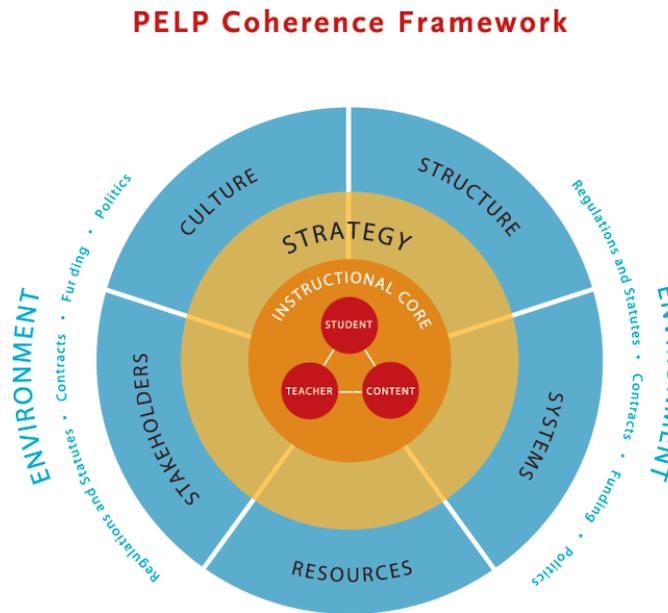


Characteristics of Highly Effective Technology Teaching and Learning in Kentucky Schools

Introduction

This document is an effort to describe the roles of the teacher and student in an exemplary technology instructional environment. The focus of the document is on the “instructional core” at the center of the educational process as described in detail in the *Public Education Leadership Program (PELP)* www.hbs.edu/pelp. Future documents will address the “outer ring” factors that are present in technology classrooms in high achieving schools and districts – essential resources for technology programs, stakeholder involvement, the learning culture, structures and system components, including sustained high quality professional learning opportunities for teachers who are at the core of the instructional process.



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Note: The following documents are not cited in the table below as they are the original sources that serve as the basis for all of the characteristics listed:

- American Association of School Librarians and Association for Education Communications and Technology. (1998). *Information Literacy Standards for Student Learning: Standards and Indicators*.
- International Society for Technology in Education (ISTE). (2008). *National Educational Technology Standards (NETS-T) and Performance Indicators for Teachers*. Washington, DC: ISTE.
- International Society for Technology in Education (ISTE). (2007). *National Educational Technology Standards (NETS-S) and Performance Indicators for Students*. Washington, DC: ISTE.
- International Technology Education Association (ITEA). (2007). *Standards for Technological Literacy: Content for the Study of Technology*. Third Edition. Reston, VA: ITEA.
- International Technology Education Association (ITEA). (2003). *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards*. Reston, VA: ITEA.
- International Technology Education Association (ITEA) (2005). *Developing Professionals: Preparing Technology Teachers*. Reston, VA: ITEA.
- Partnership for 21st Century Skills (2008). *21st Century Skills, Education & Competitiveness: A Resource and Policy Guide*. Tucson, AZ: Author.

In addition, the following state documents provide the framework and guidance for technology education in Kentucky:

- Kentucky Department of Education (2006). *Program of Studies for Technology*. Frankfort, KY: Author.
- Kentucky Professional Standards Board (2008). *Kentucky Teacher Standards*. Frankfort, KY: Author.

1. Learning Climate	Connections to Standards, Research, and Expert Opinion
<p><u>Teacher Characteristics</u></p> <p>A. Teacher creates learning environments where students are active participants as individuals and as members of collaborative groups.</p> <ol style="list-style-type: none"> 1) Uses digital tools to facilitate collaborative learning. 2) Designs online spaces and opportunities for students to collaborate online with others within/outside the classroom. 	<p>Teacher: A1, A2, D1; Student: B1, C1: Bracewell, R., Breuleux, A., Laferriere, T., Benoit, J., & Abdous, M. (1998). <i>The emerging contribution of online resources and tools to classroom learning and teaching</i>. Montreal: Universite Laval.</p> <ul style="list-style-type: none"> • Section 4.1.2: “There is...a wealth of descriptive evidence on the beneficial effects of online collaboration with other students and with experts and other resources beyond the classroom...” • Section 4.1.3: “One of the most consistent outcomes of placing information technologies in classrooms and ensuring that students have access to them has been that student interest in, and satisfaction with, schooling increase ... The same outcome is seen in the online classroom, where a more positive reaction to school has been found across diverse groups of learners.” • Section 4.1.5: “...computer-assisted cooperative learning promotes (a) higher quantity of daily achievement, (b) higher quality of daily achievement, (c) greater mastery of factual information,

