ISTE Policy Brief

Technology and Teacher Quality—

The Indelible Link

iste advocacy

Table of Contents

Letter from the ISTE CEO 2

Executive Summary 3

Introduction 5

Current Research on Educational Technology
in Promoting Teacher Quality and Effectiveness 5

Successful Implementation using Technology 8

The Effects of Access and Equity on the Use of
Technology to Promote Teacher Quality and Effectiveness 9

How Teacher Quality and Effectiveness
Fit into the Larger Picture of Global Competitiveness 10

Policy Recommendations 10
- National
- State and Local

References 12

June 2009

Dear Colleague:

On behalf of the International Society for Technology in Education (ISTE®), I am pleased to release the second in a series of policy briefs focusing on the role of technology and learning. This brief entitled, Technology and Teacher Quality-The Indelible Link, will be a useful tool for ISTE members and other education technology supporters as we collectively advocate to ensure teachers have the technology and information skills and tools necessary for success in the 21st century.

ISTE members have monitored research on the effectiveness of education technology on student outcomes for well over twenty years, and one convincing trend has emerged: when implemented appropriately, the integration of technology into instruction has a strong positive impact on student achievement.

We encourage readers to use this document as a tool for their advocacy efforts. Feel free to excerpt the Executive Summary, the research findings or share the entire report with policymakers and education leaders at the national, state and local levels.

ISTE thanks Robert Kadel who was commissioned by ISTE as the lead researcher/writer of this policy brief. ISTE appreciates all of the time and energy dedicated by the members of ISTE's Public Policy and Advocacy Committee as well as ISTE staff Mark Andrews, Talbot Bielefeldt and Hilary Goldmann. A special thank you to COMPUTER EXPLORERS for their generous support of this policy brief. For more information about ISTE's public policy and advocacy efforts and about this policy brief contact Hilary Goldmann, ISTE's Director of Government Affairs at hgoldmann@iste.org or 202.861.7777.

Sincerely,

Don Knezek, Ph.D., CAE
Chief Executive Officer

Executive Summary

- **Teacher quality goes beyond the NCLB definition.** NCLB defines teachers as "highly qualified" when they have: a) a bachelor's degree; b) full state certification or licensure; and c) proof that they know each subject they teach. While these are important credentials for a good teacher, high-quality teachers are able also to assist students in meeting the societal challenges they face. They furthermore foster an environment for learning 21st century skills, those skills that will be required of graduating students as they enter the work force, college, or military or community service.
- **Professional development should be designed to meet the needs and learning styles of teachers.** Adult learning theory tells us that teachers learn best when they are provided hands-on learning opportunities, ongoing feedback, and when they have a personal interest in the material, which in this case, is improving instruction and thereby student learning through the use of technology.
    - **Modeling.** Researchers have repeatedly demonstrated that modeling effective technology use in the classroom makes professional development successful.
    - **Online learning.** Because practitioners have a number of (often overlapping) demands on their time and resources, we must look to the growing potential of online learning as a means of providing professional development. Online learning in professional development transcends the traditional face-to-face lecture or lab practice because it: is both asynchronous and synchronous; draws upon a variety of digital media; allows for individualization; promotes the spread of ideas across teaching cultures; and disseminates information to the group practically instantaneously.
- **Professional development—from preservice to inservice.** Current research explains that to effectively integrate technology into instruction, topics and strategies must be applied consistently from college training into and through the training that instructors receive on the job. Research reviews of PT3 grants show that skill acquisition, by itself, was insufficient for full technology integration. Modeling of effective use, particularly by college faculty and professional development trainers, demonstrates to students/participants both the value of educational technology in education and the application of such technology across a variety of content areas.
- **Communities of practice.** Research also illuminates the need for collegial networks, or communities of practice, wherein practitioners communicate, collaborate, and solve problems over time and in much the same way as they expect their students to learn 21st century skills.
- **School and district leadership.** Leaders at both the school and district levels must embrace the integration of technology not just as a means to an end in the classrooms, but also as a ubiquitous tool in student, school, and district management. Thereby, administrators also model the effective use of technology for their staffs and students.
- **Professional engagement encourages technology integration.** Studies show that teachers who participate in conferences, collaborate with other teachers on technology use, and collectively demonstrate effective use of technology to their students have a strong impact on their students' propensity to adopt similar skills and behavior, leading to higher levels of academic achievement and the development of 21st century skills.
- **The digital divide remains.** Research has shown that minority students, those from poorer neighborhoods, and students who live in either inner-city or rural areas (but not suburban) tend to have less access to computers, the Internet, and educational software.
- **National policy recommendations:**
    - ISTE recommends that in the reauthorization of ESEA, the definition of "highly qualified" be amended to reflect the skills that teachers must have to meet the challenges facing students now and in the future.
    - ISTE further recommends that national policy, including Titles II-A and II-D of ESEA, must be focused on providing the funding and resources necessary for professional development in educational technology that meet standards for 21st century skills, modern information tools, and the use of digital content. Funding for Enhancing Education Through Technology (EETT, part of Title II-D) must be restored to its original levels as passed in 2001.

