based and built for easy accessibility and use.

Summary of Maryland's Progress:

Data from 1997 Technology Inventory of Maryland Schools

- Mid-and high-capacity computer to student ratio: 1 for every 12 students
- LAN connection: 29% of classrooms; 63% of computer labs; 43% of library media centers
- Internet access: 89% of schools; 23% of classrooms

Data from 1995 Technology Inventory of Maryland Schools

- Technology that accommodates diverse learning needs and disabilities: Available in 36% of elementary and 47% of secondary schools

Infrastructure Standards

- Minimum Standards for Information and Communications Distribution Systems established (1996)
- Minimum Standards for Computer and Peripheral Acquisition established as part of State contract (1996)

Recommendations:

- Continue the collection of school-level data biennially in order to monitor the availability and use of technology in Maryland schools.
- Collect data regarding availability of information and communications resources outside of school hours.
- Continue publication of a "State of the State" technology summary that indicates progress toward milestones in the Plan.
- Ensure adequate and equitable funding for schools and school districts to reach specified targets.
- Pursue cost-effective strategies to maximize the potential of all available technology in schools.
- Establish partnerships that will help all schools reach specified targets.
- Update state Minimum Standards for Telecommunications Distribution Systems.
- Accelerate and extend state funding program for wiring, equipment, software and professional development.
- Provide easy and affordable access to commercial and private information, communications and broadcast service networks for educational institutions.
- Provide access to statewide telecommunications networks for integration and interaction among schools, local school systems, higher education and state government.
- Encourage technological systems such as voice mail, computer-based telecommunications and instructional television to improve school-home communications.
- Encourage equipment configurations (e.g., full labs, mini-labs/clusters, networked classroom workstations) that support easy access and appropriate instructional use.

Objectives, Targets and Recommendations

II. Provide ongoing professional development for technology, beginning at the pre-service level.

Rationale:

For technology to be effective in schools, teachers must be comfortable with a variety of technologies that can improve learning. They must have adequate training in use of these technologies, beginning at the pre-service level for teacher candidates and continuing with professional development for experienced teachers and administrators. They also must learn how technology can most effectively support student learning. The committee recommends that minimum proficiencies be defined and required, based upon national standards. The committee also recommends that an amount equal to 30% of the cost of hardware be allocated for professional development. Support must be available not only to keep the equipment and networks working but also to help teachers understand how best to use and assess technology as an effective learning tool for students.

Targets 1999 - 2003:

- 100% of teachers will:
  - Operate a computer independently and perform basic functions in software applications.
  - Carry out basic Internet routines independently, such as find locations and information using a web browser or send and receive e-mail.
  - Integrate applications of technology into student learning activities and help students to use the technology appropriately.
  - Have access to computer workstations in each instructional area for administrative and instructional purposes.
- Professional development will be supported throughout educators' (teachers, administrators, library media specialists, support staff) careers through activities that are individualized, flexible, appropriate, and varied in formats and delivery models.
- Easily accessible support and assistance for technical and curriculum integration issues and problems will be provided.

Summary of Maryland's Progress:

Data from 1997 Technology Inventory of Maryland Schools

- Teachers able to operate a computer or use software applications independently: 82%
- Teachers able to gain access to the Internet or use e-mail independently: 53%
- Teachers who feel comfortable using technology as part of classroom activities: 57%
- Teachers who routinely use technology in lessons or act as a technology resource in the school: 1.8%
- Schools receiving support from central office staff/technicians as needed: 90%
- Schools with school-based technology coordinators: 41% (15% full-time)
- Schools with school-based technicians: 15%

State and Federal Funding for Professional Development: FY97 – FY99

- Technology in Maryland Schools Program: $2.8 Million (Approximately 15% of Hardware Investment)
- Technology Literacy Challenge Fund: $3 Million (Approximately 40% of total awards)

Recommendations:

- Define required minimum technology proficiencies for teacher candidates as well as experienced teachers and administrators.
- Develop performance-based assessments of these competencies.
- Restructure time in schools to provide opportunities for professional growth.
- Provide appropriate, timely and adequate resources and opportunities to meet professional development needs of teachers, administrators and support staff.
- Develop appropriate incentives and rewards to encourage the integration of technology K-16.
- Include professional development as a part of all state, district and school-based planning related to technology.
- Include technology competencies as a component in teacher professional development plans that align with the school improvement plan.
- Provide pre-service learning experiences that lead to appropriate use of technology to support learning and instruction.

III. Integrate the most appropriate and effective technology into all aspects of the education process

Rationale:

In order for students to reach technological fluency by the time they graduate from high school, educators must begin building knowledge and skills early in the educational process. For optimal impact on learning and achievement, technology should be taught and used primarily in the context of learning related to program areas (such as mathematics, science, social studies or English language arts) rather than as a separate "technology" skill area. To this end, technology must be integrated into State standards in all program areas and into local school system curricula K – 12. Emphasis should include knowledge and skills in basic operations and concepts; social, ethical, and human issues; and use of productivity, communication, research, problem-solving, and decision-making technology tools.

Educators must begin building technology knowledge and skills early in the educational process.

Local school systems and schools must plan for these uses of technology and identify the most appropriate and effective technologies for each skill area before purchasing and configuring equipment and software.

Targets 1999 - 2003:

- Technology will be integrated into learning activities across the K-16 curriculum to support knowledge and skill acquisition, effective communication and problem-solving.
- Technology will support administrative functions in all schools, especially collecting, analyzing and reporting data; managing information; and analyzing, processing and reporting assessment results in a timely manner.

Summary of Maryland's Progress:

- Specific technology goals for high school graduation: Included in State Core Learning Goals and Skills for Success. MSDE content standards will incorporate technology by 1999.
- Technology skills incorporated into K– 12 curriculum: Scope and sequence has been developed in several local school system curricula.
- Every local school system now has a long-range technology plan that includes how technology is to be integrated into curriculum and instruction.
- School plans are required and approved for State-funded programs.

Recommendations:

- Develop State guidelines on the integration of technology into learning, administration, and assessment.
- Develop local school system implementation plans, in concert with MSDE guidelines, to integrate technology into learning, administration and assessment.
- Ensure that technology is integrated into the K-12 curriculum in all local school systems as a component of improving student performance in all disciplines. State and local specialists in content and instruction, as well as higher education faculty, should be involved in developing these curricula.

Objectives, Targets and Recommendations

IV. Involve key stakeholders in the planning, implementation, and evaluation of the Plan.

Rationale:

The Maryland Plan for Technology in Education was developed, under the leadership of the Maryland Business Roundtable for Education, by key stakeholders throughout Maryland's public and private sectors. These stakeholders remain instrumental not only in helping to plan the use of technology in education but also for successful implementation and monitoring of progress toward specified targets.

Ultimately, all Marylanders must understand the important role technology can play in supporting school improvement. Messages about this role must be crafted carefully to address the needs and concerns of all stakeholder groups: the business community, the education community, and the community at large, including elected representatives.

Targets 1999 - 2003:

- Key stakeholders will be involved in ongoing monitoring, evaluation, and revision of the Plan over time.
- Key partnerships will be established to support implementation of strategies and activities in the Plan
- Ongoing communication will continue to inform key stakeholders on the importance of technology and the successes of the Plan.

Summary of Maryland's Progress:

The Committee on Technology in Education, established in 1995, provides direction, support, and oversight for implementation of strategies and activities in the Plan.

Significant partnerships have helped to advance the use of technology in education:

- Higher Education: Professional development opportunities, free e-mail for teachers.
- Business: Planning for technology, review of plans, technical & financial assistance.
- State Government: Funding, sponsorship of special technology events for education.
- Libraries: Internet access.

Recommendations:

- Review membership of Committee on Technology in Education to ensure representation by all stakeholders.
- Develop marketing plan for reaching various stakeholder audiences.
- Continue biennial reporting on progress.
- Continue to establish partnerships that will help to meet targets in the plan.

V. Ensure adequate funding.

Rationale:

Funding must be readily available to acquire infrastructure wiring that meets minimum standards; to purchase contemporary hardware, software and communications equipment; and to support the recurring costs of professional development, maintenance, and fees for telecommunications. Estimated cost projections are based on the most recent 1997-98 data, which indicate what is needed in order to reach the plan's specified targets in all Maryland schools. Funding must be viewed as primarily the responsibility of federal, state and local government, with secondary support from partnerships between the private and public sectors.

Targets 1999 - 2003:

- Sufficient funding will be secured to:
  - Wire all instructional and administrative areas in each public school and pay telecommunications costs for Internet access.
  - Reach a ratio of five students for every high-capacity computer.
  - Enable every Maryland teacher to possess a minimum level of competency for integrating technology into the teaching/learning process (30% of hardware expenditures will support professional development).
  - Provide sufficient and ongoing staff support.