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<p>3) Collaborates with students, peers, parents, and community members using digital tools and resources to support student success and innovation.</p> <p>4) Creates an environment that models the seamless use of technology for teaching and learning.</p> <p>B. Teacher motivates students and nurtures their desire to learn in a safe, healthy and supportive environment which develops compassion and mutual respect.</p> <p>1) Makes adjustments to the learning environment to assure healthy and safe use of technology.</p> <p>2) Advocates, models, and teaches digital citizenship (digital etiquette, digital communication, digital literacy, digital access, digital commerce, digital law, digital rights and responsibilities, digital health and wellness and digital security).</p> <p>C. Teacher cultivates cross-cultural understandings and the value of diversity.</p> <p>1) Develops and models cultural understanding and global awareness by engaging with colleagues and students of other cultures using digital collaboration tools.</p> <p>2) Customizes and personalizes learning activities to address students' diverse learning styles using digital tools and resources.</p> <p>3) Uses digital tools to bring students face-to-face with distant peers, building cultural literacy and global awareness.</p>	<p>(d) greater ability to apply one's factual knowledge in test questions requiring application of facts, (e) greater ability to use factual information to answer problem-solving questions, and (f) greater success in problem-solving.... on average small group learning with computer technology has positive effects on group task performance, individual achievement, and attitudes toward collaborative learning.”</p> <p>Teacher: A1: Brush, T. A. (1997). The effects on student achievement and attitudes when using integrated learning systems with cooperative pairs. <i>Educational Technology Research and Development</i>, 45(1), 51–64.</p> <ul style="list-style-type: none"> Students who used computer-based math lessons within a cooperative-oriented educational environment showed superior performance on standardized math inventories, as compared to those students who used the curriculum within an individual-oriented educational environment. The cooperative group also showed better attitudes towards math, towards the computer math lessons, and towards group activities in general. <p>Teacher: A1, A2, E1, E4; Student: B: Hare, J. C., Ault, M., Niileksela, C. (2009). <i>Technology rich classrooms: Effect of the Kansas Model</i>. Paper presented at the National Meeting of the National Educational Computing Conference, Washington, D. C.</p> <ul style="list-style-type: none"> Observational data from the study provided evidence that in classrooms where technology use occurred more often, students were more likely to be engaged in individual or group projects, and were less likely to be engaged in whole class activities where the entire class was paying attention to the teacher or another student. Also, teachers in technology-rich classrooms were more likely to work with individuals and groups, while teachers in non-technology-rich classrooms did more lecture and whole class discussion (p. 17). There was less off-task behavior in technology-rich classrooms (p. 18). <p>Teacher: A1; Student: B: Bebell, D. & Kay, R. E. (2009). <i>Summary of research findings from the Berkshire 1:1 Laptop Program</i>. Paper presented at the National Meeting of the National Educational Computing Conference, Washington, D. C.</p> <ul style="list-style-type: none"> “There is strong evidence that student engagement increased dramatically in response to the enhanced educational access and opportunities afforded by 1:1 computing through the BWLI program” (p. 31). “There is also somewhat more limited evidence that student collaboration and interaction with peers increased with the resources and opportunities afforded to students through 1:1 computing and the BWLI program” (p37). <p>Teacher: A2, H1, H2; Student: B, E2: Metiri Group (2006). <i>Technology in Schools: What the research says</i>. San Jose, CA: Cisco Systems.</p> <ul style="list-style-type: none"> “Social networking accelerates learning and is facilitated by technology. Students are highly motivated to communicate via technology be it text messaging, email, instant messaging, talking, or videoconferencing. Social networking via technology can connect students to a broad range of interactivity that sharpens and extends thinking and piques intellectual curiosity” (p. 12)
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<p>D. Teacher encourages students to accept responsibility for their own learning and accommodates the diverse learning needs of all students.</p> <ol style="list-style-type: none"> 1) Addresses the diverse needs of all learners by providing equitable access to appropriate digital tools and resources. 2) Provides a variety of digital tools to make the content accessible to address the learning needs of all students. 3) Develops technology-enriched learning environments that enable all students to pursue their own educational goals, manage their own learning, and assess their own progress. <p>E. Teacher displays effective and efficient classroom management that includes routines that promote comfort, order and appropriate student behaviors.</p> <ol style="list-style-type: none"> 1) Uses digital tools to manage an effective classroom. 2) Draws on the technical expertise of their students and gives them roles in managing the technology. 3) Helps students learn the content of the curriculum while gaining technology skills. 4) Organizes the classroom to facilitate student use of technology and instructional focus. <p>F. Teacher provides students equitable access to technology, space, tools and time.</p> <ol style="list-style-type: none"> 1) Provides student access, just-in-time learning, digital tools and electronic resources. 2) Creates digital space in which students 	<p>Teacher A1, A2, A3, A4, C1, C2, C3, D1, D2, D3, E3, E4, F1, F2, H3, I2; Student A1, B, C1, C3, D1: International Society for Technology in Education (ISTE), Partnership for 21st Century Skills, & State Educational Technology Directors Association (SETDA) (2007). <i>Maximizing the impact: The pivotal role of technology in a 21st century education system</i>. Washington, D. C.: ISTE.</p> <ul style="list-style-type: none"> • “Technology enables people to communicate, learn, share, collaborate and create, to think and solve problems, to manage their work, to take ownership of their lives. Technology can be a means to access content on any topic, a tool for thinking and creating, a connection to peers and experts, and a window into other cultures. Multimedia content can make the curriculum come alive and allow teachers and students to explore content deeply—or in brief, accessible chunks.... Online, collaborative projects with peers or experts in other states or countries can expose them to different cultures and perspectives” (p. 6). • “Fostering 21st century skills requires new approaches to teaching and learning, all of which can be enhanced with technology, including...creating and transforming knowledge for meaningful purposes. Students are more engaged in learning—and they learn more—when they have a stake in their work and when they can <i>do</i> something important with what they know. In the Internet age, everyone can be a content creator and innovator” (p. 7). • “Fostering 21st century skills requires new approaches to teaching and learning, all of which can be enhanced with technology, including...collaborating with others. There are few places where people work alone to accomplish important tasks. School should be no different. Students are more engaged in learning—and they can tackle bigger, more sophisticated projects—when they can collaborate with others, both inside and beyond their own schools. Further, students learn from one another through these interactions” (p. 9). • “Fostering 21st century skills requires new approaches to teaching and learning, all of which can be enhanced with technology, including...apprenticing with experts. Working with people who are more knowledgeable and skilled is a powerful way of learning. Interaction, guidance and support from experts—both in education and in other professions—is valuable for students. This model works as well when older students mentor younger students; both groups benefit from this experience” (p. 10). • “Fostering 21st century skills requires new approaches to teaching and learning, all of which can be enhanced with technology, including...differentiating instruction to meet individual needs. Students come to school with a wide range of strengths and weaknesses. It is particularly important in this era of accountability for schools to evaluate and meet individual learning needs, which requires a broader repertoire of teaching and learning strategies” (p. 10). <p>Teacher: A1, A2, C3, E2, G2; Student: C1, C3, C4, D: Sivin-Kachala, J. & Bialo, E. (2000). <i>2000 research report on the effectiveness of technology in schools</i> (7th edition). Washington, DC: Software and Information Industry Association.</p> <ul style="list-style-type: none"> • Use of online telecommunication for collaboration across classrooms in different geographic locations can improve academic skills (p. 10). • Students trained in collaborative learning on computer in small groups had higher student achievement, higher self-esteem and better attitudes toward learning than students working
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<p>regularly engage in activities to enhance learning.</p> <p>3) Provides learning experiences by using technology to actively engage all students irrespective of time zones or physical distances.</p> <p>G. Teacher effectively allocates time for students to engage in hands-on experiences, discuss and process content and make meaningful connections.</p> <p>1) Engages students in exploring real-world issues and solving authentic problems using digital tools and resources.</p> <p>2) Provides time and digital tools for students to discuss and reflect learning, irrespective of time zones and physical distance.</p> <p>H. Teacher designs lessons that allow students to participate in empowering activities in which they understand that learning is a process and mistakes are a natural part of learning.</p> <p>1) Designs activities for students to reflect on learning with digital tools: blogs, wiki, online journals.</p> <p>2) Designs activities for students to use digital tools as they discuss their learning with others.</p> <p>3) Creates opportunities for students to interact and ask experts using digital tools.</p> <p>I. Teacher creates an environment where student work is valued, appreciated and used as a learning tool.</p> <p>1) Uses digital tools and resources to highlight</p>	<p>individually (p. 11).</p> <ul style="list-style-type: none"> Expanding student responsibilities through a learner-as-multimedia-designer environment can positively impact student attitudes (p. 11). Educational technology has been found to have positive effects on student attitudes toward learning and on student self-concept. Students felt more successful in school, were more motivated to learn and had increased self-confidence and self-esteem when using computer-based instruction (p. 11). Specific characteristics of the learning environment help to maximize the benefits of educational technology, including: Educators should offer students self-directed learning experiences and activities that encourage self-expression. (p. 13). <p>Teacher A1, A2, A3, A4, C2, D1, D2, D3, E1, E4, G1; Student: C4, D: Ringstaff, C. & Kelley, L. (2002). <i>The learning return on our educational technology investment</i>. San Francisco, CA: WestEd.</p> <ul style="list-style-type: none"> “One of the most powerful uses of technology in education is to tailor instruction to students’ individual learning needs. Technology can...help teachers accommodate students’ varying learning styles” (p. 6). Researchers...noted that technology had an enduring, positive impact on student engagement only under certain conditions, particularly when the technology was integrated into other aspects of the students’ experience (p. 12). “...In another decade-long study, researchers investigating the impact of a computer-integrated instructional program ... found that elementary students in project classrooms from kindergarten through fifth grade have consistently had higher test scores and better discipline than their counterparts in traditional, self-contained classrooms” (p. 4) When compared to their peers in [non-computer equipped classrooms], project students routinely employed inquiry, collaborative, technological, and problem-solving skills uncommon to graduates of traditional high school programs. Interdisciplinary, project-based learning was commonplace at this site, where teachers worked in teams to integrate technology into the curricular framework (p. 7). “...a high school in Pittsburgh (PA) implemented a computerized “Cognitive Tutor” in its mathematics classes. This tutor presented students with real-world, contextualized problems and built learning profiles of its users. Evaluations showed that Algebra students who used this tutor outperformed students in traditional classes...” (p. 3). Numerous studies have reported that technology can lead to increased student motivation and improved self-concept. In 2000, for example, researchers commissioned by the Software and Information Industry Association (SIIA) examined 311 research reviews and reports from published and unpublished sources. They concluded that technology has been found to have a positive effect on student attitudes toward learning, self- confidence, and self-esteem.... Other reviews have reported that technology has been found to improve school attendance, decrease dropout rates, and have a positive impact on students’ independence and feelings of responsibility for their own learning (pp. 8-9). <p>Teacher A1, A2, C2, D1, D2, D3, E1, E2, E4, I2; Student C4, D1: Larson, M. B. (2005). <i>AEL</i></p>
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<p>critical features of student work.</p> <p>2) Promotes, supports, and models creative and innovative thinking and inventiveness.</p> <p><u>Student Characteristics:</u></p> <p>A. Student accepts responsibility for his/her own learning</p> <ol style="list-style-type: none"> 1) Accesses digital tools and resources to support and manage his/her own learning. 2) Explores educational goals, reflects and assesses his/her own progress using digital tools and resources. <p>B. Student actively participates and is authentically engaged.</p> <ol style="list-style-type: none"> 1) Selects from a variety of digital tools that supports his/her learning styles and interests. 2) Uses digital tools to complete authentic assignments. <p>C. Student collaborates/teams with other students</p> <ol style="list-style-type: none"> 1) Interacts, collaborates, and publishes with peers, experts, or others and at a distance employing a variety of digital tools and resources. 2) Communicates information and ideas effectively to multiple audiences using a variety of media and formats. 3) Develops cultural understanding and global awareness by engaging with learners of other cultures. 4) Contributes to project teams to produce original works or solve problems. <p>D. Student exhibits a sense of accomplishment and</p>	<p><i>framework research: A compilation of literature reviews and meta-analyses.</i> Charleston, WV: Edvantia.</p> <ul style="list-style-type: none"> • Technology integration supports instructional differentiation and benefits all students, especially gifted and intellectually advanced learners, by allowing them acceleration, depth, complexity, and the upper levels of Bloom’s taxonomy: analysis, synthesis, and evaluation (p. 4). • Whether used to read or write; to acquire knowledge and insight into science, mathematics, and other areas; to express oneself; or to learn content in a new medium, computers can support the expression and development of creativity (p. 9). • One successful self-concept intervention for elementary LD students... involved the use of specially designed language arts software that consisted of drill and practice, creative writing, provided frequent positive feedback, and provided students with the opportunity to tutor regular education peers on how to use the computers. The increase in self-esteem was attributed to “positive feelings generated as a result of mastering the computer and tutoring nondisabled peers, students’ satisfaction with their own growth and accomplishments, and positive feedback (p. 9). • An important finding from the research is that in classrooms with technology, students’ time-on-task is improved... For example, in classrooms where technology or computer-based instruction is used more than 20 percent of the time, students’ time-on-task significantly increased over classrooms where technology was only slightly (11-19% of the time) or infrequently (less than 10% of the time) used (p. 13). • Computer technologies are most effective when designed according to different educational and psychological theories and principles such as socio-cultural learning theory, computer-supported collaborative learning, constructivist theories, and cognitive science. Specifically, research supports the use of cooperative learning; giving explanations in small group learning; apprenticeship conditions; use of collaborative computational and scientific tools (Thinkertools software and SenseMaker); project-based learning; using computers to design with as well as instruments to collect, analyze, and report data; hand-held computers; and use of intelligent tutoring systems to teach students expert ways of thinking (p. 14). <p>Teacher: A1, A2, G2, H1, H2; Student: E2: Marttunen, M. & Laurinen, L. (2007). Collaborative learning through chat discussions and argument diagrams in secondary school. <i>Journal of Research on Technology in Education</i>, 40 (1), 109-126.</p> <ul style="list-style-type: none"> • This study compared students’ collaborative argument diagrams finished after an on-line debate with diagrams constructed before the debate. Results showed that collaboration not only encouraged students to elaborate their previous arguments but also helped them to recall and create ideas and arguments. <p>Teacher: A1, A2, E2, E3; Student: A1, C1, C4, D, D1, E1, E2: Mouza, C. (2008). Learning with laptops: Implementation and outcomes in an urban, under-privileged school. <i>Journal of Research on Technology in Education</i>, 40 (4), 447-472.</p> <ul style="list-style-type: none"> • Laptop students became more motivated to complete schoolwork and often went beyond required assignments, thereby improving the quality of their work...Furthermore, students took the initiative to come up with their own classroom projects that made use of technology (p. 463).
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<p>confidence</p> <ol style="list-style-type: none"> 1) Uses technology that supports learning and productivity. 2) Participates in activities where successful work is published/recognized online. <p>E. Student takes educational risks in class</p> <ol style="list-style-type: none"> 1) Uses digital tools to ask questions and request resources to more fully understand, enhance or add clarity to the learning. 2) Uses digital tools and resources to participate in conversations and challenges. <p>F. Student practices and engages in safe, responsible and ethical use of technology.</p> <ol style="list-style-type: none"> 1) Applies a fundamental understanding of the ethical/legal issues surrounding the access and use of information and media. 2) Advocates and practices digital citizenship (digital etiquette, digital communication, digital literacy, digital access, digital commerce, digital law, digital rights and responsibilities, digital health and wellness and digital security). 	<ul style="list-style-type: none"> • Teachers emphasized how peer sharing and collaboration was key to the implementation of laptops; they acknowledged the powerful role of laptops in promoting collaboration and sharing (p. 464). • Laptop students often shared their competencies with teachers...in interviews, teachers acknowledged that over time, they learned to rely on their students for technical support...other teachers also began acknowledging student expertise and asking for technical support...Acquiring increased technological competence and trading skills with the teacher, as well as with peers, provided laptop students with a sense of pride and empowerment (pp. 464-465). <p>Teacher: A2, I1; Student: B1, C1: Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing how and what children learn in school with computer-based technology. <i>Children and Computer Technology, 10</i>(2), 76–101.</p> <ul style="list-style-type: none"> • “Learning research shows that students learn best by actively constructing knowledge. Computer-based technologies are particularly suited to this type of learning, and have been shown to actively engage students” (p. 79); • “Research shows that learning proceeds more rapidly when students receive immediate feedback. Computer programs often given such feedback, and teachers can use computer tools to analyze student performance and give feedback. Research indicates that such tools can support student learning” (p. 81). • “Research shows that students who participate in computer-connected learning networks show increased motivation, a deeper understanding of concepts, and an increased willingness to tackle difficult questions” (p.81) <p>Teacher A2, A3, D2: Riel, M. & Fulton, K. (2001). The role of technology in supporting learning communities. <i>Phi Delta Kappan, 82</i> (7), 518-523.</p> <ul style="list-style-type: none"> • Technology makes broader learning communities possible through such activities as electronic field trips, online mentoring, science investigations, and humanities activities (p. 520). <p>Teacher: A2, A3, B1, B2, C1, C3, F3; Student: C1, C3, F1, F2: Ross, J. D., McGraw, T. M., & Burdette, K. (2001). <i>Toward an effective use of technology in education: A summary of research</i>. Charleston, WV: AEL.</p> <ul style="list-style-type: none"> • Information technologies can support greater school-to-home and school-to-community connections... As Internet access increases, communication barriers between schools and communities are lessened (p. 19). • Connections between the school and the rest of the community can coordinate learning goals with community goals and help to integrate education into daily life (p. 20). • Technologies can open up the more traditional classroom and provide the opportunity for students and teachers to share, discuss, and exchange ideas with larger communities of learners (p. 26). • Educators and parents should help students develop responsible and appropriate Internet use habits....Teachers must also help students learn how to validate the accuracy and evaluate the usefulness of Internet sources. Before beginning an Internet-based project, teachers should demonstrate successful search strategies and review responsible use practices. Students should be
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familiar with citation strategies for both digital and print materials to avoid plagiarism and copyright infringement. Students should know the consequences of illegal use of digital materials (pp. 71-72).