- Congress must pass the Achievement Through Technology and Innovation Act (ATTAIN) Act as part of the next iteration of our nation's K–12 laws. ATTAIN is designed to provide funds to meet the challenges faced by all schools and among those schools most in need. ATTAIN calls for new funding for hardware and software in schools and the continued professional development of teachers in integrating such technology into instruction. Proposed distributions of ATTAIN funding at the state level will provide greater funds for professional development and for formula grants, supplying additional funds to schools in low-income areas regardless of their staffs' abilities to write competitive grant proposals.
- Additionally, ISTE recommends that ESEA establish a new program, entitled "The Data Management Program to Impact Student Learning at the Classroom Level." This program would empower district administrators, principals, teachers, and other school personnel with the data, assessment, intervention, and differentiated learning strategies to tailor teaching to the individual needs of each student to ensure that all students achieve high standards.
- ISTE strongly supports the Preparing Teachers for Digital Age Learners program under Title II of the Higher Education Act. ISTE recommends that this program be funded at robust levels to ensure our nation's future teachers have the skills and know how to effectively teach in a 21st century classroom and appropriately model 21st century teaching and learning.

- **State and local policy recommendations:**
  - ISTE recommends that states expand the diversification of funding streams for educational technology. All states must have a dedicated funding stream that is tied to sustained high-quality professional development and that meets the essential conditions for teacher quality. For those states that already have dedicated funding streams for this purpose, they must ensure that the funds are adequately targeted for professional development in educational technology and possibly that those funds even be expanded.
  - ISTE recommends that administrators at the local level ensure that technology investments and professional development align to curriculum standards. Data driven decision-making—among administrators and teachers—is key in this process. Useful data on student achievement can identify those gaps where students are not meeting curriculum standards. By identifying teachers' needs for classroom and building technologies, administrators can ensure that funding is targeted where it will be most efficient and effective.
  - State licensing/certification programs should require potential teachers to demonstrate their knowledge of and abilities with certain "core" technologies as well as any technology standards that would be specific to the content area in which the teacher is becoming certified. ISTE's NETS for Teachers provide a firm foundation on which to build such certification programs.
    - As of 2003[1], 33 state educational agencies (including the District of Columbia) have either adopted the NETS·T or adapted or aligned their existing technology standards to NETS·T. ISTE recommends that all states follow suit to provide quality and consistency in educational technology professional development nationwide.
  - ISTE recommends that educational leaders "ensure that curricular design, instructional strategies, and learning environments integrate appropriate technologies to maximize learning and teaching." Additionally, the ISTE NETS·A call on local leadership to "integrate strategic plans, technology plans, and other improvement plans and policies to align efforts and leverage resources."

[1] This is the most recent year for which data are available.

Introduction

What does it mean to be a "highly qualified teacher"? The Elementary and Secondary Education Act of 2001 (ESEA, a.k.a. No Child Left Behind)[2] defines teachers as "highly qualified" when they have: a) a bachelor's degree; b) full state certification or licensure; and c) proof that they know each subject they teach (usually by merit of their college major, courses equivalent to a college major, or through state-developed tests). However, there is more to defining teacher quality than meeting these three requirements.

We must consider that the definition of highly qualified teachers changes as new challenges arise and are met: teachers are required to teach content, yes, but also to assist students in meeting the societal challenges they face and to adopt the skills that will be required of graduating students as they enter the work force, college, or military or community service. In addition to the nuts-and-bolts skills we often think of in these terms, such as being able to use a computer, word processing software, and email, such 21st century skills should be thought of more ubiquitously as the abilities to "communicate, collaborate, analyze, create, innovate and solve problems" (*Maximizing the Impact* 2007, p.3). Teachers who can meet these expectations exemplify what it means to be "highly qualified."