Summary of Maryland's Progress:
Technology in Maryland Schools Program
FY97 – 99: 392 school sites

- State share of funding for wiring, equipment, software, and professional development: $35.4 million.
- Local match for wiring project schools: $20.6 million*

* Local school systems continue to make substantial investments as well in hardware, software, professional development, telecommunications fees, and repair and maintenance of equipment.

Information Technology Investment Fund
FY97 – 99

- Assistance for electrical wiring in four low-income districts: $515,000 (funding for FY '99 pending)
- Net Weekend events, building private sector participation: $3.8 million

Federal Technology Literacy Challenge Fund 1997 & 1998

- Grants awarded to Maryland local school systems: $7.57 million

Maryland Models for Learning: Partnerships established to pilot models of technology use

- Logan Online (Bell Atlantic, Microsoft, Xerox, Baltimore County, and State of MD to fully equip school and connect home to school):
- Reinventing Education II, the Digital Portfolio Assessment Tool: (IBM, MBRT, and MSDE)
- Hyattsville Wireless Community (GTE, Prince George's County, State of MD) to support parent/teacher communication and classroom instruction using wireless technology.

Recommendations:

- Accelerate and extend the current state-funded initiative to help ensure all targets are met.
- Continue using all available sources of federal funds (e.g. Technology Literacy Challenge Fund, Goals 2000, Title I, and Perkins) to help meet targets.
- Continue to market the importance of funding to local government, chambers of commerce and local school systems, ensuring that technology remains an ongoing priority in local budgets.
- Continue and expand cost-effective strategies for acquiring wiring, equipment and software.
- Consider foundations as a source of funds for technology in education.
- Use savings realized from new sources (e.g., E-rate) to supplement and accelerate the implementation of state and local school system technology plans.
- Give technology funding on the basis of recipient's having a sound plan for using the technology to support student learning.
- Give priority consideration for funding to schools and school systems that have the greatest financial and technological need.

Objectives, Targets and Recommendations

VI. Assess the impact of technology.

Rationale:

Maryland needs to assess its success not only in reaching the Plan's targets but also, ultimately, in achieving the vision of learners as competent and creative thinkers as well as effective communicators and problem-solvers. To assess real progress, multiple measures must be used, including standardized State and local school system assessments, targeted research studies, school and classroom-based evaluations, and State and local surveys and inventories. Technology should be used, as appropriate, to facilitate the assessment, analysis and communication of results.

Targets 1999 - 2003:

- Achievement of all targets in the Plan will be tracked and documented by the year 2003.
- Learners will demonstrate the knowledge and proficiencies identified in Maryland's Learning Outcomes & Core Learning Goals, especially the knowledge and skills related to technology identified in Skills for Success.

Summary of Maryland's Progress:
Progress toward targets

- Biennial technology inventory of equipment, networks, and estimate of teacher knowledge and skills in all Maryland public schools: 95% of school participation in 1995; 100% participation in 1997. Results published in Where Do We Stand? (1997) and Where Do We Stand Now? (1998).
- Pre/Post Teacher Survey in state-funded project schools: Administered annually in Fall (1996 - 1998).

Learner Performance

- Workforce survey conducted every 18 months by MBRT to determine employer satisfaction with skills and performance of graduates

Recommendations:

- Continue to conduct school-based technology inventories on a biennial basis.
- Continue to conduct surveys of how teachers use and integrate technologies.
- Include assessment of student technology-related knowledge and skills as part of State and local standardized assessments in specific content or program areas.
- Conduct research studies focusing on targeted populations with criteria derived from Core Learning Goals.
- Provide technical assistance to, and feedback on, school and local school system technology plans to ensure that a strong evaluation component is included.
- Utilize technology to compile, evaluate and disseminate data.
- Committee on Technology in Education should review and disseminate research on effects of technology on student learning.

ACTION PLAN

Ensure access for all learners.

		Accountable	Support	Start	Finish
High-capacity computer for every five students. Lower the students to high-capacity computer ratio to 5:1.	Accelerate and extend the state initiative, Technology in Maryland Schools, to cover additional number of schools.	MSDE	Governor, legislature	12/98	12/03
	Extend state buying consortium to enhance purchase power.	Dept. of Budget & Mgmt., MSDE	Higher ed.	Ongoing	Ongoing
	Facilitate dissemination of grants and funding information by posting on various websites.	MSDE	MBRT, Tech Corps	1999	Ongoing
	Extend the capability of low-capacity hardware.	Local school systems	Vendors	1999	Ongoing
	Solicit additional recycled computers.	MSDE, Local school systems	Dept. of Gen. Svcs., MBRT, Tech Corps	Ongoing	Ongoing
	Ensure that e-rate savings or other cost-saving/funding measures supplement, not supplant, the purchase of new high-capacity computers.	School boards, County government officials	School system tech. plan	Ongoing	Ongoing
Connection to LAN from every instructional and administrative area of the school.	Accelerate and extend the Technology in Maryland Schools program to complete the wiring of all schools.	Interagency Comm., MSDE	Governor, legislature	2000	2003
	Enlist parent, community, and other volunteer groups to assist in wiring projects.	Local school systems	Governor's office, MSDE, MBRT, Tech Corps	Ongoing	Ongoing
	Ensure that e-rate savings or other cost-saving/funding measures supplement, not supplant, the purchase of LANs.	County government officials, School boards	School system tech. plan	Ongoing	Ongoing
High-speed Internet access from every instructional and administrative area of the school.	Provide each school with a high-speed link to wide-area network services that include the Internet.	Local school systems	Higher ed., State government, Libraries	1999	2003

		Accountable	Support	Start	Finish
	Ensure that e-rate savings or other cost-saving/funding measures supplement, not supplant, the purchase of high-speed access.	County government officials, School board	School system tech. plan	Ongoing	Ongoing
	Enlist parent, community, and other volunteer groups to assist in wiring projects.	Local school systems	Governor's office, MBRT, Tech Corps	Ongoing	Ongoing
	Establish a K-16 Education Network that incorporates the resources and cooperation of higher education, K-12 education, and state and local governments and provides cost-effective access.	Governor's office, Information Tech. Board, Higher ed.	MSDE, Local school systems, Libraries, Local government	1999	2003
Provide technology that accommodates diverse learning needs and disabilities.	Develop awareness; disseminate information — Monograph — Website — Correlation of software and Core Learning Goals — Summer Technology Academy	Center for Technology in Education (a partnership between JHU & MSDE)	MSDE, Local school systems	1999	Ongoing
Update and implement the state Minimum Telecommunications Distribution Systems Standards for school construction projects in Maryland public schools.		MSDE	Local school systems, industry experts	11/97	1/99
Provide information and communication resources outside of school hours.	Work with libraries and public agencies to provide outside of school hours access.	Local school systems, local government	State government, MSDE	1999	Ongoing
	Investigate strategies to make technology in schools available to student and community members outside of school hours.	Schools	Local school systems	1999	Ongoing
Collect data to assess progress.	Continue the collection of school-level data bi-annually in order to monitor the availability and use of technology in Maryland schools.	MSDE	Local school systems, schools	Biennially	
	Collect data regarding availability of information and communication resources outside of school hours.	MSDE	Local school systems, schools	10/99	6/00

		Accountable	Support	Start	Finish
	Continue the publication of "State of the State" technology progress report based on data.	MBRT, Committee on Technology in in Education	MSDE, Local school systems	Annually	

Provide on-going professional development for technology, beginning at the pre-service level.