Teacher: A3, G1; Student: C4: Kozma, R. B. (2003). Technology and classroom practices: An international study. *Journal of Research on Technology in Education*, 36 (1), 1-14.

- “The outcomes reported in our cases suggest that when teachers go beyond these basic practices and use technology to also plan and prepare instruction and collaborate with outside actors, and when students also use technology to conduct research projects, analyze data, solve problems, design products, and assess their work, students are more likely to develop new ICT (information and communication technologies), problem solving, information management, collaboration, and communication skills” (p. 13).

Teacher A4, C2, D1, D2, D3, H3; Student A1, A2, B2, C1, C2, D2, E1, E2: Lemke, C., & Coughlin, E. C. (1998). *Technology in American schools: Seven dimensions for gauging progress. A policymaker's guide*. The Milken Exchange on Educational Technology.

- “New technology can engage students in real-life academics and encourage students to be more independent and responsible for their own learning” (p. 15).
- “Technology adds a powerful tool to teachers’ repertoires, enabling them to meet the individual learning needs of their students more effectively” (p. 15).
- “Connecting learning to the world beyond the classroom can bring relevant, real-life context to the study of basic skills, work skills, and critical thinking. This creates an opportunity for students to access information, communicate with experts and peers and make contributions to knowledge bases through electronic publication” (p. 15).
- The “Learning Environments” dimension of this document states that educators should establish a learning context that requires and enables students to use contemporary tools to research issues, solve problems, and communicate results, both individually and in teams” (p. 20)

Teacher: A4, F1, F2: Commission on Architecture and the Built Environment (2002). *The value of good design*. London: Author.

- A study of two new building projects in France found that educational environments designed to integrate information and communication technology were more conducive to learning.

Teacher A4: Byrom, E. (1997). *Review of the professional literature on the integration of technology into educational programs*. Durham, NC: SERVE, Inc.

- “Teachers who are most successful at technology integration are those who are so comfortable with technology that they seamlessly know when to use it for student-focused learning and when to use direct instruction” (p. 5).

Teacher: B1, B2; Student: F2: Pruitt-Mentle, D. (2009). *National C3 baseline study: State of cyberethics, safety and security awareness in US schools*. Paper presented at the National Meeting of the National Educational Computing Conference, Washington, D. C.

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- “The call for a national focus impacting student and educator awareness and knowledge about C3 efforts has surged recently...A comprehensive national approach to responding to the problem would aim to increase the training opportunities for educators, help bridge the gap between existing Internet awareness curriculum partners, call for expanding content to include a broader range of topics covered under the domains-particular safety and security, and include program evaluation. More hands-on training opportunities for educators (not just resources and assemblies), and increased and on-going opportunities for youth throughout the K-12 experience would provide the comprehensive effort needed to close the gap between danger and knowledge.” (p.11)

Teacher: B1, B2; Student: F2: Wright, V.H. (2009). *Cyberbullying: Using virtual scenarios to educate and raise awareness*. Paper presented at the National Meeting of the National Educational Computing Conference, Washington, D. C.

- “At this time, there is a need to raise awareness about the effects of cyberbullying and to create educational opportunities to serve multiple audiences (i.e., teachers, teacher educators, school administrators, school counselors, mental health professionals, students, parents) in the quest to identify and hopefully prevent cyberbullying in the future” (p. 3)

Teacher: B1, B2, C3; Student C2, C3, D1, F1, F2: North Central Regional Educational Laboratory. (2003). *enGauge 21st Century Skills: Literacy in the digital age*. Naperville, IL: Author.

--Students who are technologically literate (p. 22):

- understand and model positive, ethical use of technology in both social and personal contexts.
 - Use a variety of technology tools in effective ways to increase creative productivity.
- “...as students access electronic resources, it is critical that they recognize the importance of honoring the intellectual property of others by strictly adhering to copyright and fair use laws” (p. 26).
--“Every student should have the opportunity to interact cross-culturally in meaningful ways. Such interaction might include, for example, communicating via e-mail or videoconference with peers in other countries to enhance language proficiency; participating in a shared environmental science project; or sharing viewpoint on international events via moderated, online exchanges...The learning that takes place...can serve as a bridge to openness and appreciation of diversity and other cultures” (p. 28).
--“In today’s wired, networked society, it is imperative that students learn to communicate effectively using a range of media, technology, and environments...expertise in the use of these new interactive communication conventions is as essential to students as expertise with phones was a decade ago” (p. 56).

Teacher: C2, D1, D2, G2, H1: Smith, R., Clark, T., & Blomeyer, R. L. (2005). *A synthesis of new research on K-12 online learning*. Naperville, IL: Learning Point Associates.

- “Zucker (2005) states that online courseware should include student-student interaction facilitating metacognition and a culture of reflection, which also impacts student academic performance” (p. 55).
- “Kleiman et al. (2005) argue that the inclusion of principles of differentiation is essential in meeting the diverse needs of online learners” (p. 58).

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Teacher: C2, D2, E2, E4, F2, G2, I1: Means, B. & Olson, K. (1995). *Technology's role in education reform: Findings from a national study of innovating schools*. Washington, D. C.: Office of Educational Research and Improvement.

- Many technology applications (e.g., word processing, databases) offer teachers a window into the student's thinking, inquiry, and problem-solving processes. When the work students are doing is visible on a monitor or printout, teachers have access to students' misconceptions, the ways in which they sort and categorize information, the relationships they form among ideas, and the conjectures they make. Teachers need good diagnostic skills to take advantage of the opportunities provided by the technology (p. 31).
- Particularly in the upper grade levels, teachers who have become accustomed to playing the role of coach rather than that of all-knowing lecturer and demonstrator find that they can rely on students to help set up equipment and troubleshoot technical difficulties (p. 78).
- The kinds of technology-supported project-based learning activities that have been advocated by education reformers, and are featured throughout this study, require a different approach to scheduling than the traditional model of education. Rather than segmenting time rigidly into discrete subject-specific periods of teacher lecture and individual seat work, project-based activities require extended blocks of time as students move from one aspect of a multifaceted task to another and work (often collaboratively) to bring their project to fruition. The need for large blocks of time is especially true of projects in which technology is being used as a tool to support a variety of tasks (pp. 88-89).
- Another way in which technology enhances teachers' ability to present information is by providing capabilities for easy tailoring of materials for individual students or groups. One of the classrooms studied at the Progressive School made this kind of tailoring a general practice so that the teacher-developed exercises students worked on were better linked to student interests and abilities and to the activities of their specific projects (p. 168).

Teacher: C2: Kalay, P. & Chen, D. (2002). Integrating a decision support system into a school: The effects on student functioning. *Journal of Research on Technology in Education*, 34 (4), 435-452.

- A significant improvement was seen in student achievement, student mobility rates, and dropout rates after the school began using a student information system to plan teaching and learning.... Improvement in student outcomes "shows that objective professional judgment led to an improvement in the quality of the learning environment for most of the students"...and "support the research assumption and the basic perception of adaptive teaching that better adaptation between the student and the learning environment has a positive influence on educational achievement" (p. 449).

Teacher E1, E4: Waxman, H. C., Lin, M., & Michko, G. M. (2003). *A meta-analysis of the effectiveness of teaching and learning with technology on student outcomes*. Naperville, IL: Learning Point Associates.

- Another important finding from the Waxman and Huang (1996) study is that students in classrooms where technology was moderately used (more than 20 percent of the time) were found

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	<p>to be on task significantly more of the time than students from the other two groups—in which technology was infrequently used (less than 10 percent of the time) or in which technology was slightly used (11 percent to 19 percent of the time). These findings are similar to prior studies that found that computer-based instruction increases students’ time-on-task (MacArthur, Haynes, & Malouf, 1986; Schofield & Verban, 1988; Worthen, Van Dusen, & Sailor, 1994) (p. 5).</p> <p>Teacher: G1; Student: B2: CEO Forum on Education and Technology. (2001, June). <i>The CEO Forum school technology and readiness report: Key building blocks for student achievement in the 21st century</i>. Retrieved Nov. 10, 2009 from http://www.ceoforum.org/downloads/report4.pdf</p> <ul style="list-style-type: none"> • “One of the most dramatic ways education technology can make learning more dynamic and engaging is by forging real world contexts for academic exploration. Technology allows educators and students to augment curriculum w/current information and timely study of real-world events” (p.7)
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<h2>2. Classroom Assessment and Reflection</h2>	<h2>Connections to Standards, Research, and Expert Opinion</h2>
<p>Teacher Characteristics:</p> <p>A. Teacher uses multiple methods to systematically gather data about student understanding and ability.</p> <ol style="list-style-type: none"> 1) Uses a variety of technologies to gather/analyze data and provide students with multiple and varied classroom assessments aligned with content and technology standards. 2) Provides digital assessment options based on learning needs including student’s self-reflection and peer feedback. <p>B. Teacher uses student work/data, observations of instruction, assignments and interactions with colleagues to reflect on and improve teaching practice.</p> <ol style="list-style-type: none"> 1) Uses a variety of technologies to collaborate with peers within professional learning communities. 	<p>Teacher: A1, A2, H1; Student: B1, B2: CEO Forum on Education and Technology. (2001, June). <i>The CEO Forum school technology and readiness report: Key building blocks for student achievement in the 21st century</i>. Retrieved Nov. 10, 2009 from http://www.ceoforum.org/downloads/report4.pdf</p> <ul style="list-style-type: none"> • “Technology makes learning more student-centered, which enables students to define objectives and create a plan to reach them, thus creating more student ownership of their own learning. Technology also offers self-assessment tools so that students can monitor their own progress” (p. 7). • “A Boston College study demonstrated that methods of evaluating student learning should reflect the tools used in instruction” (p. 14); • “Technology can help provide different kinds of assessment to serve diverse student needs” (p. 15). <p>Teacher A1, A2: McMillan, J. H. (2000). <i>Basic assessment concepts for teachers and school administrators</i>. College Park, MD: ERIC Clearinghouse on Assessment and Evaluation.</p> <ul style="list-style-type: none"> • One of the 11 assessment principles, drawn from professional standards documents, is that teachers will use computer-based assessment techniques appropriately. <p>Teacher: A1, A2, B1, B2, C2, G1, J1, J2; Student B2: Ringstaff, C. & Kelley, L. (2002). <i>The learning return on our educational technology investment</i>. San Francisco, CA: WestEd.</p> <ul style="list-style-type: none"> • “One of the most powerful uses of technology in education is to tailor instruction to students’ individual learning needs. Technology can...help teachers accommodate students’ varying learning styles” (p. 6). • Researchers found a strong complementary relationship between the adoption of technology and the creation of collaborative learning environments for teachers (p. 12).