Teachers and educational technology both play vital roles in this process and in the ability to adapt to the changing needs of our educational system and economy throughout the years. ISTE's National Educational Technology Standards for Teachers (NETS·T) state that highly qualified teachers should be able to:

- Facilitate and inspire student learning and creativity
- Design and develop digital-age learning experiences and assessments
- Model digital-age work and learning
- Promote and model digital citizenship and responsibility
- Engage in professional growth and leadership

While these standards relate specifically to educational technology, they align with the needs of all students and schools in the 21st century. (Furthermore, by meeting updated standards for teacher quality and by enhancing 21st century skills, we ensure greater achievement for students both within school and beyond.)

The research that follows shows how the professional development of teachers can be attuned to these necessities and how technology plays an integral role in the process. This research is followed by brief discussions of how access and equity in the distribution of resources and professional development affect teacher quality; how teacher quality and technology fit within the larger picture of global competitiveness; and finally, recommendations for making teacher quality a central focus of educational technology policy.

Current Research on Educational Technology in Promoting Teacher Quality and Effectiveness

Adult learning theory tells us that adults—and in this specific case, teachers—learn best when they are provided hands-on learning opportunities, ongoing feedback, and when they have a personal interest in the material, in this case, improving instruction and thereby student learning. Research has shown that three areas of teacher professional development bear the weight of providing such experiences. First, the most beneficial preservice teacher education programs have been those that provide not only skill acquisition, but also instructional modeling, field experience, and peer collaboration. Second, research on successful inservice professional development shows the value of modeling effective instructional practices as well as "communities of practice," wherein educators collaborate on the seamless and consistent use of instructional innovations. Third, school leadership has a strong impact on teacher quality by, again, modeling effective use as well as ensuring a commitment that what is taught in professional development sessions is then implemented in the classroom. Finally, current research makes a strong case for the use of online learning both as a means of delivering professional development and also as the topic of

[2] ESEA was originally passed in 1965, and Congress reauthorizes it every five years. NCLB is the moniker given to the reauthorization of ESEA as passed in 2001.

the professional development (i.e., how to engage students in online learning). **One theme that runs throughout the studies reviewed here is that long-term, consistent professional development is required for the successful implementation of any innovation over time**.

A Foundation in Adult Learning Theory

Speck (2005), Lockwood (1999), and Byrom (1998) have applied adult learning theory to teacher professional development. The authors have encouraged research-based practices in helping teachers acquire innovative instructional skills. Adults learn best when training programs and educational experiences are:

- Personally interesting to them
- Hands-on and collaborative in nature
- Grounded in knowledge they already have (thus taking advantage of individuals' existing knowledge, rather than making them feel inadequate for what they do not know)
- Explicitly tied to outcomes (e.g., an innovation's impact on student learning)

Preservice Technology Training Aligned to Inservice Expectations

Bearing these components in mind, one must consider first the role of higher education and pre-service teacher programs in preparing teachers to use educational technology. Bielefeldt (2001) describes the most successful teacher preparation programs as those that "balance facilities, faculty professional development, coursework, and field experience" (p.10). Similarly, Schrum (1999) stated that pre-service teachers needed to be exposed to: skills-based technology courses; the integration of technology in instructional methods courses; and field placements (internships, student teaching, etc.) that place an emphasis on teaching with technology.

A great deal of research information on this topic has come from grants in the Preparing Tomorrow's Teachers to Use Technology (PT3) program, funded by the U.S. Department of Education from 1999 to 2004. Mims et al. (2006) analyzed the reports, articles, and conference presentations from 33 PT3 grants to determine how they influenced preservice teacher education programs. The authors point to the importance, again, of modeling effective use of technology in instruction, as well as enhancing faculty efficacy with technology. Skill acquisition, by itself, was insufficient for full technology integration. Hall et al. (2006) also found that PT3 grants that focused some resources on the professional development of college or university faculty in using technology in their instruction had an impact on the use of educational technology by their preservice students when the students became teachers. (See also Willis and Raines, 2001.)