		Accountable	Support	Start	Finish
Define required technology competencies/proficiencies for instructional staff and develop assessment measures.	Develop and require technology proficiencies for certification and recertification.	Higher ed., MSDE	Local school systems	1999	2000
	Link professional development standards for teachers and administrators with standards for students.	Higher ed., MSDE	Local school systems	1999	2000
	Develop performance-based assessment measures for these proficiencies.	Higher ed., MSDE, Local school systems			
Restructure time in schools to provide opportunities for professional growth.	Collect and disseminate information about various delivery systems and models that address time issues.	MSDE, Local school systems, Higher ed.	MICCA, MEMO	1999	Ongoing
	Establish flexible blocks of time and innovate uses of time during school day/school year.	Local school systems, schools	MSDE	1999	Ongoing
	Support collaboration, observation, mentoring, and reflection.	Local school systems, schools	MSDE	Ongoing	Ongoing
Provide appropriate, timely, and adequate resources and opportunities to meet professional development needs of teachers, administrators, and support staff, including:	Develop model programs/materials in a variety of formats to address all required competencies.	Statewide technology-related coalitions (e.g. MICCA, MEMO), MSDE, MD Teaching and Learning with Technology Consortium	Local school systems	1999	Ongoing
	Develop state website devoted to professional staff development in order to disseminate information and resources.	MSDE, MD Teaching and Learning with Technology Consortium	Higher ed., Local school systems	1999	2000

		Accountable	Support	Start	Finish
	Establish on-line directory of best practices (electronic learning communities) by content area.	Statewide technology-related coalitions (e.g. MICCA, MEMO)	MSDE, Local school systems	1999	2000
	Ensure access to appropriate hardware/software and connectivity.	Local school systems, schools	MSDE	Ongoing	Ongoing
	Ensure adequate staffing for technical and user support.	Local school systems, schools	MBRT, Tech Corps	1999	Ongoing
	Revise Public School Library Program Regulations and Standards to promote library media specialists as instructional technology leaders within the school to work with teachers in increasing proficiency in the use of various technologies and in the integration of technology into the curriculum.	MSDE, Local school systems		1999	Ongoing
	Provide library media specialists with adequate support personnel for technical and organizational issues to ensure continuous access to technology for teachers and students.	Local school systems, schools	MSDE	1999	Ongoing
	Explore various options to supplement support, including library media specialists, students, and volunteer groups.	Local school systems, schools	MSDE, MBRT, Tech Corps	Ongoing	Ongoing
	Provide adequate funding.	MSDE, Local school systems, schools		1999	Ongoing
	Integrate new and appropriate technology into the delivery and support of professional development.	MSDE, Local school systems, MD Teaching and Learning with Technology Consortium	Higher ed., vendors	1999	Ongoing
Develop appropriate incentives and rewards that encourage the integration of technology (K-16).	Include technology competencies in teacher professional development plans that align with school improvement plan.	Schools	Local school systems	Ongoing	Ongoing

		Accountable	Support	Start	Finish
	Hiring, promotion and tenure policies should include recognition of innovative uses of technology in teaching and research (higher ed. and K-12).	Local school systems, schools, Higher ed.	MSDE, K-16 Council	Ongoing	Ongoing
	Fund a variety of opportunities and formats at the school level for staff development (sabbaticals, conferences, field trips, site visits, personal laptops, ISP accounts for teachers at home, distance learning).	Local school systems, schools	MSDE	Ongoing	Ongoing
	Compensate teachers and library media specialists people for development, implementation and dissemination of innovative instructional projects and activities (individuals and teams).	MSDE, Local school systems, schools, MICCA, MEMO		Ongoing	Ongoing
	Fund more collaborative endeavors that promote the integration of technology in the classroom, with higher ed., business partners, state agencies.	MSDE, Local school systems	K-16 Council	Ongoing	Ongoing
Develop, through the Maryland Technology Academy, a network of knowledgeable and skilled teacher leaders who will help other teachers learn how to integrate technology into classroom practice.		MSDE, Higher ed., MD Teaching and Learning with Technology Consortium	Local school systems	1999	Ongoing
Provide teacher preservice learning experiences that lead to appropriate use of technology for instruction and learning.	Include technology as part of the content and methods of teaching.	Higher ed.	MSDE, Local school systems	Ongoing	Ongoing
	Use technology during the instruction in content and methods of teaching.	Higher ed.	MSDE, Local school systems	Ongoing	Ongoing
	Use technology in all levels of research in higher education.	Higher ed.	MSDE, Local school systems	Ongoing	Ongoing

Integrate the most appropriate and effective technology in all aspects of the education process to maximize student achievement of learner outcomes.

Integrate technology into all aspects of the school system.

		Accountable	Support	Start	Finish
Develop state curriculum standards, policy, and practices that help integrate technology into classrooms K-12.	Incorporate technology goals and indicators from Skills for Success into Maryland Student Learning Outcomes, Core Learning Goals, and curriculum standards.	MSDE	Local school systems	Ongoing	Ongoing
	Support ongoing collaboration among content specialists/ coordinators, library media administrators, and technology coordinators at the state and local levels.	MSDE	Local school systems	Ongoing	Ongoing
	Identify appropriate methodologies to integrate technology into content areas to meet desired learner outcomes.	MSDE, Local school systems	K-16 Council	6/98	Ongoing
	Identify and share best educational practices in the integration of technology across curricular areas.	MSDE, Local school systems, MICCA, MEMO	K-16 Council	1/99	Ongoing
	Establish technology competencies for instructional staff as a certification/recertification requirement.	MSDE, Higher ed.	Local school systems	9/98	12/00
	Investigate ways technology can be used as an assessment tool.	MSDE, Local school systems	Higher ed.	Ongoing	Ongoing
Develop local school system curriculum, policy, and practices that help integrate technology into all content areas within local school systems. (This will need to be an ongoing process, as technology changes.)		Local school systems	MSDE	9/98	Ongoing
	Ensure that technology is a component in all new and revised curriculum K-12.	Local school systems	MSDE	6/98	Ongoing
	Support ongoing collaboration among content specialists/coordinators, library media administrators, and technology coordinators.	Local school systems	MSDE	6/98	Ongoing

		Accountable	Support	Start	Finish
	Identify appropriate methodologies to integrate technology into content areas to meet desired learner outcomes.	Local school systems	MSDE	Ongoing	Ongoing
	Identify and share best educational practices in the integration of technology across curricular areas.	Local school systems. MICCA, MEMO	MSDE	6/98	Ongoing
	Implement flexible and/or innovative scheduling for teachers, library media specialists and students to enable the effective use of technology.	Local school systems. schools	MSDE	6/98	Ongoing
	Encourage instructional strategies to support the integration of technology, such as problem/ project-based learning, working in teams, and work-based learning.	Local school systems, schools	MSDE	6/98	Ongoing
Develop a plan to support the integration of technology across the content areas as part of each school's School Improvement Plan.	Align school technology plan with school improvement plan.	School Improvement Team	Local school systems	Ongoing	Ongoing
	Require all teachers to implement the curriculum that integrates technology.	Local school systems. schools	MSDE	6/99	Ongoing
	Support ongoing collaboration among content teachers, library media specialists, and technology coordinators.	Schools	Local school systems	Ongoing	Ongoing
	Identify and share best educational practices in the integration of technology across curricular areas	Local school systems, schools, MICCA, MEMO.	MSDE	Ongoing	Ongoing
	Implement flexible and/or innovative scheduling for teachers, library media specialists, and students to enable the effective use of technology.	Schools	Local school systems, MSDE	9/99	1/2000
	Implement instructional strategies to support the integration of technology, such as problem/ project-based learning, cooperative learning and work-based learning.	Local school systems. schools	Local school systems, MSDE	Ongoing	Ongoing

		Accountable	Support	Start	Finish
Use technology for administration and assessment to accomplish the following:	Collect school, local and state education data.	Local school systems, schools	MSDE, Business	Ongoing	Ongoing
	Managing information and budgets.	Local school systems, schools	Business	Ongoing	Ongoing
	Analyzing, processing, and reporting of assessment activities.	Local school systems, schools	MSDE	Ongoing	Ongoing
	Facilitating communication among staff, partners, students, and the community.	Local school systems, schools	MSDE	Ongoing	Ongoing
	Establishing a home/school communication system to ensure full integration of technology (e.g. aggregate LEA, school, MSDE websites, produce a public e-mail directory).	Local school systems, schools	MSDE	1/99	Ongoing
Ensure that assistive technology is available for learners, teachers, administrators, and other staff with special needs to support use of technology throughout the curriculum.		Local school systems, schools	MSDE, Business, Higher ed.	Ongoing	Ongoing

Involve key stakeholders in the planning, implementation, and evaluation of plan.

		Accountable	Support	Start	Finish
Involve key stakeholders in on-going planning, monitoring, evaluation, and revision of plan over time.	Review membership of the Committee on Technology in Education (COTE) in order to ensure representation by all stakeholders.	MBRT	MSDE	1/99	Annually
	Continue Committee on Technology in Education subcommittees to assist with plan implementation.	MBRT	MSDE	Ongoing	Ongoing
	Establish multiple vehicles to obtain feedback from all stakeholders.	MBRT, MSDE		1/99	Ongoing
Establish key partnerships to support implementation of strategies and activities in plan.	Identify needs and appropriate groups for partnerships.	COTE, MSDE, Local school systems	State and Local Governments, Higher ed.	1/99	Ongoing
	Determine forums for sharing information.	COTE, MSDE	Local school systems	1/99	Ongoing

		Accountable	Support	Start	Finish
Communicate to key stake-holders the importance of technology and success of the plan.	Continue annual reporting of progress and key messages.	COTE, MSDE, Local school systems		Ongoing	Ongoing
	Present at conferences and public meetings as appropriate	MBRT, MDSE, Local school systems		Ongoing	Ongoing

Ensure adequate funding.