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<p>2) Uses data sources to inform learning and teaching.</p> <p>C. Teacher revises instructional strategies based upon analysis of student achievement data.</p> <ol style="list-style-type: none"> 1) Uses digital tools and resources to research and implement best practices in classroom assessments. 2) Uses digital tools to revise instructional strategies according to student learning needs. <p>D. Teacher uncovers students' prior understandings of the concepts to be addressed and addresses students' misconceptions/incomplete conceptions.</p> <ol style="list-style-type: none"> 1) Uses digital tools and resources to address misconceptions. <p>E. Teacher co-develops scoring guides/rubrics with students and provides adequate modeling to make clear the expectations for quality performance.</p> <ol style="list-style-type: none"> 1) Uses digital tools and resources to provide students models of quality performances. 2) Collaborates with students and others to develop scoring guides/rubrics using technologies. <p>F. Teacher guides students to apply rubrics to assess their performance and identify improvement strategies.</p> <ol style="list-style-type: none"> 1) Provides students opportunities to critique their performance against the rubric using a variety of digital tools and resources. 	<ul style="list-style-type: none"> • “Technology can also analyze and provide immediate feedback on performance, and can suggest modifications in instruction where necessary to improve student achievement” (p. 7). <p>Teacher B1, B2, J3: Riel, M. & Fulton, K. (2001). <i>The role of technology in supporting learning communities</i>. Phi Delta Kappan, 82 (7), 518-523.</p> <ul style="list-style-type: none"> • “Communications technology provides opportunities for collaborative learning environments for teachers in which they can reflect on practice with colleagues, share expertise in a distributed knowledge framework, and build a common understanding of new instructional approaches, standards, and curriculum” (p. 522). <p>Teacher B1, B2, C2, J1, J2, J3: Carroll, T. (2007). Teaching for the future. In <i>Building a 21st century U. S. education system</i>, B. Wehling & C. Schneider (Eds.), pp. 46-58. National Commission on Teaching and America's Future.</p> <ul style="list-style-type: none"> • “To create and sustain... learning communities, teachers...should have an opportunity to use the Internet to extend the reach of their community beyond the boundaries of their school to draw on the wealth of resources and expertise that can be used to strengthen their learning organization” (pp. 49-50). • “Current information technologies make this personalization possible because they enable teachers to assess and monitor student learning from week to week, giving teachers powerful tools to customize activities to individual needs” (p. 50) <p>Teacher B1, B2, J3; Student: E2: Lemke, C., & Coughlin, E. C. (1998). <i>Technology in American schools: Seven dimensions for gauging progress. A policymaker's guide</i>. The Milken Exchange on Educational Technology.</p> <ul style="list-style-type: none"> • “Network technology... breaks down the isolation of the teaching profession, allowing teachers to connect with each other across vast distances and exchange ideas, share resources and improve practice” (p. 15). • “Connecting learning to the world beyond the classroom can bring relevant, real-life context to the study of basic skills, work skills, and critical thinking. This creates an opportunity for students to access information, communicate with experts and peers and make contributions to knowledge bases through electronic publication” (p. 15). • The “Professional Competency” dimension of this document states that teachers use technology “and communication networks to advance their professional practice” (p. 22) <p>Teacher B1, B2, C1, D1, E1, J3; Student A2, B1, B2: International Society for Technology in Education (ISTE), Partnership for 21st Century Skills, & State Educational Technology Directors Association (SETDA) (2007). <i>Maximizing the impact: The pivotal role of technology in a 21st century education system</i>. Washington, D. C.: ISTE.</p> <ul style="list-style-type: none"> • “Technology enables people to...manage their work, to take ownership of their lives.” (p. 6). • “Fostering 21st century skills requires new approaches to teaching and learning, all of which can be enhanced with technology, including... addressing misconceptions. Many students come to school with faulty or incomplete knowledge. Unless educators address these misconceptions
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<p>2) Provides a variety of digital tools so students develop strategies for improving and revising their work.</p> <p>G. Teacher provides regular and timely feedback to students and parents that moves learners forward.</p> <p>1) Uses a variety of technologies to deliver descriptive and qualitative feedback to students and parents.</p> <p>2) Provides digital tools and resources to students and parents to support learning.</p> <p>H. Teacher allows students to use feedback to improve their work before a grade is assigned.</p> <p>1) Provides a variety of digital tools for the student to analyze work based on feedback.</p> <p>2) Utilizes technologies in order to provide opportunities for students to revise their work.</p> <p>I. Teacher facilitates students in self- and peer-assessment</p> <p>1) Promotes student reflection using digital tools and resources to reveal and clarify students' conceptual understanding and thinking, planning, and creative process.</p> <p>2) Provides students with peer assessment opportunities using digital tools and resources.</p> <p>J. Teacher reflects on instruction and makes adjustments as student learning occurs.</p> <p>1) Uses digital tools to assess student learning while teaching.</p> <p>2) Uses digital tools and resources to adapt</p>	<p>explicitly, students are not likely to let them go, which can hinder their progress in school” (p. 9).</p> <ul style="list-style-type: none"> • “Fostering 21st century skills requires new approaches to teaching and learning, all of which can be enhanced with technology, including...collaborating with others. There are few places where people work alone to accomplish important tasks. School should be no different. Students are more engaged in learning—and they can tackle bigger, more sophisticated projects—when they can collaborate with others, both inside and beyond their own schools. Further, students learn from one another through these interactions” (p. 9). • “Technology also can be an extraordinary support for teachers, who can use it to become more effective in their classrooms. Standards and standards-based lessons and multimedia resources available online can provide teachers with exemplary models, research-based strategies and useful materials” (p. 10). • “Such technologies as videoconferencing, online learning, networking and instant messaging can support professional development and professional learning communities. Using technologies like these, educators can learn and collaborate with peers, mentors, experts and community members routinely. They can build ongoing professional relationships, develop capacity in teaching 21st century skills, benefit from just-in-time communications, and reduce the time and expense of travel” (p. 13). <p>Teacher: B1, B2, C1, G1, G2, J3: Ross, J. D., McGraw, T. M., & Burdette, K. (2001). <i>Toward an effective use of technology in education: A summary of research</i>. Charleston, WV: AEL.</p> <ul style="list-style-type: none"> • The Panel on Educational Technology (1997) suggests ways teachers may use computers and computer networks to support teaching and learning, including that teachers can monitor, guide, and assess the progress of their students; and use computer-mediated communication tools to exchange ideas, experiences, and curricular materials; consult with experts in a variety of fields; and facilitate dialogue with students, parents, and administrators (p. 7). <p>Teacher: B1, D1, F2, G1, H1, H2, I1; Student: B2: Sivin-Kachala, J. & Bialo, E. (2000). <i>2000 research report on the effectiveness of technology in schools</i> (7th edition). Washington, DC: Software and information Industry Association.</p> <ul style="list-style-type: none"> • Specific characteristics of the learning environment help to maximize the benefits of educational technology, including: Exemplary computer-using educators benefit from a social network of other computer-using educators at their school (p. 13). • Studies focusing on science education suggest the benefits of simulations, microcomputer-based laboratories, video to anchor instruction to real-world problems, and software that targets students' misconceptions (p. 10). • In tutorial and practice software, programs with feedback providing knowledge of correct responses were found to be superior to programs that require students to keep answering until they achieve a correct response. Furthermore, feedback that identifies <i>why</i> a response is wrong was found to be more effective than feedback that only identifies <i>what</i> was wrong (p. 12). • Students can benefit academically from software with embedded conceptual change strategies sequences of instruction that move students from their faulty preconceptions to a more accurate understanding of the concepts involved (p. 12).
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<p>instruction and support further learning.</p> <p>3) Evaluates and reflects on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning.</p> <p><u>Student Characteristics:</u></p> <p>A. Student recognizes what proficient work looks like and determines steps necessary for improving his/her work.</p> <ol style="list-style-type: none"> 1) Uses digital tools and resources to self-assess work using models of quality performance. 2) Uses technologies to collaborate with students and others to improve his/her work. <p>B. Student monitors progress toward reaching learning targets.</p> <ol style="list-style-type: none"> 1) Uses digital tools and resources to identify and target learning goals. 2) Uses digital tools and resources to measure/monitor learning goals. <p>C. Student develops and/or uses scoring guides periodically to assess his/her own work or that of peers.</p> <ol style="list-style-type: none"> 1) Uses digital tools and resources to develop scoring guides for his/her own work. 2) Uses digital tools to assess/evaluate the work of peers. <p>D. Student uses teacher and peer feedback to improve his/her work.</p> <ol style="list-style-type: none"> 1) Using teacher feedback, accesses digital tools to improve his/her work. 	<p>Teacher: B2, C2, J2: Kalay, P. & Chen, D. (2002). Integrating a decision support system into a school: The effects on student functioning. <i>Journal of Research on Technology in Education</i>, 34 (4), 435-452.</p> <ul style="list-style-type: none"> • A significant improvement was seen in student achievement, student mobility rates, and dropout rates after the school began using a student information system to plan teaching and learning.... Improvement in student outcomes “shows that objective professional judgment led to an improvement in the quality of the learning environment for most of the students”...and “support the research assumption and the basic perception of adaptive teaching that better adaptation between the student and the learning environment has a positive influence on educational achievement” (p. 449). <p>Teacher: C2, D1; Student: B2, D1: Hendrix, J. & Tracy, B. (2009). <i>Continuing to assess technology in math classrooms for state assessments</i>. Retrieved 11/11/09 from http://www.iste.org/Content/NavigationMenu/Research/NECC_Research_Paper_Archives/NECC2009/Hendrix_Jeremy_NECC09.pdf</p> <ul style="list-style-type: none"> • Using a student response system in preparing for state math assessment, teachers and students could see immediately the concepts students had not mastered and focus on those. Results showed that when students received immediate feedback and remediation during preparation for the state test, students had increased engagement, which led to higher assessment scores and ratings (p2). <p>Teacher: D, D1, E1, F2, H1; Student: A2, B2, C2, D2, E1: Means, B. & Olson, K. (1995). <i>Technology's role in education reform: Findings from a national study of innovating schools</i>. Washington, D. C.: Office of Educational Research and Improvement.</p> <ul style="list-style-type: none"> • Many technology applications (e.g., word processing, databases) offer teachers a window into the student’s thinking, inquiry, and problem-solving processes. When the work students are doing is visible on a monitor or printout, teachers have access to students’ misconceptions, the ways in which they sort and categorize information, the relationships they form among ideas, and the conjectures they make. Teachers need good diagnostic skills to take advantage of the opportunities provided by the technology (p. 31). • Technology can function as a tool for monitoring growth and self-progress through feedback and the automatic maintenance of a running record of a student’s work. A variety of technologies offer opportunities for students to critically examine their own and each other’s work, for example, through viewing videotapes of exhibitions or performances or through electronic transmission of one another’s texts for review and editing (p. 160). <p>Teacher: G1, J1; Student: A1, B2, D1: Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing how and what children learn in school with computer-based technology. <i>Children and Computer Technology</i>, 10(2), 76-101.</p> <ul style="list-style-type: none"> • “Research shows that learning proceeds more rapidly when students receive immediate feedback. Computer programs often given such feedback, and teachers can use computer tools to analyze student performance and give feedback. Research indicates that such tools can support student
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<p>2) Uses digital tools to gain feedback and insights from peers to improve his/her work.</p> <p>E. Student reflects on work and makes adjustments as learning occurs.</p> <p>1) Takes responsibility in the use of digital tools and resources to reflect on work in order to learn and achieve.</p> <p>2) Creates a variety of online work (e.g. blogs, discussion board, etc.) to demonstrate creative application of knowledge learned.</p>	<p>learning” (p. 81).</p> <p>Teacher: I1, I2; Student A2: Smith, R., Clark, T., & Blomeyer, R. L. (2005). <i>A synthesis of new research on K-12 online learning</i>. Naperville, IL: Learning Point Associates.</p> <ul style="list-style-type: none"> “Zucker (2005) states that online courseware should include student-student interaction facilitating metacognition and a culture of reflection, which also impacts student academic performance” (p. 55). <p>Student: A1, B2: Kozma, R. B. (2003). Technology and classroom practices: An international study. <i>Journal of Research on Technology in Education</i>, 36 (1), 1-14.</p> <ul style="list-style-type: none"> The outcomes reported in our cases suggest that when teachers go beyond these basic practices and use technology to also plan and prepare instruction and collaborate with outside actors, and when students also use technology to conduct research projects, analyze data, solve problems, design products, and assess their work, students are more likely to develop new ICT (information and communication technologies), problem solving, information management, collaboration, and communication skills” (p. 13). <p>Student: A2, D2: Marttunen, M. & Laurinen, L. (2007). Collaborative learning through chat discussions and argument diagrams in secondary school. <i>Journal of Research on Technology in Education</i>, 40 (1), 109-126.</p> <ul style="list-style-type: none"> This study compared students’ collaborative argument diagrams finished after an on-line debate with diagrams constructed before the debate. Results showed that collaboration not only encouraged students to elaborate their previous arguments but also helped them to recall and create ideas and arguments. <p>Student E2: Larson, M. B. (2005). <i>AEL framework research: A compilation of literature reviews and meta-analyses</i>. Charleston, WV: Edvantia.</p> <ul style="list-style-type: none"> Whether used to read or write; to acquire knowledge and insight into science, mathematics, and other areas; to express oneself; or to learn content in a new medium, computers can support the expression and development of creativity (p. 9).
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<h3>3. Instructional Rigor and Student Engagement</h3>	<h3>Connections to Standards, Research, and Expert Opinion</h3>
<p>Teacher Characteristics:</p> <p>A. Teacher instructs the complex processes, concepts and principles contained in state and national standards using differentiated strategies</p>	<p>Teacher A1, B1, D1, D2, E1, F1; Student A1, A2, D1, D2, D3: International Society for Technology in Education (ISTE), Partnership for 21st Century Skills, & State Educational Technology Directors Association (SETDA) (2007). <i>Maximizing the impact: The pivotal role of technology in a 21st century education system</i>. Washington, D. C.: ISTE.</p>