Modeling of Technology Use by Trainers and Experienced Teachers

Slavit et al. (2003) studied the practices of several teachers who used the Plan for Learning And Teaching with Educational technology (PLATE) professional development program. PLATE stressed the importance of Faculty Development Leaders—other teachers who had already been incorporating technology into instruction—in modeling effective technology use for teachers learning through the PLATE program. Other researchers have drawn the same conclusion: **guidance, modeling, and leadership are essential in the effective integration of technology into education** (Zhao et al., 2001; Abbot and Faris, 2000).[Hilary, the reference for Zhao says 2002, not sure which year is correct-Kate]

Communities of Practice

Furthermore, professional development in the use of technology for teaching should be ongoing and consistent (as opposed to a "shotgun" approach). To have a lasting effect on technology integration, schools require communities of teachers acting to encourage and model effective technology use. Hartnell-Young (2006) and Lieberman (1995) both discussed how a collegial network or "community of practice" is necessary for long-term successful implementation of teaching innovations. Becker and Ravitz (2001) and Ronnkvist et al. (2000) studied survey responses from 4,100 teachers in 1,100 U.S. schools about their uses of educational technology and how effective professional development leads to greater and more successful student computer use. Becker and Ravitz

state, "teachers who are most broadly engaged with their teacher peers in collaborative and leadership roles, and who thus influence their peers more than most, are much more likely than the average teacher to have their students exploit computer resources during class" (p.2).

Professional Engagement

Teachers should incorporate technology use into their out-of-school activities as a means of building confidence in technology use in school. Becker's (1999) study of teacher surveys indicated that teachers with computers and Internet access at home were twice as likely to use the Internet as teachers who had Internet access at school but not at home. Becker and Riel (2000) found that teachers who are "professionally engaged," that is, participate in conferences and collaborate with other teachers on technology use, also demonstrate effective use of technology for project-based learning and student collaboration. Teacher confidence with and interest in technology can be encouraged and enhanced by participation in technology use outside of the school building. Home computer use is a significantly positive predictor of confidence in using computers for classroom instruction. Furthermore, participation in conferences and out-of-school meetings related to the use of educational technology provides knowledge of the latest instructional technologies and networking opportunities with other teachers and instructional technologists (Becker and Riel 2000, Becker 1999). It is unclear whether this is a causal relationship or whether the two are merely correlated. However, it underscores the idea that teachers who interweave their professional technology use with their personal technology use tend to have greater and more effective use of technology in the classroom.

School and District Leadership in (and Modeling of) Technology Use

Hartnell-Young's (2006) article also points to the support necessary for making communities of practice work in incorporating technology—school leadership as well as infrastructure and funding provided through school and state organizations. School and district leaders must show a commitment to teaching with technology, being realistic in the resources necessary to effectively implement technology and reinforcing that what is learned in professional development sessions is incorporated into the classroom.

Additionally, school leadership is required to demonstrate and encourage regular technology use by making it an established component of school management and communication. For example, Cradler (2002, see also CEO Forum 1999), reports that by using email to communicate with staff—particularly in large buildings—school administrators can make more efficient use of time spent in staff meetings and promoting communication from vast and varied teacher populations. Practitioners are also making use of Web 2.0 communication tools, such as blogs, wikis, and social networking sites to share ideas, content, and discussion both synchronously and asynchronously.

The Case for Online Learning

With restrictions to time and content access—that is, traditional professional development requires that participants be in seats in a room to learn the content—one area of technology professional development requires special attention: online learning. It plays a dual role in the professional development process: online learning is both the delivery mechanism of professional development and is the topic being learned in professional development to then be integrated into education. Online learning is both a *type* of professional development and *topic* of it.

Ferdi Serim, ISTE At-Large Board Representative, states that the potential of the Internet has not been the technology itself, but the opportunities that technology provides for creating vast communication networks of students, teachers, and professionals (Serim 2008a, 2008b). Serim's description is akin to what is termed "Web 2.0," the creation of Web content by multiple participants all striving to achieve ubiquity in their work (and play) and to learn from what others contribute. Wikis, blogs, online discussions, social networking sites, curriculum management sites, and video sites that allow users to respond to content either via text or their own videos—these are just a few examples of the potential of online learning for sharing content and instructional strategy. It is, one might say, the collective consciousness of a group being formed out of digital media and discussion and made available only to the group, to the entirety of the public, or somewhere in between. Online learning in professional development and in

instruction transcends the traditional face-to-face lecture, lab, or discussion because, among other advantages, it is both asynchronous and synchronous, draws upon a variety of digital media, and disseminates information to the group practically instantaneously.