		Accountable	Support	Start	Finish
MSDE, local school systems, and business community work collaboratively to seek federal funding for all aspects of educational technology.	Provide information and technical assistance for local school systems to seek grants for federal funds.	MSDE	Local school systems	Ongoing	Ongoing
	MSDE, local school systems, higher education and business community work with congressional delegation in a coordinated effort to provide funding for educational technology in support of federal initiatives.	MSDE	Govemor's office, Local school systems, MBRT	Ongoing	Ongoing
	Support legislation that ensures educational bills including technology components.	MSDE	Govemor's office, local elected officials	Ongoing	Ongoing
	Participate in all federal programs (e.g. e-rate) that support the integration of technology into classrooms and schools.	MSDE, Local school systems	Govemor's office, Local govemments	1/98	Ongoing
MSDE, local school systems, and business community work collaboratively to seek state funding for all aspects of educational technology.	Accelerate and extend funding for Technology in Maryland Schools program to support all targets in the plan.	Interagency Committee, MSDE	Maryland General Assembly	12/98	12/03
	Continue supplemental funding requests from the Information Technology Investment Fund.	Interagency Committee, MSDE, Govemor's office	Maryland General Assembly	12/98	12/03
	Provide funding for MD Technology Academy	Govemor's office, MD General Assembly	MSDE	12/98	Ongoing
Local school systems, local governments and local business community work collaboratively to seek local funding for all aspects of educational technology.	Local school systems review and revise as necessary their long-range technology plans.	Local school systems	Local government, Business, Community, Tech Corps	Annually	Annually
	Local school systems prepare annual budgets that include funds for education technology to submit to local govemment.	Local school systems	Local govemment	Ongoing	Ongoing

		Accountable	Support	Start	Finish
	Local school systems establish partnerships with state government, business, or volunteer groups to supplement funding for technology.	Local school systems	Business, Tech corps.	Ongoing	Ongoing
Obtain educational technology equipment, hardware, software and services in the most economical and efficient manner.	Continue state procurement policy where when local school systems can purchase from state contracts bid through state procurement office. — Market use to local school systems. — Review state procurement and improve to better meet local school system needs.	Dept. of Budget & Mgmt., Higher ed., Public School Construction Program, MSDE	Local school systems	Ongoing	Ongoing
	Establish an approved contract list for a wide range of products and services based on identified needs of local school systems with potential participants.	Depts. of Budget & Mgmt. & General Services, Public School Construction Program	Local school systems	Ongoing	Ongoing
	Provide information to Department of General Services and Department of Budget and Management regarding local school system's individual procurement (periodically).	MSDE	Local school systems	Ongoing	Ongoing
	Continue work with foundation (i.e. Christina) to recycle used computers from government and business into education.	MSDE	Dept. of General Services	Ongoing	Ongoing
	Develop a plan, policy, or procedure for the disposition of recycled equipment.	Local school systems	Dept. of General Services	Ongoing	Ongoing
Administer funds in a fair and equitable manner.	Grants and other funding will be awarded on the basis of an approved technology plan and proposals that meet specified criteria.	MSDE	Committee on Technology in Education	Ongoing	Ongoing
	Priority consideration will be given to schools and school systems that have the greatest financial and technological need — Update current indicators of need. — Update rubrics for selection.	MSDE, Public School Construction Program	Committee on Technology in Education, Local school systems.	Ongoing	Ongoing

Assess the impact of technology.

		Accountable	Support	Start	Finish
Conduct research studies to assess student learning.	Focus on targeted populations.	Committee on Technology in Education	MSDE, Higher ed., Local school systems	1/99	Ongoing
	Use criteria derived from Core Learning Goals.	Committee on Technology in Education	MSDE, Higher ed., Local school systems	1/99	Ongoing
Review/monitor/disseminate research studies on effects of technology on student learning.	Provide copies of summaries to Committee on Technology in Education and local school systems.	MSDE, Committee on Technology in Education	Local school systems, Tech Corps	Ongoing	Ongoing
	Include best research on websites.	MSDE, Committee on Technology in Education	Local school systems, Tech Corps	Ongoing	Ongoing
For existing state-funded projects, develop summaries and disseminate results on best practices and student learning.	Continue to conduct surveys of teacher utilization and integration.	MSDE, Local school systems	Committee on Technology in Education	Ongoing	Ongoing
	Provide copies of summaries to Committee on Technology in Education and local school systems.	MSDE	Local school systems	Ongoing	Ongoing
	Develop teacher recognition program (external support).	MSDE, Committee on Technology in Education	Local school systems	Ongoing	Ongoing
	Publish best practices on website.	MSDE, Local school systems		1999	Ongoing
Continue to conduct school-based technology inventories on a biennial basis.	Develop electronic data collection system.	MSDE, Committee on Technology in Education	Local school systems	2000	Ongoing
	Provide electronic access to data and summaries.	MSDE, Committee on Technology in Education	Local school systems	2000	Ongoing
Provide technical assistance to and feedback on school district technology plans to ensure strong evaluation component.	Review district technology plans.	MSDE, Committee on Technology in Education		Ongoing	Ongoing
	Provide feedback on technology plans and support implementation of plans.	MSDE, Committee on Technology in Education		Ongoing	Ongoing
	Provide models of effective evaluation measures and strategies.	MSDE, Higher ed.		Ongoing	Ongoing
Include assessment of student technology-related knowledge and skills as part of state and local standardized assessments in specific content or program areas.		MSDE, Local school systems		2001	Ongoing

COSTS

A thorough review of technology available in Maryland schools as summarized in the 1998 "Where Do We Stand Now?" report revealed the key challenges that face our state as we enter the next century. Analysis of the costs of meeting these challenges is a key element of the revised four-year Maryland Plan.

Maryland's fundamental strategy for funding technology must be to view it not only as a one-time capital investment but also as an ongoing operational expense. Just as with professional development or transportation, technology in schools is simply a cost of doing business in today's world. Maryland is making this commitment, treating technology as an integral part of instructional budgeting rather than as a stand-alone item.

The original 1995 Maryland Plan called for $150 million in funding over five years. With the subsequent strong commitment from federal, state, local and corporate sectors, however, we have reached that target in only three years. A new funding analysis has been done based on the updated objectives and targets of this revised plan. The estimate cost for achieving all specified targets by the year 2003 is approximately $400 million (see Funding Analysis Table for all figures.) This analysis reflects an investment of approximately $120 per student per year.

The responsibility for this funding will not fall solely upon any one entity; technology funding will continue to be a partnership among federal, state, local and corporate stakeholders. Nor will this require all "new" money; a strong base of funding has already been committed for portions of the Plan. For example, the Technology in Maryland Schools Program which provides wiring through State and local capital funds, as well as equipment, software, and professional development from State General Funds, was a state commitment through 2001. Federal support through programs such as the Technology Literacy Challenge Fund and Technology Innovation Challenge Grant Program has been strong. A large portion of funding from other federal programs, such as Title I and Special Education, are also used for these purposes targeting students living in high poverty and with special needs. In addition, local school systems are making on-going investments for purchases of equipment and software, payment of telecommunications charges, and support for professional development.

Additional resources will be required to fully carry out the Plan. But savings may be achieved through such trends as the Universal Service telecommunications discounts for schools and libraries, the anticipated continuing drop in equipment prices, and large pooled statewide purchasing services. Such savings should be recycled to support full implementation of the Plan. In some cases, funding for other programs can actually help to support technology. For example, professional development for teachers in such areas as science, math, social studies, and English Language Arts can include learning how to use technology to achieve instructional goals.

The funding analysis for the revised Maryland Plan is based upon specific assumptions that can be drawn from trends in the technology industry and the needs and resources of Maryland schools (See Funding Analysis Table for details). Among these assumptions are: the importance of continued federal/state/local/corporate fiscal partnerships; the need to achieve a statewide 5-to-1 ratio of students to high-capacity computers and to connect each classroom to the Internet; the provision of one technology support staff person per 500 computers; and the inclusion, within professional development, of the cost of substitute teachers, stipends, materials and other expenses.

It is the strong belief of the Committee on Technology in Education that this funding analysis, based upon a careful evaluation of costs and priorities, reflects what it will take to ensure that Maryland students get the full benefit of technology in their education.

Maryland Statewide Educational Technology Funding Analysis

Figures used in this chart are based on certain assumptions which are included in Section D - Assumptions.