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<p>that make them accessible to all students.</p> <p>1) Implements technology tools and resources to meet the diverse learning needs of all students.</p> <p>B. Teacher scaffolds instruction to help students reason and develop problem-solving strategies.</p> <p>1) Uses a variety of technologies/electronic resources to effectively differentiate and scaffold instruction to help students reason and develop problem-solving strategies for all students.</p> <p>C. Teacher orchestrates effective classroom discussions, questioning, and learning tasks that promote higher-order thinking skills.</p> <p>1) Orchestrates effective classroom/online discussions (asynchronous, synchronous)</p> <p>D. Teacher provides meaningful learning opportunities for students.</p> <p>1) Implements learner-centered instruction that enables students to develop 21st Century Skills (including global awareness, financial, economic, business and entrepreneurial literacy, civic literacy, health literacy, information, media and ICT literacy, life and career skills).</p> <p>2) Effectively incorporates technology that prepares students to apply 21st Century Skills and meet future challenges.</p> <p>E. Teacher challenges students to think deeply about problems and encourages/models a variety of approaches to a solution.</p>	<ul style="list-style-type: none"> • In a 21st century education system, technology must be used comprehensively and purposefully to support students in mastering the full range of what they need to learn—core subjects, 21st century theme and 21st century skills... Technology also must enable students to acquire <i>all</i> of the 21st century skills they need to participate fully in the global economy and to manage their own destinies.” (p. 6); • “Technology enables people to communicate, learn, share, collaborate and create, to think and solve problems, to manage their work, to take ownership of their lives.... Technology can be a means to access content on any topic, a tool for thinking and creating, a connection to peers and experts, and a window into other cultures. Multimedia content can make the curriculum come alive and allow teachers and students to explore content deeply—or in brief, accessible chunks.... Online, collaborative projects with peers or experts in other states or countries can expose them to different cultures and perspectives” (p. 6). • “Fostering 21st century skills requires new approaches to teaching and learning, all of which can be enhanced with technology, including building conceptual understanding of core content. Mastering content knowledge takes more than rote memorization or drills. Students need to understand the essential underpinnings of mathematics, science, history and literature, for example, to be prepared for higher-level courses and complex subject matter” (p. 9). • “Fostering 21st century skills requires new approaches to teaching and learning, all of which can be enhanced with technology, including...applying knowledge and skills to interdisciplinary challenges. Most work in organizations today cannot be categorized into neat silos as a “math problem” or a “science issue,” for example. Students need to learn to apply a range of knowledge and skills to complex problems” (p. 9). • “Fostering 21st century skills requires new approaches to teaching and learning, all of which can be enhanced with technology, including...apprenticing with experts. Working with people who are more knowledgeable and skilled is a powerful way of learning. Interaction, guidance and support from experts—both in education and in other professions—is valuable for students. This model works as well when older students mentor younger students; both groups benefit from this experience” (p. 10). • “Fostering 21st century skills requires new approaches to teaching and learning, all of which can be enhanced with technology, including...differentiating instruction to meet individual needs. Students come to school with a wide range of strengths and weaknesses. It is particularly important in this era of accountability for schools to evaluate and meet individual learning needs, which requires a broader repertoire of teaching and learning strategies” (p. 10). <p>Teacher: A1, B1, E1, H1; Student: C1: Ringstaff, C. & Kelley, L. (2002). <i>The learning return on our educational technology investment</i>. San Francisco, CA: WestEd.</p> <ul style="list-style-type: none"> • “One of the most powerful uses of technology in education is to tailor instruction to students’ individual learning needs. Technology can...help teachers accommodate students’ varying learning styles” (p. 6). • “...many researchers investigating the use of technology in education have found that technology is most powerful when used as a tool for problem solving, conceptual development, and critical thinking.... this kind of use consists of learning “with” technology. It involves students using
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<p>1) Provides online opportunities for students to research, ask an expert or work with a mentor to formulate possible solutions and/or create new innovations.</p> <p>F. Teacher integrates a variety of learning resources with instruction to increase learning options.</p> <p>1) Integrates a variety of digital learning resources to increase learning options for all students, i.e., online collaborations/conferences, virtual field experiences, and career explorations.</p> <p>G. Teacher structures and facilitates ongoing formal and informal discussions based on a shared understanding of rules and discourse.</p> <p>H. Teacher integrates the application of inquiry skills into learning experiences.</p> <p>1) Implements effective digital experiences to support student inquiry in authentic situations.</p> <p>I. Teacher clarifies and shares with students learning intentions/targets and criteria for success.</p> <p>1) Communicates learning intentions/targets using online tools (Teacher Web pages, blogs, courses, etc.)</p> <p>Student Characteristics:</p> <p>A. Student articulates and understands learning intentions/targets and criteria for success.</p> <p>1) Uses technology for assignment planning, developing study skills and planning career.</p>	<p>technology to gather, organize, and analyze information, and using this information to solve problems” (p. 5).</p> <p>Teacher A1, B1, F1; Student: C1: Larson, M. B. (2005). <i>AEL framework research: A compilation of literature reviews and meta-analyses</i>. Charleston, WV: Edvantia.</p> <ul style="list-style-type: none"> • Technology integration supports instructional differentiation and benefits all students, especially gifted and intellectually advanced learners, by allowing them acceleration, depth, complexity, and the upper levels of Bloom’s taxonomy: analysis, synthesis, and evaluation (p. 4). • Computer technologies are most effective when designed according to different educational and psychological theories and principles such as socio-cultural learning theory, computer-supported collaborative learning, constructivist theories, and cognitive science. Specifically, research supports ...using computers to design with as well as instruments to collect, analyze, and report data... (p. 14). <p>Teacher: A1, B1: Means, B. & Olson, K. (1995). <i>Technology's role in education reform: Findings from a national study of innovating schools</i>. Washington, D. C.: Office of Educational Research and Improvement.</p> <ul style="list-style-type: none"> • Another way in which technology enhances teachers’ ability to present information is by providing capabilities for easy tailoring of materials for individual students or groups. One of the classrooms studied at the Progressive School made this kind of tailoring a general practice so that the teacher-developed exercises students worked on were better linked to student interests and abilities and to the activities of their specific projects (p. 168). <p>Teacher: B1, C1; Student: C1: Metiri Group (2006). <i>Technology in Schools: What the research says</i>. San Jose, CA: Cisco Systems.</p> <ul style="list-style-type: none"> • “Emergent research suggests that video can add rich context to students’ learning experiences without increasing cognitive load on working memory, translating into increases in complex, higher-order thinking “(p. 5). • “The experimental research findings suggest that the sequencing and scaffolding of learning using simulations and visual modeling positively affects learning” (p. 10) <p>Teacher: B1, C, E1; Student: B1, C1: Bracewell, R., Breuleux, A., Laferriere, T., Benoit, J., & Abdous, M. (1998). <i>The emerging contribution of online resources and tools to classroom learning and teaching</i>. Montreal: Universite Laval.</p> <ul style="list-style-type: none"> • Section 3.2: “...8th graders whose teachers used computers mostly for "simulations and applications" - generally associated with higher-order thinking- performed better on NAEP than students whose teachers did not. Meanwhile, 8th graders whose teachers used computers primarily for "drill and practice" - generally associated with lower-order thinking - performed rather poorly.” • Section 4.1.2: “There is...a wealth of descriptive evidence on the beneficial effects of online collaboration with other students and with experts and other resources beyond the classroom...” • Section 4.1.4: “Studies of students conducting Internet searches have shown that they are more
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<p>2) Uses digital tools and resources to master content.</p> <p>B. Student reads and understands a variety of texts.</p> <p>1) Uses technology to read and understand a variety of print and nonprint texts (multimedia).</p> <p>2) Uses digital tools to communicate effectively.</p> <p>C. Student applies and refines inquiry skills.</p> <p>1) Uses a variety of technological and information resources (e.g. libraries, databases, networks, video, conferences) to gather, evaluate and synthesize information and to create and communicate knowledge.</p> <p>D. Student utilizes technology to develop creative/innovative ideas, products and solutions.</p> <p>1) Uses technology in authentic situations to develop new ideas, products, and solutions across disciplines.</p> <p>2) Selects appropriate technology tools to complete authentic tasks across disciplines.</p> <p>3) Uses digital tools to personalize learning and extend learning towards self-reliance and independence.</p>	<p>successful when search procedures are structured either through modeling by the teacher or through scaffolding using templates to guide the search.... Similarly, studies of students using computer mediated communication to do problem solving and other learning tasks have shown that the use of templates or texts to guide interaction produces more effective communication between participants.”</p> <p>Teacher: B1, H1; Student: C1: Hare, J. C., Ault, M., Niileksela, C. (2009). <i>Technology rich classrooms: Effect of the Kansas Model</i>. Paper presented at the National Meeting of the National Educational Computing Conference, Washington, D. C.</p> <ul style="list-style-type: none"> • “When focused on higher order thinking skills, integrating technology into teaching appears to have a particularly significant effect” (p. 10). • “Technology-rich classrooms were more likely to be engaged in higher level cognitive abilities, such as Knowledge Representation or Knowledge Construction” (p. 19). <p>Teacher B1, C, E1, H1; Student A1, B2, C1: Lemke, C., & Coughlin, E. C. (1998). <i>Technology in American schools: Seven dimensions for gauging progress. A policymaker's guide</i>. The Milken Exchange on Educational Technology.</p> <ul style="list-style-type: none"> • “Connecting learning to the world beyond the classroom can bring relevant, real-life context to the study of basic skills, work skills, and critical thinking. This creates an opportunity for students to access information, communicate with experts and peers and make contributions to knowledge bases through electronic publication” (p. 15). • “New technology can engage students in real-life academics and encourage students to be more independent and responsible for their own learning” (p. 15). • The “Learner” dimension of this document states that the use of technology develops higher level skills by making it “increasingly possible for the student to engage in learning practices that lead to new ways of thinking, understanding, constructing knowledge and communicating results” (p. 18). <p>Teacher: B1, H1; Student: A2: Sivin-Kachala, J. & Bialo, E. (2000). <i>2000 research report on the effectiveness of technology in schools</i> (7th edition). Washington, DC: Software and information Industry Association.</p> <ul style="list-style-type: none"> • Technology has been used effectively to support mathematics curricula that focus on problem solving and hands-on, constructivist, experiential activities. Students participating in such technology-supported learning experiences have demonstrated superior conceptual understanding of targeted math topics than students receiving traditional instruction (p. 10). • Instructional scaffolding—gradually decreasing the level of help available and/or gradually increasing the complexity of the task—can be effective in improving student achievement (p. 12). • When upper elementary students use the Internet to conduct research, they tend to spend more of their time browsing rather than conducting carefully planned searches. Teachers are advised to provide a variety of support, possibly including “natural language” search engines, guided practice in conducting searches, broadly defined research tasks, and instruction in identifying and using relevant source material. These findings may apply to older students with limited Internet research
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experience as well (p. 14).