Granted, online learning may not be the *best* option for every student; but it should be an option nonetheless. This presents us with a major challenge in professional development: the educational community at large does not require teachers to be able to do what it expects of students, namely, to use computers and the Internet for learning. We should expect all teachers to have taken, designed, and taught at least one online class, and the responsibility for this falls on the shoulders of higher education pre-service programs as well as in-service professional development (Serim 2008b).

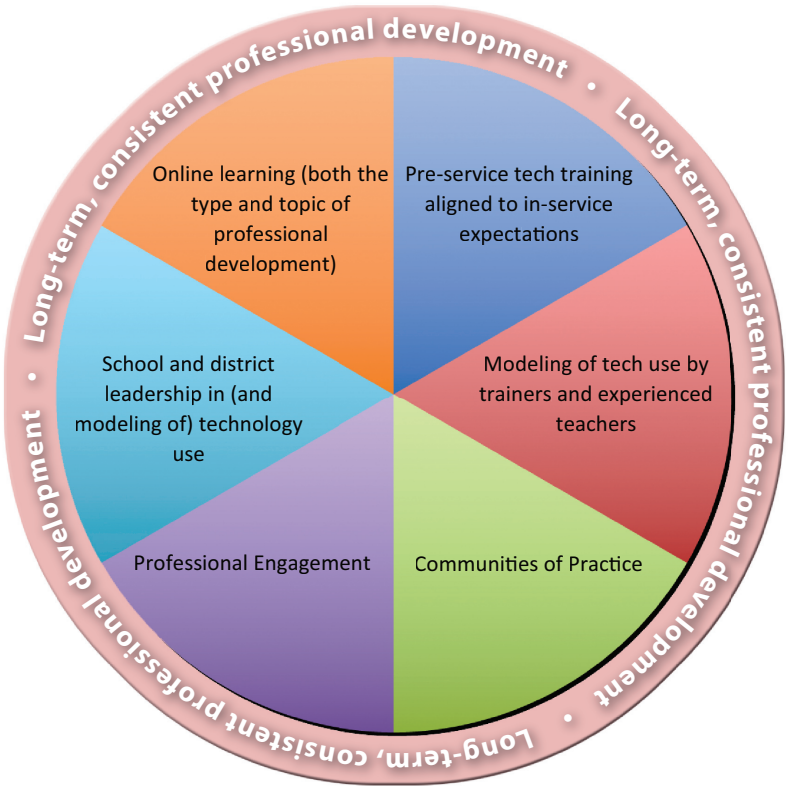
Successful Implementation using Technology

One of the most oft-cited restrictions to effective professional development (of any kind) is practitioners' lack of available time (see, e.g., Abdal-Haqq 1996). As discussed earlier, teacher quality and effectiveness is most enhanced when technology professional development takes place over time with consistent follow-up both in the classroom and in future professional development sessions. Similarly, practitioners require consistent opportunities to apply what they have learned, attend additional workshops, to seek out technical assistance when needed, etc. (Honey and McMillan 1996, Cradler and Cradler 1995).

Any professional development program must be long-term and consistent to make a lasting impression upon practitioners and in schools. Bearing that in mind, successful implementation rests on the following six components, each of which is an integral part of the whole:

- Preservice technology training aligned to inservice expectations
- Modeling of technology use by trainers and experienced teachers
- Communities of Practice
- Professional Engagement
- School and district leadership in (and modeling of) technology use
- Online learning (both the type and topic of professional development)

Components of Professional Development for Effective Technology Use



The Effects of Access and Equity on the Use of Technology to Promote Teacher Quality and Effectiveness

Becker and Riel (2000) used survey data from teachers from across the U.S. to determine patterns and differences in technology professional development. They discovered, first of all, levels of professional engagement (e.g., collaborating with peers, attending conferences) are higher among schools in high socio-economic areas, particularly because such schools are more able to provide the technological resources necessary for such engagement. Furthermore, they discovered that teachers in schools in lower socio-economic areas were more likely to use their technological resources for routine skills practice and independent work, as opposed to the collaborative and project-based learning that takes place in schools in higher socio-economic areas. Foss (2002) confirms these findings with regard to the use of WebQuests, projects, and tasks that enhance critical thinking skills.