	Total Quantity	Unit Cost	FY 2000 Year 1	FY 2001 Year 2	FY 2002 Year 3	FY 2003 Year 4	Total Cost
A. Hardware/Software/ Wiring Costs							
Personal Computers	89,365	$1,500	$33,511,875	$33,511,875	$33,511,875	$33,511,875	$134,047,500
PC File Servers	932	$5,000	$1,165,000	$1,165,000	$1,165,000	$1,165,000	$4,660,000
Printers (1 per 5 computers)	17,873	$600	$2,680,950	$2,680,950	$2,680,950	$2,680,950	$10,723,800
Basic Software Applications	89,365	$150	$3,351,188	$3,351,188	$3,351,188	$3,351,188	$13,404,750
Assistive devices for special needs	1,297	$500	$648,500	$648,500	$648,500	$648,500	$2,594,000
Projection Equipment	905	$3,500	$791,875	$791,875	$791,875	$791,875	$3,167,500
Wiring Distribution System	672	$150,000	$19,800,000	$27,000,000	$27,000,000	$27,000,000	$100,800,000
	Subtotal		**$61,949,388**	**$69,149,388**	**$69,149,388**	**$69,149,388**	**$269,397,550**
B. Replacement Costs							
Replacement of outdated PCs			$0	$0	$10,000,000	$10,000,000	$20,000,000
	Subtotal		**$0**	**$0**	**$10,000,000**	**$10,000,000**	**$20,000,000**
C. Operational Costs							
Telecommunications Fees	1297	$7,200	$2,334,600	$4,669,200	$7,003,800	$9,338,400	$23,346,000
Distance Learning Fees	129	$50,000	$1,612,500	$1,612,500	$1,612,500	$1,612,500	$6,450,000
Operation and Maintenance				$737,614	$1,475,229	$2,212,843	$4,425,686
Professional Development			$12,644,816	$12,644,816	$12,644,816	$12,644,816	$50,579,265
Technology Support Staff	178	$60,000	$2,670,000	$5,340,000	$8,010,000	$10,680,000	$26,700,000
	Subtotal		**$19,261,916**	**$25,004,131**	**$30,746,345**	**$36,488,559**	**$111,500,951**
	Grandtotal		**$81,211,304**	**$94,153,518**	**$109,895,732**	**$115,637,947**	**$400,898,501**

D. Assumptions

- Funding to come from multiple sources (federal, state, and local) with support from businesses and other partnerships
- Personal computer costs are based on a 5:1 student to high capacity computer ratio. High-capacity computers are currently defined as those having processors that are 486 or higher on the Windows platform and 68040 or higher on the Macintosh platform. Given the rapid change in technology, these definitions will change.
- Upgrades of existing low capacity PCs are included in new computer purchases
- Fileserver costs are projected on current data of schools with 50% or more classrooms connected to a Local Area Network (LAN)
- Printer costs are projected on 1 printer per 5 computers
- Software is minimal application purchases only
- Wiring estimation includes networking components and average facility requirements
- Telecommunications fees include monthly line charges and Internet Service Provider fees
- Distance Learning capability to include every high school
- Professional development costs include items such as substitutes/stipends for teachers, salary for resource teachers/trainers/mentors, materials and manuals.
- Technology support staff estimates are projected on 1 staff member per 500 personal computers

APPENDICES

REVIEW OF RESEARCH ON TECHNOLOGY IN SCHOOLS

An overview: Technology can play a positive role

Despite caveats about over-generalizing research findings, and in response to the public's frustration with researchers' tendency to obfuscate when simple answers are sought, several recent national reports have dealt with the question of technology effectiveness. A RAND study for the U.S. Department of Education[1], which became the basis for the Department's influential report Getting America's Students Ready for the 21st Century: Meeting the Technology Literacy Challenge [2], made the following four points:

- Numerous studies of a wide variety of specific applications of technology show improvements in student performance, student motivation, teacher satisfaction, and other important educational results.
- There are examples of technology-rich schools that report significant improvements in student motivation, academic outcomes, and other results such as improved problem-solving or collaboration.
- Traditional ways of assessing the effectiveness of educational programs (e.g. test scores alone) are generally deficient for assessing the contributions of technology.
- Good implementation is crucial to the successful application of technology in education.

Breaking down the research

This review gives an overview of research on the impacts of technology in three areas of focus: basic skills instruction, the development of higher-order thinking skills, and in support of what have been called information age skills. It also describes research on the effectiveness of distance education, as a special area of interest to Maryland policymakers.

Technology's role in enhancing basic skills

This is the area of greatest immediate concern to policy makers, and it is also where there is the most research available. It should be noted, however, that most of these studies are based on computer-based instruction (CBI) or computer-assisted instruction (CAI) built around the "drill and practice" models of developing isolated skills, often embodied in network-based systems known as integrated learning systems.[3] Further, the majority of these studies consider software programs that were developed prior to 1990.[4]

In comprehensive meta-analyses aggregating several hundred studies conducted by research teams at many different research centers, looking at a variety of computer uses with different populations, researchers[5] presented the following conclusions:

- Students usually learn more in classes in which they received computer-based instruction.
- Students learned their lessons in less time with computer-based instruction.
- Students liked their classes more when they received computer help in them.
- Students developed more positive attitudes toward computers when they received help from them in school.
- Computers did not, however, have positive effect in every

[1] Thomas K. Glennon and Arthur Melmed. Fostering the Use of Educational Technology: Elements of a National Strategy. Santa Monica CA: RAND, 1996.

[2] Richard Riley. Getting America's Students Ready for the 21st Century: Meeting the Technology Literacy Challenge. Washington, DC: US Department of Education, 1996.

[3] President's Committee of Advisors on Science and Technology, Panel on Educational Technology. Report to the President on the Use of Technology to Strengthen K-12 Education in the United States. March 1997.

[4] James A. Kulik, "Meta-Analytic Studies of Findings on Computer-based Instruction," in E.L. Baker and H.F. O'Neill, Jr. (eds.), Technology Assessment in Education and Training, Hillsdale, NJ: Lawrence Erlbaum, 1994.

[5] Much of this meta-analysis was conducted by Kulik and Kulik. See, for example, Kulik, James A., "Meta-analytic Studies of Findings on Computer-based Instruction," in E.L. Baker, and H.F. O'Neill, Jr. (eds.), Technology Assessment in Education and Training, Hillsdale, NJ: Lawrence, Erlbaum, 1994, and Kulik, Kulik, and Bangert-downs, "Effectiveness of Computer-based Instruction: an Updated Analysis." Computers in Human Behavior, (1991), 75-94.

area in which they were studied.

Another, more recent meta-analysis[6], looking at 176 studies, including research from 1990 to 1995, found positive effects at all school levels, subject areas, and for both regular and special education students. The conclusion:

- the use of technology as a learning tool can make a measurable difference in student achievement, attitudes and interactions with teachers and other students.

The choice of words is important: "can make a measurable difference," not "will make a measurable difference." As noted in another comprehensive research review[7]:

"The new technologies can contribute in several ways to better learning in various subjects and to the development of various skills and attitudes. The nature and breadth of learning depends on previously acquired knowledge, and on the type of the learning activities using technology."

As new skills are acquired in the motivating context of the computer-based instruction (which provides immediate feedback and private, personalized pacing), these skills are reinforced in ways that fit the behaviorist model of teaching and learning that has been the foremost instructional approach in classrooms over the last century. Key elements in the motivating factors of technology are not just the bells and whistles of positive feedback, but the opportunities for self-pacing and self-regulation, although the authors of this study suggest that low-achieving students often required more structure.

Writing achievement is another key "basic skills" area where technology has provided positive benefits: students writing more and with greater proficiency. Because word processing software can make writing less of a physical chore and more of a process of creation, teachers can help students focus more on content. When editing is a less onerous and more continuous part of the writing process, multiple drafts can be produced and shared for critiquing with peers. Technology does not diminish the need for instruction in basic skills of spelling, grammar, writing structure, tone, voice, and organization, but it can facilitate the structured application of these skills. When a sound model of writing instruction is used, researchers have found that students using word processing have demonstrated higher levels of achievement than those writing without the support of word processing.[8]

Technology's role in developing higher order skills

While progress in basic skills via technology should not be discounted, some have expressed concern that these skills can be developed by other means that do not require the expense of technology.[9] These educators maintain that technology may offer the most promise as a tool for advanced skill acquisition and for supporting new models of teaching and learning. The use of educational technology to help students develop higher order skills of problem solving, and the ability to access, organize, display, and communicate information are the components least likely to be measured on traditional pencil and paper standardized tests.[10] As the tests become more sophisticated in assessing student performance on problem solving tasks, like those measured in the Maryland School Performance Assessments, it will require close analysis of how technology use and higher-level thinking are correlated.