Teacher: B1, E1, H1; Student: C1, D1: Kozma, R. B. (2003). Technology and classroom practices: An international study. *Journal of Research on Technology in Education*, 36 (1), 1-14.

- The outcomes reported in our cases suggest that when teachers go beyond these basic practices and use technology to also plan and prepare instruction and collaborate with outside actors, and when students also use technology to conduct research projects, analyze data, solve problems, design products, and assess their work, students are more likely to develop new ICT (information and communication technologies), problem solving, information management, collaboration, and communication skills” (p. 13).

Teacher: C, E: Hopson, M. H. Simms, R. L. & Knezek, G. A. (2001-2002). Using a technology-enriched environment to improve higher-order thinking skills. *Journal of Research on Technology in Education*, 34 (2), 109-119.

- The creation of a technology-enriched classroom environment appears to have had a minimal but positive effect on student acquisition of higher-order thinking skills. Although the difference in scores (between experimental and control group students) was not significant for every level of Bloom’s Taxonomy, the scores were generally higher for analysis and synthesis and significantly higher for evaluation (p. 114).

Teacher: C1, G; Student: A2, B2, D1: Marttunen, M. & Laurinen, L. (2007). Collaborative learning through chat discussions and argument diagrams in secondary school. *Journal of Research on Technology in Education*, 40 (1), 109-126.

- This study compared students’ collaborative argument diagrams finished after an on-line debate with diagrams constructed before the debate. Results showed that collaboration not only encouraged students to elaborate their previous arguments but also helped them to recall and create ideas and arguments.

Teacher: D, Student: C1: Partnership for 21st Century Skills (2008). *21st Century Skills, Education & Competitiveness: A resource and policy guide*. Tucson, AZ: Author.

Teacher: E1; Student: C1: CEO Forum on Education and Technology. (2001, June). *The CEO Forum school technology and readiness report: Key building blocks for student achievement in the 21st century*. Retrieved Nov. 10, 2009 from <http://www.ceoforum.org/downloads/report4.pdf>

- “The tailored, customized nature of digital content and technology challenges students to think critically; rather than accept info from a textbook, students access their own information through research, evaluate their sources, and arrive at conclusions supported by evidence” (pp. 9-10);
- “The ability to communicate w/experts inside and outside school enhances the learning process. Students can work on projects together or collaborate w/experts at universities or other students across the country; assessment should include use of graphing calculators, word processing, and student self-assessment tools in computer-based testing “(p. 10).

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Teacher: E1: Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing how and what children learn in school with computer-based technology. *Children and Computer Technology*, 10(2), 76–101.

- “Through the Internet, students from around the world can work as partners to scientists, businesspeople, and policymakers who are making valuable contributions to society” (p. 83).

Teacher: E1; Student: C1: Bebell, D. & Kay, R. E. (2009). *Summary of research findings from the Berkshire 1:1 Laptop Program*. Paper presented at the National Meeting of the National Educational Computing Conference, Washington, D. C.

- “There is supporting evidence that student research skills and collaboration were enhanced by the improved educational access and opportunities afforded by 1:1 computing through the BWLI program....BWLI students and teachers quickly adopted the Internet as a research tool and resource “(p. 35).

Teacher E1; Student: C1, D1: Larson, M. B. (2005). *AEL framework research: A compilation of literature reviews and meta-analyses*. Charleston, WV: Edvantia.

- Whether used to read or write; to acquire knowledge and insight into science, mathematics, and other areas; to express oneself; or to learn content in a new medium, computers can support the expression and development of creativity (p. 9).

Teacher: I1: Ross, J. D., McGraw, T. M., & Burdette, K. (2001). *Toward an effective use of technology in education: A summary of research*. Charleston, WV: AEL.

- The Panel on Educational Technology (1997) suggests ways teachers may use computers and computer networks to support teaching and learning, including that teachers can use computer-mediated communication tools to facilitate dialogue with students, parents, and administrators (p. 7).

Student A2, B2, C1: North Central Regional Educational Laboratory. (2003). *enGauge 21st Century Skills: Literacy in the digital age*. Naperville, IL: Author.

--Students who are technologically literate (p. 22):

- Use communication tools to reach out to the world beyond the classroom and communicate ideas in powerful ways;
- Use technology effectively to access, evaluate, process, and synthesize information from a variety of sources.
- “Most experts agree that students should develop technological skills in the context of learning and solving problems related to academic content” (p. 22).
- “Browsing, searching, and navigating online have become essential skills for all students, as has recognition of the limits of digital archives...Familiarity with natural inquiry, Boolean search strategies, and organizational systems (cataloguing, abstracting, indexing, rating) is extremely important as student locate information from sources across the globe” (p. 26).

Student: A2, C1, D3: Mouza, C. (2008). Learning with laptops: Implementation and outcomes in an

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	<p>urban, under-privileged school. <i>Journal of Research on Technology in Education</i>, 40 (4), 447-472.</p> <ul style="list-style-type: none"> Laptop students became more motivated to complete schoolwork and often went beyond required assignments, thereby improving the quality of their work...Furthermore, students took the initiative to come up with their own classroom projects that made use of technology (p. 463). <p>Student D1, D2: International Technology Education Association (ITEA, 2006). <i>Technological literacy for all: A rationale and structure for the study of technology</i>. Reston, VA: ITEA.</p> <ul style="list-style-type: none"> "...a study of technology can assist the high school student to learn in an interdisciplinary nature by providing relevance to many other school subjects" (p. 27).
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4. Instructional Relevance	Connections to Standards, Research, and Expert Opinion
<p><u>Teacher Characteristics:</u></p> <p>A. Teacher designs learning opportunities that allow students to participate in empowering activities in which they understand that learning is a process and mistakes are a natural part of the learning.</p> <p>B. Teacher links concepts and ideas to students' prior experiences and understandings, using multiple representations, examples and explanations.</p> <p>C. Teacher incorporates student experiences, interests and real-life situations in instruction.</p> <p>D. Teacher selects and utilizes a variety of technology that support student learning.</p> <ol style="list-style-type: none"> 1) Models skills, attitudes, and values associated with digital citizenship. 2) Designs activities that develop and assess levels of digital citizenship in students. 	<p>Teacher: A, F1: CEO Forum on Education and Technology. (2001, June). <i>The CEO Forum school technology and readiness report: Key building blocks for student achievement in the 21st century</i>. Retrieved Nov. 10, 2009 from http://www.ceoforum.org/downloads/report4.pdf</p> <ul style="list-style-type: none"> "One of the most dramatic ways education technology can make learning more dynamic and engaging is by forging real-world contexts for academic exploration. Technology allows educators and students to augment curriculum w/current information and timely study of real-world events" (p.7); "Education technology can help teachers reduce isolation by encouraging communication w/outside experts, peers, students, community members, and parents" (p. 10). <p>Teacher: A; Student: A: Marttunen, M. & Laurinen, L. (2007). Collaborative learning through chat discussions and argument diagrams in secondary school. <i>Journal of Research on Technology in Education</i>, 40 (1), 109-126.</p> <ul style="list-style-type: none"> This study compared students' collaborative argument diagrams finished after an on-line debate with diagrams constructed before the debate. Results showed that collaboration not only encouraged students to elaborate their previous arguments but also helped them to recall and create ideas and arguments. <p>Teacher B, E1, G1, G2; Student D2, F2: International Society for Technology in Education (ISTE), Partnership for 21st Century Skills, & State Educational Technology Directors Association (SETDA) (2007). <i>Maximizing the impact: The pivotal role of technology in a 21st century education system</i>. Washington, D. C.: ISTE.</p> <ul style="list-style-type: none"> "In a 21st century education system, technology must be used comprehensively and purposefully to support students in mastering the full range of what they need to learn—core subjects, 21st century theme and 21st century skills... Technology also must enable students to acquire <i>all</i> of the