Similar to the Digital Divide faced by inner city and rural schools in providing technology access to students, teachers in these areas also have less access to technology resources than their counterparts in suburban, middle- and high-income areas. (See *A Nation Online: Entering the Broadband Age* [2003] and *Falling Through the Net: Defining the Digital Divide* [2000].) Inservice teacher training relies on school and district resources—not just funding, but access to training facilities, computers labs, and instructors well versed in the integration of technology into instruction. Because school district funds rely heavily on local property taxes for revenue, those districts that have low property values usually have fewer funds available for effective professional development.

Finally, ISTE's 2007 report, *A National Consideration of Digital Equity* (Davis et al. 2007), discusses four specific challenges that are central to the digital divide:

- Technology is not valued as an instructional tool Educators are receiving inadequate professional development
- There remains a significant number of students with limited access to technology outside of school
- Obtaining funding for technology continues to be difficult (pp. 2–4)

The report details five strategies for schools and districts to address these challenges:

- Legitimize the significant role culture plays in students' educational experience
- Continue to challenge perceptions about the role of technology in education
- Encourage others to recognize the critical link between technology professional development and classroom practice
- Create opportunities for students to access technology outside of the classroom
- Continue to seek funding for technology in spite of challenges (pp. 11–13)

ISTE invites the reader to review this report in more detail as part of the discussion of equitable technology access as a requirement for effective professional development.

How Teacher Quality and Effectiveness Fit into the Larger Picture of Global Competitiveness

The 2007 report *Maximizing the Impact: The Pivotal Role of Technology in a 21st Century Education System*, co-published by ISTE, SETDA, and the Partnership for 21st Century Skills, addresses the impact of the integration of educational technology into instruction on those skills American students will need to compete in the global economic market. Such skills include the abilities to "communicate, collaborate, analyze, create, innovate and solve problems" (p.3). These activities are now only rarely addressed in a pencil-and-paper format in the public, private, and non-profit sectors; yet schools that do not incorporate technology into instruction hinder students from learning and applying the tools that will be required of them beyond school.

Teachers play a critical role in this process. Just as the modeling of effective technology use positively affects teachers' integration of technology, teachers' modeling and incorporation of technology plays a direct role in providing those skills to students (Maximizing the Impact, 2007).

Policy Recommendations

Based upon the research and considerations discussed above, ISTE makes the following recommendations regarding policy at the national, state, and local levels.

National Policy

ISTE recommends that in the reauthorization of ESEA, the definition of "highly qualified" be amended to reflect the skills that teachers must have to meet the challenges facing students now and in the future. ISTE members strongly believe that for students to achieve in the 21st century all teachers must have the skills to use modern information tools and digital content to support student learning in content areas and for assessment and learning management.

ISTE further recommends that national policy, including Titles II-A and II-D of ESEA, must be focused on providing the funding and resources necessary for professional development in educational technology that meet standards for 21st century skills, modern information tools, and the use of digital content. Funding for Enhancing Education Through Technology (EETT, part of Title II-D) must be restored to its original levels as passed in 2001.[3]

[3] EETT's appropriation levels have dropped from $700 million in 2002 to $272 million in 2007, having been cut substantially each successive year of the program. Source: http://www.ed.gov/programs/edtech/funding.html

Further, the Achievement Through Technology and Innovation Act (ATTAIN), the successor to Enhancing Education Through Technology, is designed to provide funds to meet the challenges faced by all schools and among those schools most in need. ATTAIN calls for the continued professional development of teachers in integrating technology into instruction. Proposed distributions of ATTAIN funding at the state level will provide greater funds for professional development and for formula grants, supplying additional funds to schools in low-income areas regardless of their staffs' abilities to write competitive grant proposals. Congress must pass the ATTAIN Act as part of the next iteration of our nation's K–12 laws. ATTAIN will build on the success of the Enhancing Education Through Technology program and, if fully funded, will propel our nation's schools to 21st century learning environments.

Additionally, ISTE recommends that ESEA establish a new program focusing on Data Management to Impact Student Learning at the Classroom Level. Such a program would empower district administrators, principals, teachers, and other school personnel with the data, assessment, and intervention and differentiated learning strategies to tailor teaching to the individual needs of each student to ensure that all students achieve high standards.