Because these cognitive applications of technology are more difficult to evaluate, the research in this area is less extensive and data are more difficult to aggregate and compare. The situation is compounded by the fact that much of today's school improvement efforts challenge teachers in multiple ways, calling on them to transform their practice by requiring high standards for all their students, to adopt new curricula emphasizing higher-order skills, and to use constructivist, student-centered teaching methods. These learning environments place greater demands on teachers; applying technologies to this environment adds to the challenge.[11] Assessing the impact is even more complex.

6 Jay Sivin-Kachala and Ellen R. Bialo, Report on the Effectiveness of Technology in Schools 1990-1994, Washington DC: Software Publishers Association, 1994.
7 Gregoire, Inc., Robert Bracewell, and Therese Laferriere, The Contribution of New Technologies to Learning and Teaching in Elementary and Secondary Schools, a collaboration of Laval University and McGill University, 1996.
8 I. Snyder, "Writing with word processors: A research overview," Educational Research, 35 (1), Spring 1993, 61.
9 See, for example, Todd Oppenheimer, "The Computer Delusion." The Atlantic Monthly, 1997.
10 Gilbert Valdez and Mary McNabb, "Executive Summary: Positioning Technology Within Schools," from Research on Technology Effectiveness (CD-Rom). Oakbrook, IL: North Central Educational Regional Laboratory, 1997.
11 Barbara Means and Kerry Olson, "Technology's Role Within Constructivist Classrooms" presentation at the annual meeting of the American Education Research Association, San Francisco, CA, April 1995. p.1.

A recent national study of teacher practice in technology-intensive classrooms, however, suggests that teachers' use of computers can play a role in shifting their instructional practice to a more "constructivist" approach that advances these school improvement goals. Becker (1998)[12] defines practices that support this constructivist model:

- Learning activities connected to real-world problems in which students have an interest.
- Tasks that require longer blocks of time to complete and deeper understanding of content.
- Curriculum that is thematic and interdisciplinary, with greater emphasis on depth over breadth of coverage.
- A teaching style emphasizing collaborative learning and student initiative and independence.
- Teachers learning and reflecting along with students, instead of being seen as the sole source of information.

Becker's research found that the teachers who report having changed their instructional practice from traditional fact transmission models to the knowledge construction model are the same teachers who have most thoroughly employed computers in their teaching. They are also the teachers who most often incorporate the Internet into their instruction. He suggests that computers encourage and even demand such practices, which in turn change the pedagogical beliefs of teachers who use them.

Another large national study confirms this view of the interaction between technology use and changed teaching practice. Nine national case studies of technology-supported school change efforts, undertaken by SRI's Center for Technology in Learning, found that "learning skills in the context of meaningful projects elicited greater student interest and understanding, as well as higher self-imposed standards for quality." This research suggests that, among possible reasons why technology can be a catalyst for fundamental shifts in teaching, are the following:

- Teachers see complex assignments as feasible.
- Technology appears to provide an entry point to content areas and inquiries that might otherwise be inaccessible until much later in an academic career.
- Technology can extend and enhance what students are able to produce, whether the task at hand is write a report or graphing data.
- Use of software tools enabled students to go further than previous classes had without technology in a whole variety of curriculum areas.
- Teachers reported that students made greater use of outside information sources, showed more consideration of multiple perspectives, and improved understanding of audience needs.
- Perhaps as a result of these effects, teachers felt that use of technology enhances creativity, improves design skills and the ability to present information well, and promotes better oral communication skills.
- The most common — in fact, nearly universal — teacher-reported effect on students was an increase in motivation.
- Most of the case study teachers described an increase in collaboration and more peer teaching among their students.

Another large-scale study[13] of 500 students in 14 schools, comparing students with Internet access and those without, found similar outcomes. Student learning in this case was measured by outside evaluators assessing students' research projects. Overall, students with online access to the Internet produced "better projects than students without access, scoring higher in all nine learning criteria with statistically-significant scores for 5 of the 9 learning measures. Students with on-line access demonstrated greater abilities to:

- bring together different points of view.
- present a full picture (e.g. who, what, when, where, why, and how).
- effectively present their ideas and information.
- effectively state an issue.
- produce a complete project.

One of the most comprehensive, long-term research studies has been the work conducted by the Apple Classrooms of Tomorrow (ACOT) research program. ACOT studied what happens in classrooms in which every teacher and student has

[12] Henry J. Becker "The Influence of Computer and Internet Use on Teachers' Pedagogical Practices and Perceptions." paper presented at the annual meeting of the American Educational Research Association, April 1998.

[13] Center for Applied Special Technology. The Role of On-line Communications in Schools: A National Study. Peabody, MA: CAST, 1996. http://www.cast.org/stsstudy.html.

access to a computer both in the classroom and at home. While far from a typical situation, this research gives a window into what occurs when technology is pervasive in the classroom, and when teachers are trained and encouraged to use technology across the curriculum. More than 20 universities and research institutions conducted ACOT-supported research spanning ten years (ACOT had its own research think tank, independent of the company's sales and marketing division). Summaries of these studies[14] include the following findings:

- Test scores indicated that, despite time spent learning to use the technology, students were performing well, and some were clearly performing better.
- The students wrote more, more effectively, and with greater fluidity.
- Some classes finished whole units of study far more quickly than in past years.
- Access to technology actually encouraged them to collaborate more than in traditional classrooms.
- Technology was becoming more interesting to students as they began using it for creating and communicating.
- Students became socially aware and more confident.
- Students communicated effectively about complex processes when using computers.
- Students started using technology routinely and appropriately.
- Students became independent learners and self-starters.
- Students worked well collaboratively.
- Technology helped all students, including those at risk for failure and those with disabilities.

Technology had benefits that went beyond its value as an instructional tool. For example, it served as an assessment tool to provide information on demand about students' progress and accomplishments. It also provided new ways for families to increase their involvement in their children's education, especially as computers were increasingly integrated in home activities.

Technology's role in producing information-age skills

How well does technology become a vehicle for students' developing the very skills that the technology itself requires; that is, in developing the technological fluency that will enable them to work and thrive in the information age? Because technologies change so rapidly, students do not need to be trained to use a specific piece of hardware or software. Rather, research tells us that what is necessary is a general understanding of technological applications, the enthusiasm and confidence to try new things, and the ability to "think with technology" — to know when technology can help solve a problem or complete a task, and when other methods are more appropriate. It also means being able to use the tools of the technological age in the ways that experts use them.

Here, too, there is less hard data to prove effectiveness, but there are promising examples. For example, in Projects ICONS[15], an International Communications and Negotiation Simulations, pioneered at the University of Maryland, high school students take on the roles of decision-makers and negotiators on issues such as human rights, nuclear proliferation, international debt, or conflicts in the Middle East or other areas. Telecommunications link them with teams in other countries around the world. Research suggests that they learn not just content but also new skills in technologically-supported negotiation, collaboration, and communications — skills increasingly necessary to conduct business or diplomacy in the shrinking 21st- century global community.

In science projects like Global Lab[16], students do not just study science, they carry out science, focusing on a study site in their local community, using technological tools for collecting, analyzing, and sharing environmental data worldwide. In activities like these, students are learning to become facile with technology, but in the context of learning the skills, content, rules, ethos, and behaviors of the relevant discipline.

[14] See, for example, Judith H. Sandholtz, Cathy Ringstaff, and David C. Dwyer, Teaching with Technology: Creating Student Centered Classrooms. New York: Teacher College Press. 1996.

[15] http://www.icons.umd.edu

[16] http://globallab.terc.edu

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Technological resources give them authentic contexts, tools, and collaborative opportunities to work as historians, scientists, economists, scholars, entrepreneurs, and politicians. As they develop skills of "telecollaboration" they are using one of the most sophisticated deployments of classroom telecommunication.[17]

Technology for distance learning

Distance learning, like technology, is a term that is broadly used. We use it here to refer to the use of technologies to connect learners with teachers and learning resources located at another physical location. It can involve a range of video, audio, and text-based technologies with varying levels of one- or two-way interactivity. It can consist of a whole course packaged and delivered from one school to another, or pieces of courses or information sharing between various experts and learners and between learners. The most common model is a course taught "live" at one site and delivered to learners at multiple distant sites. How effective is distance learning?