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<p>E. Teacher effectively incorporates 21st Century Learning Skills that prepare students to meet future challenges.</p> <ol style="list-style-type: none"> 1) Effectively designs activities to develop 21st Century Learning Skills to prepare students for future careers and post-secondary educational experiences. <p>F. Teacher works with other teachers to make connections between and among disciplines.</p> <ol style="list-style-type: none"> 1) Collaborates with others (e.g., teachers, experts, community, post-secondary), both face-to-face and online, to integrate technology as part of the curriculum while making connections between and among disciplines. 2) Utilizes technologies to engage students in purposeful interdisciplinary authentic experiences that lead students to make connections within and among disciplines and to develop their own meaningful understanding of the content. <p>G. Teacher makes lesson connections to community, society, and current events.</p> <ol style="list-style-type: none"> 1) Integrates multicultural and global perspectives to foster inquiry enabling students to examine their world from personal, community and various cultural perspectives. 2) Utilizes the diversity and culture of each student to build effective learning experiences. 3) Collaborates with students, families and community members with differing 	<p>21st century skills they need to participate fully in the global economy and to manage their own destinies.” (p. 6)</p> <ul style="list-style-type: none"> • Online, collaborative projects with peers or experts in other states or countries can expose them to different cultures and perspectives” (p. 6). • “Fostering 21st century skills requires new approaches to teaching and learning, all of which can be enhanced with technology, including...creating and transforming knowledge for meaningful purposes. Students are more engaged in learning—and they learn more—when they have a stake in their work and when they can <i>do</i> something important with what they know. In the Internet age, everyone can be a content creator and innovator” (p. 7). <p>Teacher: B; Student: B, C: Larson, M. B. (2005). <i>AEL framework research: A compilation of literature reviews and meta-analyses</i>. Charleston, WV: Edvantia.</p> <ul style="list-style-type: none"> • Computer technologies are most effective when designed according to different educational and psychological theories and principles such as socio-cultural learning theory, computer-supported collaborative learning, constructivist theories, and cognitive science. Specifically, research supports ...using computers to design with as well as instruments to collect, analyze, and report data... (p. 14). • Studies show that student achievement is higher when teachers organize instruction around assignments that connect to students’ lives beyond school, demand higher-order thinking, in-depth understanding, and elaborated communication. This technology-integrated learning process allows gifted students to pursue their individual interests within the curriculum to a direction, depth, and subtlety, which they find highly motivating. As a result, students produce more intellectually complex work and perform at a higher level on standardized tests (p. 18). <p>Teacher C; Student D1: Ringstaff, C. & Kelley, L. (2002). <i>The learning return on our educational technology investment</i>. San Francisco, CA: WestEd.</p> <ul style="list-style-type: none"> • “...a high school in Pittsburgh (PA) implemented a computerized “Cognitive Tutor” in its mathematics classes. This tutor presented students with real-world, contextualized problems and built learning profiles of its users. Evaluations showed that Algebra students who used this tutor outperformed students in traditional classes...” (p. 3). • Researchers...noted that technology had an enduring, positive impact on student engagement only under certain conditions, particularly when the technology was integrated into other aspects of the students’ experience (p. 12). <p>Teacher: D1, D2: Pruitt-Mentle, D. (2009). <i>National C3 baseline study: State of cyberethics, safety and security awareness in US schools</i>. Paper presented at the National Meeting of the National Educational Computing Conference, Washington, D. C.</p> <ul style="list-style-type: none"> • “The call for a national focus impacting student and educator awareness and knowledge about C3 efforts has surged recently...A comprehensive national approach to responding to the problem would aim to increase the training opportunities for educators, help bridge the gap between existing Internet awareness curriculum partners, call for expanding content to include a broader range of topics covered under the domains-particular safety and security, and include program
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perspectives to engage students in applying technology knowledge and concepts to examine issues and solve problems relevant to the student, school, community and world.

Student Characteristics:

- A. Student poses and responds to meaningful questions.
- B. Student uses appropriate tools and techniques to gather, analyze, and interpret quantitative and qualitative data.
- C. Student develops descriptions, explanations, predictions and models using evidence.
- D. Student works collaboratively to address complex, authentic problems which require innovative approaches to solve.
 - 1) Interacts with technologies and digital resources to examine the world from personal and community/international perspectives to deepen understanding of content and foster inquiry.
 - 2) Participates in outside-of-school projects and problem-solving activities that have meaning for the students and the community.
- E. Student communicates knowledge and understanding in a variety of real-world forms.
- F. Student communicates knowledge and understanding for a variety of purposes.
 - 1) Implements technology tools to communicate with real-world audiences for a variety of

evaluation. More hands-on training opportunities for educators (not just resources and assemblies), and increased and on-going opportunities for youth throughout the K-12 experience would provide the comprehensive effort needed to close the gap between danger and knowledge.” (p.11)

Teacher: D1, D2, F1: Ross, J. D., McGraw, T. M., & Burdette, K. (2001). *Toward an effective use of technology in education: A summary of research*. Charleston, WV: AEL.

- The Panel on Educational Technology (1997) suggests ways teachers may use computers and computer networks to support teaching and learning, including that teachers can use computer-mediated communication tools to exchange ideas, experiences, and curricular materials; consult with experts in a variety of fields, and facilitate dialogue with students, parents, and administrators (p. 7).
- Educators and parents should help students develop responsible and appropriate Internet use habits...Teachers must also help students learn how to validate the accuracy and evaluate the usefulness of Internet sources. Before beginning an Internet-based project, teachers should demonstrate successful search strategies and review responsible use practices. Students should be familiar with citation strategies for both digital and print materials to avoid plagiarism and copyright infringement. Students should know the consequences of illegal use of digital materials (pp. 71-72).

Teacher: E, Student: F1: Partnership for 21st Century Skills (2008). *21st Century Skills, Education & Competitiveness: A resource and policy guide*. Tucson, AZ: Author.

Teacher F1; Student E, F1: Lemke, C., & Coughlin, E. C. (1998). *Technology in American schools: Seven dimensions for gauging progress*. A policymaker's guide. The Milken Exchange on Educational Technology.

- “Connecting learning to the world beyond the classroom can bring relevant, real-life context to the study of basic skills, work skills, and critical thinking. This creates an opportunity for students to access information, communicate with experts and peers and make contributions to knowledge bases through electronic publication” (p. 15).
- “Network technology... breaks down the isolation of the teaching profession, allowing teachers to connect with each other across vast distances and exchange ideas, share resources and improve practice” (p. 15).
- The “Professional Competency” dimension of this document states that teachers use technology “and communication networks to advance their professional practice” (p. 22)

Teacher F1: Riel, M. & Fulton, K. (2001). The role of technology in supporting learning communities. *Phi Delta Kappan*, 82 (7), 518-523.

- “Communications technology provides opportunities for collaborative learning environments for teachers in which they can reflect on practice with colleagues, share expertise in a distributed knowledge framework, and build a common understanding of new instructional approaches, standards, and curriculum” (p. 522).

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purposes.

- 2) Selects appropriate technology tools and resources and applies technology skills to develop innovative ideas and create solutions.

Teacher F1: Carroll, T. (2007). Teaching for the future. In *Building a 21st century U. S. education system*, B. Wehling & C. Schneider (Eds.), pp. 46-58. National Commission on Teaching and America's Future.

- “To create and sustain... learning communities, teachers...should have an opportunity to use the Internet to extend the reach of their community beyond the boundaries of their school to draw on the wealth of resources and expertise that can be used to strengthen their learning organization” (pp. 49-50).

Teacher F1, F2: International Technology Education Association (ITEA, 2006). *Technological literacy for all: A rationale and structure for the study of technology*. Reston, VA: ITEA.

- “...a study of technology can assist the high school student to learn in an interdisciplinary nature by providing relevance to many other school subjects” (p. 27).

Teacher: F1, G3; Student: B, D, F2: Kozma, R. B. (2003). Technology and classroom practices: An international study. *Journal of Research on Technology in Education*, 36 (1), 1-14.

- “The outcomes reported in our cases suggest that when teachers go beyond these basic practices and use technology to also plan and prepare instruction and collaborate with outside actors, and when students also use technology to conduct research projects, analyze data, solve problems, design products, and assess their work, students are more likely to develop new ICT (information and communication technologies), problem solving, information management, collaboration, and communication skills” (p. 13).

Teacher: F2; Student: D1: Ringstaff, C. & Kelley, L. (2002). *The learning return on our educational technology investment*. San Francisco, CA: WestEd.

- “...many researchers investigating the use of technology in education have found that technology is most powerful when used as a tool for problem solving, conceptual development, and critical thinking.... this kind of use consists of learning “with” technology. It involves students using technology to gather, organize, and analyze information, and using this information to solve problems” (p. 5).
- Interdisciplinary, project-based learning was commonplace at this site [that was participating in a project that equipped classrooms with computers], where teachers worked in teams to integrate technology into the curricular framework (p. 7).

Teacher: G1; Student B, D1, D2, E, F1, F2: North Central Regional Educational Laboratory. (2003). *enGauge 21st Century Skills: Literacy in the digital age*. Naperville, IL: Author.

--Students who are technologically literate (p. 22):

- Use communication tools to reach out to the world beyond the classroom and communicate ideas in powerful ways.
- Use technology to identify and solve complex problems in real-world contexts.

--Students who are information literate:

- Identify different sources of information including text, people, video, audio, and databases;

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	<ul style="list-style-type: none"> • Identify and retrieve relevant information from sources; use technology to enhance searching; • Use retrieved information to accomplish a specific purpose; • Present information clearly and persuasively using a range of technology tools and media; • Evaluate the processes and products of these activities, including resulting social consequences (p. 26). <p>--“Every student should have the opportunity to interact cross-culturally in meaningful ways. Such interaction might include, for example, communicating via e-mail or videoconference with peers in other countries to enhance language proficiency; participating in a shared environmental science project; or sharing viewpoint on international events via moderated, online exchanges...The learning that takes place...can serve as a bridge to openness and appreciation of diversity and other cultures” (p. 28).</p> <p>--“In today’s wired, networked society, it is imperative that students learn to communicate effectively using a range of media, technology, and environments...expertise in the use of these new interactive communication conventions is as essential to students as expertise with phones was a decade ago” (p. 56).</p> <p>Teacher: G3; Student: D1, D2, F1: Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing how and what children learn in school with computer-based technology. <i>Children and Computer Technology</i>, 10(2), 76–101.</p> <ul style="list-style-type: none"> • “Computer technology can provide students with an excellent tool for applying concepts in a variety of contexts, thereby breaking the artificial isolation of school subject matter from real-world situations” (p.82); • “A study of a social studies project found that students who used computers to create a multi-media presentation of what they had learned scored higher on a post-test than students who completed a textbook unit on the same topic” (p.89). <p>Student: A, B, C, D1: Mouza, C. (2008). Learning with laptops: Implementation and outcomes in an urban, under-privileged school. <i>Journal of Research on Technology in Education</i>, 40 (4), 447-472.</p> <ul style="list-style-type: none"> • Laptop students became more motivated to complete schoolwork and often went beyond required assignments, thereby improving the quality of their work...Furthermore, students took the initiative to come up with their own classroom projects that made use of technology (p. 463).
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<h3>5. Knowledge of content</h3>	<h3>Connections to Standards, Research, and Expert Opinion</h3>
<p>Teacher Characteristics: A. Teacher demonstrates an understanding and in-depth knowledge of content and maintains an ability to convey this content to students.</p>	<p>Teacher: A1, A2, B2, C1, E1, E2, F2: Means, B. & Olson, K. (1995). <i>Technology's role in education reform: Findings from a national study of innovating schools</i>. Washington, D. C.: Office of Educational Research and Improvement.</p> <ul style="list-style-type: none"> • In addition to learning how to use a variety of technology applications themselves, teachers need