Regarding pre-service teacher education programs, ISTE strongly supports the Preparing Teachers for Digital Age Learners (PTDAL) program under Title II of the Higher Education Act. ISTE recommends that this program be funded at robust levels to ensure our nation's future teachers have the skills and know how to effectively teach in a 21st century classroom and appropriately model 21st century teaching and learning. Specifically the PTDAL program focuses on effective teaching with modern digital tools and content that substantially connect preservice preparation of teacher candidates with high-needs schools or transform the way schools of education teach classroom technology integration to teacher candidates. ISTE and the National Council for Accreditation of Teacher Education (NCATE) have developed a set of performance assessment standards for initial and advanced endorsements in the areas of Technology Facilitation and Technology Leadership. The ISTE/NCATE standards provide the foundations for achieving success with this policy.

State and Local Policy

ATTAIN calls for "meaningful professional development around technology that leads to changes in teaching and curriculum, and which improves student academic achievement and technology literacy." State funds or the allocation of federal funds should be made available for this purpose. ATTAIN calls for 40% of formula grants to be used for professional development, up from 25% under EETT.

Additionally, ISTE recommends that states expand the diversification of funding streams for educational technology. The Education Counts Research Center, provided by Education Week (http://www.edweek.org), shows that states have a range of options for funding educational technology (e.g., earmarked taxes or lotteries, bond sales, partnering with private foundations to finance educational technology). All states must have a dedicated funding stream that is tied to sustained, high-quality professional development and that meets the essential conditions for teacher quality. For those states that already have dedicated funding streams for this purpose, they must ensure that the funds are adequately targeted for professional development in educational technology and possibly that those funds be expanded.

State licensing/certification programs should require potential teachers to demonstrate their knowledge of and abilities with certain "core" technologies as well as any technology standards that would be specific to the content area in which the teacher is becoming certified. The ISTE NETS for Teachers provide a firm foundation on which to build such certification programs (see http://cnets.iste.org/teachers). As of 2003, 33 state educational agencies (including the District of Columbia) have either adopted the NETS·T or adapted or aligned their existing technology standards to NETS·T. ISTE recommends that all states follow suit to provide quality and consistency in educational technology professional development nationwide.

Finally, in the NETS for Administrators, ISTE recommends that educational leaders "ensure that curricular design, instructional strategies, and learning environments integrate appropriate technologies to maximize learning and teaching." Additionally, the ISTE NETS·A call on local leadership to "integrate strategic plans, technology plans, and other improvement plans and policies to align efforts and leverage resources" (See http://cnets.iste.org/administrators.). Furthermore, the research discussed above demonstrates the crucial role that school leaders play in supporting, modeling, and reinforcing those technology-based strategies that teachers learn through professional development.

References

Abbott, J. A., & Faris, S. E. (2000). Integrating technology into pre-service literacy instruction: A survey of elementary education students' attitudes toward computers. *Journal of Research on Computing in Education*, *33*(2), 149-161

Abdal-Haqq, I. (1996). *Making time for teacher professional development*. ERIC Digest. (ERIC # ED400259).

A nation online: Entering the broadband age. (2003). Washington, DC: National Telecommunications and Information Administration.

Becker, H. J. (1999). Internet use by teachers (Report No. 1). Irvine, CA: Teaching, Learning, & Computing. Research funded by the program of Research on Education Policy and Practice at the National Science Foundation and the Office of Educational Research and Improvement, U.S. Department of Education. NSF Grant # REC-9600614. Retrieved March 2008 from **http://www.crito.uci.edu/tlc/html/findings.html.**

Becker, H.J. & J.L. Ravitz. (2001). Computer Use by Teachers: Are Cuban's predictions correct? Paper presented at the Annual Meeting of the American Educational Research Association, Seattle, WA.

Becker, H. J., & Riel, M. M. (2000). Teacher professional engagement and constructive-compatible computer usage. Research funded by the program of Research on Education Policy and Practice at the National Science Foundation and the Office of Educational Research and Improvement, U.S. Department of Education. NSF Grant # REC-9600614. Retrieved March 2008 from **http://www.crito.uci.edu/tlc/html/findings.html.**

Bielefeldt, T. (2001). Technology in teacher education. *Journal of Computing in Teacher Education*, *14*, 4-15.

Byrom, E. (1998). *Factors influencing the effective use of technology for teaching and learning: Lessons learned from the SEIR-TEC intensive site schools*. Greensboro, NC: SERVE. Retrieved April 2008 from **http://www.serve.org/seir-tec/publications/lessons.html.**

The CEO Forum on Education and Technology, (1999). Professional development: A link to better learning. *The CEO Forum School Technology and Readiness Report.* Retrieved March 2008 from **http://www.ceoforum.org.**

Cradler, R. (2002). *Netschools Evaluation*. San Mateo, CA: Educational Support Systems.