One of the most comprehensive analyses of distance learning research[18] makes the following statement:

"Comparing the achievement of learners (as measured by grades, test scores, retention, job performance) who are taught at a distance and those taught in face-to-face classes is a line of research going back more than 50 years. The usual finding in these comparison studies is that there are no significant differences between learning in the two different environments." (p.65)

While many studies have looked at distance learning effectiveness in training and professional development, results are also positive when reviewing K-12 applications, especially in secondary schools. For example, at the high school level, Martin and Rainy (1993) compared the results of a course in anatomy and physiology taught to seven conventional classes with the results of teaching the same courses to seven classes by video-conference. While there were no differences in the students' pre-test scores, there were significant differences in the post-test scores, in favor of the distance learners.

Much of the research no longer asks if distance education courses can be as effective as conventional classroom instruction, but rather, who learns best in distance learning settings and why. Whether students learn or not depends less on the medium than on the characteristics of the learners, and on numerous other variables of program design, instruction, and administration, as well as content variables. Most studies suggest that the absence of face-to-face contact is not in itself detrimental to the learning process; what makes any course good or poor is how well it is designed, delivered, and conducted, not whether the students are taught face-to-face or at a distance.

Moore and Kearsley (1996) list a number of key variables that determine the effectiveness of distance education courses:

- Number of students at learning site (individual, small group, large group).
- Length of class/course (hours, days, weeks, months).
- Reasons for students taking the class/course (required, personnel development, certification).
- Prior educational background of student (especially with self-study and/or distance learning).
- Nature of instructional strategies used (lecture, discussion/debate).
- Kind of learning involved.
- Type of pacing.
- Amount and type of interaction/learner feedback provided.
- Role of tutors/site facilitators.
- Preparation and experience of instructors and administrators.
- Extent of learner support provided.

[17] Boris Berenfeld, "Linking Students to the Infosphere", T.H.E. Journal, April 1996, 76-81.
[18] Michael Moore and Greg Kearsley, Distance Education: A Systems View. Boston: Wadsworth Publishing Company, 1996.

INTEGRATING TECHNOLOGY IN SPECIFIC PROGRAM AREAS

Science

As teachers plan instruction related to their science program, technology should be incorporated into their lessons. These lessons, ranging from Kindergarten through grade 12, are based on the 5 E model: engagement, exploration, explanation, extention and evaluation. Technology resources can be incorporated as another tool of the student scientist during any portion of a lesson where it may be logically applied and developmentally appropriate. The science classroom experience provides an opportunity for students to use the technology skills they have developed in other classrooms.

In the Maryland K-8 Outcomes for Science, students' understanding of the Concepts of Science are developed and deepened through their learning related to the Nature of Science, Habits of Mind, Processes of Science, and Applications of Science. Technology can support a variety of learning experiences in all of these Outcomes, while laying the foundation for knowledge and skills to be developed in the high school science program.

In the High School Core Learning Goals for science, each of the concept areas – Earth/Space Science, Biology, Chemistry and Physics – is connected to Goal 1 "Skills and Processes" and contains specific references to the technology associated with that area. The technology-related Expectations and Indicators in Goal 1 include the following:

The student will:

- select appropriate instruments and materials to conduct an investigation.
- develop skills in using laboratory and field equipment to perform investigative techniques.
- learn the use of new instruments and equipment by following instructions in a manual or from oral direction.
- analyze outputs generated by technology such as spreadsheet, graphing and database programs, probe ware on computers and/or graphing calculators.
- use models and/or computer simulations to extend his/her understandings of scientific concepts.
- use computers and/or graphing calculators to perform calculations for tables, graphs and spreadsheets.
- use computers and/or graphing calculators to produce the visuals that will be used for communicating results.

Mathematics

The mathematics classroom must address the needs of the future. Students must learn the power of technology in order to deal with real-life situations. They need to know when and how technology will improve their ability to solve problems.

What we teach, how we teach, and the means by which we evaluate the relative success of that teaching and learning are inextricably influenced by technology. Skills and strategies previously not emphasized now need to be stressed (e.g., the increased need to recognize when computation and estimation are most appropriately done using mental, paper and pencil, and/or technology-supported methods, as well as the ability to judge the feasibility of solutions to problems). Instructional use of technology allows teachers to capitalize on the power of visualization and the connections between and among graphic, numeric and symbolic representations (such as when applying the properties of one-, two-, and three-dimensional geometric figures to represent, investigate, model, analyze, solve and evaluate solutions to problems).

Teaching mathematics as an investigative, exploratory subject requires the use of technology. Projects and group explorations that use technology may be added to instructional lessons to help students make connections among the different areas of mathematics as well as content from other disciplines. Technological research tools such as the Internet enable students to collect real-world, up-to-the-minute data, analyze the data, and then to share their findings and conclusions with others.

The student will:

- analyze a wide variety of patterns and functional relationships using the language of mathematics and appropriate technology (such as graphing calculators, spreadsheets and computer software).
- model and interpret real-world situations, using the language of mathematics and appropriate technology (such as graphing calculators, CBLs, spreadsheets and computer software).
- represent and analyze two- and three-dimensional figures using tools and technology (such as interactive software and graphing calculators).
- apply geometric properties and relationships to solve problems using tools and technology (such as interactive software and graphing calculators).
- apply concepts of measurement using tools and technology (such as interactive software and graphing calculators).
- demonstrate the ability to apply probability and statistical methods for representing and interpreting data and communicating results, using technology when needed (using graphing calculators, spreadsheets and computer software).

English Language Arts

English Language Arts (ELA) education has traditionally helped students master the listening, speaking, reading and writing skills requisite for success and active participation in community life. The 1986 English Language Arts Curricular Framework notes that ELA education provides "the means for universal basic literacy." In today's information-rich society, however, "universal basic literacy" needs redefinition in light of the rapid development of new information and communication technologies. From the use of conventional printed texts to electronic hypertext on the World Wide Web, from the simple graphics of posters and charts to the dynamic visual language of film, learners engage as creators and receivers of messages. Knowledgeable, reflective, critical and creative participants in contemporary life need to gain access to, respond to, and make strategic use of a whole spectrum of technology and media.

Each classroom should have sufficient technologies available for students to routinely use them for one of the following learning activities related to the English Language Arts Core Learning Goals and indicators:

- Composing and editing original texts (word processing).
- Researching (on-line services and CD ROM catalogues).
- Prewriting, drafting, revising, editing and publishing original texts (word processing with appropriate tools, such as spell checkers, dictionary/thesaurus and grammar check).
- Preparing and presenting multimedia presentations and oral texts.
- Locating, retrieving, evaluating and using information from various sources.
- Responding to print and non-print texts.

Second-language programs have many of the same goals. English to Speakers of Other Languages (ESOL) programs provide support and transitional services to linguistically-diverse students who need to improve listening, speaking, reading and writing in their new language, English, in order to succeed in the culture of American schools. ESOL programs translate to the above-listed English Language Arts Core Learning Goals. Similarly, foreign language programs for English-speaking students provide the means to develop insight into the nature of language and culture, to connect with other disciplines and to communicate in languages other than English. An important goal of all second-language education is to enable students to participate in multilingual communities at home and around the world. Communication technologies provide such access to the world and its languages.

Social Studies

Access to computers with Internet and multimedia capability in the classroom, as well as the library media center, provides students with appropriate current materials, including economic and geographic data, necessary to reach the critical thinking levels called for in the Expectations and Indicators of the Social Studies Core Learning Goals. Students can learn to research historical and current situations and events, as well as answers to questions or background on issues. They can also become aware of research methodologies that will assist them in study, work and other informational needs after graduation. These capabilities would also enhance students' participation in interactive on-line field trips and experiences, such as the Pride of Baltimore program, the

Whitbred Race and MayaQuest. Multimedia capability is important not only because it allows teachers to address a variety of learning styles, but also because it provides a vehicle for students, through development of projects and presentations, to demonstrate proficiency in Core Learning Goals and Skills for Success.

The student will:

- construct a historical argument based on research and interpretation.
- create and use visual and mathematical data presented in graphic organizers to gain comprehension in a field of social studies.
- draw upon visual, literary and musical sources to gain historical comprehension.
- use library media resources to access, organize and evaluate information and data from multiple perspectives and from multiple print and non-print sources, both primary and secondary.
- demonstrate ability to use Geographic Information Systems (GIS).
- analyze the influences of technology in the social studies.
- demonstrate the ability to create a multimedia presentation.
- use technology to create graphic representation of data.
- compose and edit original text (word processing).
- understand how to use technology for such civic activities as campaigning and lobbying.

Physical Education

Physical education is an applied science that requires students to use the processes and principles of science to conduct an ongoing experiment in which they are the subject. Technology devices such as heart rate monitors, body composition machines, blood pressure monitors, and spirometers which interface with computers provide objective biofeedback which allows students to evaluate the effects of physical activity on their own bodies. Computerized exercise equipment allows students to control the variables of time, distance and intensity to determine the effectiveness of their activity programs. Camcorders combined with appropriate software allow students to apply biomechanical principles to their own movement in analyzing and improving physical skills. Technology allows teachers to vary instruction to meet the different skill and fitness levels of students.