Cradler, J., & Cradler, R. (1995). *Prior studies for technology insertion*. San Francisco: Far West Laboratory.

Davis, T., Fuller, M., Jackson, S., Pittman, J., & Sweet, J. (2007). *A national consideration of digital equity*. Washington, D.C.: International Society for Technology in Education. (**http://www.iste.org/digitalequity**).

Falling through the net: Defining the digital divide. (2002). Washington, DC: National Telecommunications and Information Administration.

Foss, J. (2002). The 'digital divide' goes to school. *Children's Advocate*, December, 5.

Hall, L.D., C. Fisher, S. Musanti, & D. Halquist. Professional development in teacher education: What can we learn from PT3? *TechTrends*, 50, 25-31.

Hartnell-Young, E. (2006). Teachers' roles and professional learning in communities of practice supported by technology in schools. *Journal of Technology and Teacher Education*, *14*, 461-80.

Honey, M., & McMillan, K. (1996). Case studies of K-12 educators' use of the Internet: Exploring the relationship between metaphor and practice. *Center for Children & Technology CCT Reports Issue No. 5*. Retrieved March 2008 from **http://www2.edc.org/CCT/index.asp.**

Lieberman, A. (1995). Practices that support teacher development. *Phi Delta Kappan*, *76*, 591-96.

Lockwood, A. T. (1999). *The promise and potential of professional development*. Unpublished manuscript.

Marzano, R. (2006) *Classroom assessment & grading that work*. Alexandria, VA: Association for Supervision and Curriculum Development.

Maximizing the impact: The pivotal role of technology in a 21st century education system. (2007). Eugene, OR: International Society for Technology in Education; Glen Burnie, MD: State Educational Technology Directors Association; Tucson, AZ: Partnership for 21st Century Skills.

Mims, C., D. Polly, C. Shepherd, & F. Inan. (2006). Examining PT3 projects designed to improve preservice education." *TechTrends*, *50*, 5-24.

Ronnkvist, A., S.L. Dexter, & R.E. Anderson. Technology support: Its depth, breadth and impact in America's schools. Research funded by the program of Research on Education Policy and Practice at the National Science Foundation and the Office of Educational Research and Improvement, U.S. Department of Education. NSF Grant # REC-9600614. Retrieved March 2008 from **http://www.crito.uci.edu/tlc/html/findings.html.**

Serim, F. (2008a), forthcoming). *Visible thinking: Strengthening and assessing digital age learning*. Eugene, OR: International Society for Technology in Education.

Slavit, D., R. Sawyer, & J. Curley. (2003). "Filling your PLATE: A professional development model for teaching with technology." *TechTrends*, *47*, 35-38.

Speck, M. (2005). *Why can't we get it right?: Designing high-quality professional development for standards-based schools*. Thousand Oaks, CA: Corwin Press.

Willis, E. M., & Raines, P. (2001). "Technology in secondary teacher education." *T.H.E. Journal (Technological Horizons In Education)*, *29*(2), 54.

Zhao, Y., Pugh, K., Sheldon, S., & Byers, J. (2002). Conditions for classroom technology innovations. *Teachers College Record*, *104*(3) 482-515.

About ISTE

The International Society for Technology in Education (ISTE) is the trusted source for professional development, knowledge generation, advocacy, and leadership for innovation. ISTE is the premier membership association for educators and education leaders engaged in improving teaching and learning by advancing the effective use of technology in PK–12 and teacher education. Home of the National Educational Technology Standards (NETS) and the National Educational Computing Conference (NECC). ISTE represents more than 100,000 professionals worldwide. We support our members with information, networking opportunities, and guidance as they face the challenge of transforming education.

Visit www.iste.org to learn more about ISTE and its new initiatives —including the next generation of NETS for Students, Teachers, and Administrators.

iste advocacy

Washington, DC—Headquarters
1710 Rhode Island Ave., NW, Suite 900
Washington, DC 20036-3132
1.866.654.4777 (U.S. & Canada)
1.202.861.7777 (Int'l)
Fax 1.202.861.0888

Eugene, OR—Operations
180 West 8th Ave., Suite 300
Eugene, OR 97401-2916
1.800.336.5191 (U.S. & Canada)
1.541.302.3777 (Int'l)
Fax 1.541.302.3778

This policy brief is made possible through the support of COMPUTER EXPLORERS®