A computer with Internet access serves as a daily station in the gymnasium to allow students to:

- obtain and evaluate current physical activity, scientific and consumer information.
- utilize software to determine energy needs and design personal fitness plans.
- download personal biofeedback and biomechanical information into electronic portfolios.
- record, evaluate, monitor and plan improvements in personal goals, personal program plans and data displays of personal progress.

The student will:

- use biofeedback data to analyze the effects of a variety of physical activities and exercise plans on the systems of the body.
- apply the principles of exercise physiology to the development and continual revision of a personal fitness plan.
- use biomechanical and motor learning principles to analyze and refine personal performance of motor patterns and skills.
- interpret personal biofeedback and biomechanical data and use this information to solve problems and design activity programs to achieve personal goals.
- understand the concepts of aerobic and anaerobic activity.
- obtain, analyze and evaluate physical activity information, products and services.
- use technology to control the intensity and duration of physical activity to design tests to evaluate their current physiological status and progress.
- describe ways in which technology and medical advances can influence personal health.
- maintain an electronic journal/portfolio of motor learning progress, intrapersonal and interpersonal responses to physical activity and physiological changes resulting from physical activity.
- determine the caloric expenditure of various physical activity plans.
- use biofeedback data to critically self evaluate motor/fitness status and progress.

Health Education

Health literacy is the capacity to obtain, interpret and understand health information and services and the capacity to use that information in health- enhancing ways. A health-educated person is a critical thinker and problem solver, a self-directed learner and an effective communicator. Computers with Internet access should be incorporated into all health education lessons to provide students with access to current and ever-changing medical information and to allow students to ask specific questions of medical experts and utilize relevant software to analyze and evaluate personal health behaviors.

Students are continually asked to set personal goals and apply decision-making processes to real-life situations. Word processing programs, database and publishing programs allow students to maintain electronic journals, monitor progress toward personal goals, convey health information to others and gather and interpret health behavior data. Camcorders provide self analysis and immediate feedback opportunities as students practice important life skills such as communication, refusal skills, decision making and conflict resolution.

The student will:

- demonstrate the ability to evaluate resources from home, school and community and technological sources that provide valid information concerning health issues, services and careers.
- evaluate the validity of health information.
- demonstrate the ability to access school and community health services for self and others.
- evaluate the impact of technology, research and medical advances on personal, family and community health.
- evaluate the effectiveness of communication methods for expressing accurate health information.
- demonstrate the ability to analyze and adapt health messages and communication techniques to the characteristics of a particular audience.

Library Media

School library media programs are recognized as integral to student achievement because they provide all students and staff members with equal and timely access to ideas and information. Through an integrated instructional program, school library media specialists ensure that their students are effective users of ideas and information. The library media specialist also provides guidance to teachers in the application of technology and in the implementation of information literacy skills, using state and national standards as a basis. The newly-released national standards published jointly by The American Association of School Librarians and the Association for Educational Communications and Technology, *Information Power: Building Partnerships for Learning* and *Information Literacy Standards for Student Learning*, are nationally recognized as an excellent foundation for student learning in all curricular areas. Through the Maryland Learning Outcomes for Library Media Skills, the library media program helps student to make real-world connections through the application of information technologies, and to become information- literate, independent learners and socially responsible citizens.

In the Learning Outcomes for Library Media Skills, students will demonstrate the ability to:

- locate and use materials and equipment.
- review, evaluate and select media for an identified information need.
- learn and apply study, research, reference and critical thinking skills to organize information.
- comprehend content in various types of media.
- retrieve and manage information.
- appreciate all types of print and non-print media sources of information and recreation.
- create print and non-print media.

Fine Arts

Each of the fine arts disciplines (dance, music, theater and visual arts) is fundamental to human existence and pervades all aspects of life. The Essential Learner Outcomes for the Fine Arts, approved by the State Board of Education in October 1997, encompass several theoretical stances that contribute to the learner's understanding of arts content, processes and skills. The outcomes include a wealth of possibilities for making connections among the disciplines and the development of fine arts skills, creativity and aesthetic judgment within disciplines. These areas of focus are addressed within the context of a rich historical and cultural heritage. The outcomes encourage the exploration of contemporary technologies that significantly affect how the arts and humanities are produced and received and how they influence teaching, learning, perception and communication processes.

Fine arts classrooms should have sufficient technologies available for students and teachers to use them routinely for the following learning and assessment activities related to the Essential Learner Outcomes for the Fine Arts:

- gaining access to computer catalogs to find plays and other dramatic texts.
- getting on the Internet to study current reviews of artistic performances, playwrights, composers and artists.
- studying the images, artifacts and sounds included in major collections of world art.
- creating works of art.
- establishing process portfolios.
- documenting personal creative efforts over time.

Technologically-rich fine arts education environments enable instructors to make frequent use of the Internet, CD-roms, videotapes, laser discs and portable computers linked to video projectors. They provide exciting laboratory experiences for students, enabling them to:

- create, edit and preserve original works of art.
- experience world collections of artistic images, sounds and texts.
- explore an enormous range of career opportunities made possible through enlightened encounters that include creating, performing and responding to the arts.

Early Learning

Every pre-kindergarten to third-grade student has daily access in classroom and lab settings to state-of-the-art technology, including software, hardware, multimedia and communication tools. Young learners will be able to use technology to develop necessary social, cognitive and physical skills and construct meaning through the exploration and application of a variety of interactive materials. Through telecommunications, including e-mail and Internet, student learning extends to the world beyond the classroom. Young learners begin to make decisions about the quality and appropriateness of information provided through technology and how it may be used. The technology addresses multiple learning styles, accommodations and adaptations, and it supports a variety of learning strategies such as cooperative learning and student-directed learning.

Students will demonstrate abilities:

- in the basic operation and concepts for effectively using technology.
- to use technology tools such as word processing, database, spreadsheet, content-specific software, telecommunications and multimedia.
- to search for information and communicate long-distance.
- to read, write, edit text, solve math problems, apply scientific methods, learn about their environment and other cultures, and pursue the fine arts.
- to obtain and use information from a variety of teacher-guided and rapidly changing sources (e.g. e-mail, website).
- to work cooperatively with peers when using technology.
- to take care of technology and use it in a responsible way.

Career and Technology Education

Career and technology education (CTE) prepares students for further education, careers and lifelong learning through academic instruction, career development, technical skills development and work-based learning. Career and technology education instructional programs incorporate different forms of technology currently utilized in business and industry to ensure that students understand and evaluate the uses of current technologies for a variety of purposes and situations. The student will:

- identify and use resources and strategies for keeping abreast of advances in technologies.
- identify and describe current technologies used to meet a variety of needs, including obtaining and managing information, communicating, performing work and solving problems in a variety of situations.
- evaluate the uses of current technologies in specific situations.
- identify needs not being met by current technologies and emerging technological solutions that may meet those needs.
- use technologies safely, effectively, legally and ethically.
- use appropriate technologies to obtain, store, manage, ana-

lyze and convey information.

- use appropriate technologies for research, creativity and problem solving.
- monitor, evaluate and plan to improve personal uses of technologies.
- analyze and evaluate the effects of technologies on individuals, society and the environment.

Technology Education

Technology education is an integrated, experienced-based instructional program designed for citizens who are knowledgeable about technology — its evolution systems, techniques, utilization and social and cultural significance. It allows the application of mathematics and science concepts in technology systems. Students discover, create, and solve problems by using a variety of tools, machines, materials, processes and computer systems. The Maryland curricular framework for technology education identifies the technology-based outcomes for students enrolled in technology education to ensure that students will:

- demonstrate knowledge and skills regarding diverse technology systems, including their functioning and applications.
- demonstrate knowledge of the nature of technology, and the relationships and impacts among technological achievement, the environment, the advancement of science, the individual, and society. The contexts for this knowledge shall be historical, current and futuristic.
- demonstrate the ability to solve problems with technology using a systems approach, higher-order thinking skills, individual and collaborative ingenuity, and a variety of resources including information, tools and materials.
- make ethical decisions about technological issues, including the development and use of technology and technology resources.
- demonstrate in an experiential setting the safe, effective and creative use of technology resources — including tools, machines and materials — in carrying out technological processes.
- apply science, mathematics, language arts, social studies and technological concepts to solve practical problems and extend human capabilities.
- apply knowledge of — and perform tasks representative of — technology-based careers, including engineers, technologists, technicians and craftspersons.
- recognize the multicultural and gender diversity included in past, present and future uses of technology.

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