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<p>1) Demonstrates proficient use of technology tools and resources to facilitate experiences that advance student learning, creativity and innovation in both face-to-face and virtual environments.</p> <p>2) Demonstrates continual growth in technology knowledge, skills and pedagogy to support student learning.</p> <p>B. Teacher maintains ongoing knowledge and awareness of current content developments.</p> <p>1) Participates in local and global learning communities/professional development that supports 21st Century Skills, digital citizenship, and applications of technology to improve his/her own learning.</p> <p>2) Keeps abreast of current developments in education technology and facilitates effective use of digital tools to support student learning.</p> <p>C. Teacher designs and implements standards-based courses/lessons/units using state and national standards.</p> <p>(1) Designs, develops and evaluates authentic learning experiences incorporating technology tools and resources to promote student learning and creativity.</p> <p>(2) Designs and adapts relevant learning experiences incorporating universal designs for learning (UDL) to include multiple means of representation, action and expression, and engagement .</p> <p>D. Teacher uses and promotes the understanding of</p>	<p>to develop criteria for selecting applications and skill in weaving them into broader instructional activities, strategies for allocating time for technology access among students, and techniques for managing technology-based instruction within the classroom. All of these decisions need to be closely tied to an examination of curriculum issues and the intended learning outcomes (p. 29).</p> <ul style="list-style-type: none"> • In our case study projects, such early adopters showed themselves not only willing to spend their own time to learn about technology but also willing to spend time on chores such as learning to repair computers and keep a network operating, scheduling equipment rotations, and advising their fellow teachers on technology options (p. 77). • The most ambitious and successful technology-supported projects typically were planned and executed by teacher teams rather than a teacher working alone. All the well-known advantages of teamwork, such as multiple sources of inspiration, expertise, and energy, apply to the difficult job of bringing off a student-centered classroom. When teachers work together, they seem to plan more far-reaching and ambitious activities than when they work in isolation (p. 5). • Both observational and interview data from our case studies provide confirming evidence for the proposition that technology is an important enabler for classes organized around complex, authentic tasks. When technology is used in support of challenging projects, it in turn can contribute to students’ sense of authenticity and to the “real-life” quality of the task at hand. As one teacher put it, students need to feel that they are “using real tools for real purposes” (p. 135). • Another way in which technology enhances teachers’ ability to present information is by providing capabilities for easy tailoring of materials for individual students or groups. One of the classrooms studied at the Progressive School made this kind of tailoring a general practice so that the teacher-developed exercises students worked on were better linked to student interests and abilities and to the activities of their specific projects (p. 168). <p>Teacher A1, A2, C1, C2, F2; Student: A2, D2: Ringstaff, C. & Kelley, L. (2002). <i>The learning return on our educational technology investment</i>. San Francisco, CA: WestEd.</p> <ul style="list-style-type: none"> • “...a high school in Pittsburgh (PA) implemented a computerized “Cognitive Tutor” in its mathematics classes. This tutor presented students with real-world, contextualized problems and built learning profiles of its users. Evaluations showed that Algebra students who used this tutor outperformed students in traditional classes...” (p. 3). • Researchers...noted that technology had an enduring, positive impact on student engagement only under certain conditions, particularly when the technology was integrated into other aspects of the students’ experience (p. 12). • A variety of studies indicate that technology will have little effect unless teachers are adequately and appropriately trained. Studies suggest that teachers who receive formal training use technology more frequently for instruction, and this use can lead to significant improvements in student achievement. According to a report by the National Center for Education Statistics (1999b), teachers who report feeling prepared to teach using technology use it more frequently and in a greater variety of ways, and are more likely to have their students use technology as a tool in tasks that require higher-order thinking (pp. 12-13) • When compared to their peers in [non-computer equipped classrooms], project students routinely employed inquiry, collaborative, technological, and problem-solving skills uncommon to
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<p>appropriate content vocabulary.</p> <ol style="list-style-type: none"> 1) Uses vocabulary to demonstrate digital citizenship. 2) Uses vocabulary to facilitate hardware, software and systems learning. <p>E. Teacher provides essential supports for students who are struggling with the content.</p> <ol style="list-style-type: none"> 1) Provides essential and specialized technology support for students who, for a variety of reasons (language, disability, etc.) struggle with successfully attaining the content. 2) Collaborates with other professionals to make informed decisions and adapt content for student learning. <p>F. Teacher accesses a rich repertoire of instructional practices, strategies, resources and applies them appropriately.</p> <ol style="list-style-type: none"> 1) Researches best practices in order to select appropriate technology tools and resources to maximize content learning. 2) Utilizes technology tools and resources to support content in authentic, meaningful ways which require students to use critical thinking skills. <p><u>Student Characteristics:</u></p> <p>A. Student demonstrates growth in content knowledge.</p> <ol style="list-style-type: none"> 1) Selects technology tools to support and enhance his/her content knowledge to be more fully engaged in the learning. 2) Demonstrates critical thinking skills using appropriate digital tools and resources to 	<p>graduates of traditional high school programs. Interdisciplinary, project-based learning was commonplace at this site, where teachers worked in teams to integrate technology into the curricular framework (p. 7).</p> <ul style="list-style-type: none"> • "...many researchers investigating the use of technology in education have found that technology is most powerful when used as a tool for problem solving, conceptual development, and critical thinking.... this kind of use consists of learning "with" technology. It involves students using technology to gather, organize, and analyze information, and using this information to solve problems" (p. 5). <p>Teacher: A2: Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., & Means, B. M. (2000). Changing how and what children learn in school with computer-based technology. <i>Children and Computer Technology</i>, 10(2), 76–101.</p> <ul style="list-style-type: none"> • Studies show that a teacher’s ability to help students depends on a mastery of the structure of the knowledge in the domain to be taught. Teaching with technology is no different in this regard. Numerous literature surveys link student technology achievement to teachers’ opportunities to develop their own computer skills (p. 90). <p>Teacher B1, E2: Riel, M. & Fulton, K. (2001). <i>The role of technology in supporting learning communities</i>. Phi Delta Kappan, 82 (7), 518-523.</p> <ul style="list-style-type: none"> • “Communications technology provides opportunities for collaborative learning environments for teachers in which they can reflect on practice with colleagues, share expertise in a distributed knowledge framework, and build a common understanding of new instructional approaches, standards, and curriculum” (p. 522). <p>Teacher B1, F1: Carroll, T. (2007). Teaching for the future. In <i>Building a 21st century U. S. education system</i>, B. Wehling & C. Schneider (Eds.), pp. 46-58. National Commission on Teaching and America's Future.</p> <ul style="list-style-type: none"> • “To create and sustain... learning communities, teachers...should have an opportunity to use the Internet to extend the reach of their community beyond the boundaries of their school to draw on the wealth of resources and expertise that can be used to strengthen their learning organization” (pp. 49-50). <p>Teacher B1, F1, F2; Student: C1: Lemke, C., & Coughlin, E. C. (1998). <i>Technology in American schools: Seven dimensions for gauging progress. A policymaker's guide</i>. The Milken Exchange on Educational Technology.</p> <ul style="list-style-type: none"> • “Connecting learning to the world beyond the classroom can bring relevant, real-life context to the study of basic skills, work skills, and critical thinking. This creates an opportunity for students to access information, communicate with experts and peers and make contributions to knowledge bases through electronic publication” (p. 15). • The “Learner” dimension of this document states that the use of technology develops higher level schools by making it “increasingly possible for the student to engage in learning practices that lead to new ways of thinking, understanding, constructing knowledge and communicating results”
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<p>plan, conduct research, manage projects, solve problems and make informed decisions.</p> <p>3) Demonstrates digital citizenship by using technology appropriately</p> <p>B. Student uses and seeks to expand appropriate content vocabulary.</p> <p>1) Extracts knowledge and information from reference materials, technical manuals, literature, and other texts (print and online) that are characterized by demanding and context-dependent vocabulary.</p> <p>2) Uses vocabulary to demonstrate digital citizenship and technology knowledge</p> <p>C. Student connects ideas across content areas.</p> <p>1) Effectively uses a variety of technology tools and resources to articulate knowledge in meaningful ways across disciplines and his/her life.</p> <p>2) Effectively uses a variety of technology tools and resources to extend his/her own learning in school and local/international community.</p> <p>D. Student uses ideas in realistic problem-solving situations.</p> <p>1) Demonstrates and models digital citizenship and responsibility.</p> <p>2) Uses appropriate digital resources and critical thinking skills to problem solve and make informed decisions in his/her life.</p>	<p>(p. 18).</p> <ul style="list-style-type: none"> • “Network technology... breaks down the isolation of the teaching profession, allowing teachers to connect with each other across vast distances and exchange ideas, share resources and improve practice” (p. 15). • The “Professional Competency” dimension of this document states that teachers use technology “and communication networks to advance their professional practice” (p. 22) <p>Teacher B1, E2, F1: International Society for Technology in Education (ISTE), Partnership for 21st Century Skills, & State Educational Technology Directors Association (SETDA) (2007). <i>Maximizing the impact: The pivotal role of technology in a 21st century education system</i>. Washington, D. C.: ISTE.</p> <ul style="list-style-type: none"> • “Technology also can be an extraordinary support for teachers, who can use it to become more effective in their classrooms. Standards and standards-based lessons and multimedia resources available online can provide teachers with exemplary models, research-based strategies and useful materials” (p. 10). • “Such technologies as videoconferencing, online learning, networking and instant messaging can support professional development and professional learning communities. Using technologies like these, educators can learn and collaborate with peers, mentors, experts and community members. routinely. They can build ongoing professional relationships, develop capacity in teaching 21st century skills, benefit from just-in-time communications, and reduce the time and expense of travel” (p. 13). <p>Teacher: B1, D1, E2, F1; Student: A3, B2, D1: Ross, J. D., McGraw, T. M., & Burdette, K. (2001). <i>Toward an effective use of technology in education: A summary of research</i>. Charleston, WV: AEL.</p> <ul style="list-style-type: none"> • The Panel on Educational Technology (1997) suggests ways teachers may use computers and computer networks to support teaching and learning, including that teachers can use computer-mediated communication tools to exchange ideas, experiences, and curricular materials; consult with experts in a variety of fields; and facilitate dialogue with students, parents, and administrators (p. 7). • Educators and parents should help students develop responsible and appropriate Internet use habits...Teachers must also help students learn how to validate the accuracy and evaluate the usefulness of Internet sources. Before beginning an Internet-based project, teachers should demonstrate successful search strategies and review responsible use practices. Students should be familiar with citation strategies for both digital and print materials to avoid plagiarism and copyright infringement. Students should know the consequences of illegal use of digital materials (pp. 71-72). <p>Teacher: B1: Sivin-Kachala, J. & Bialo, E. (2000). <i>2000 research report on the effectiveness of technology in schools</i> (7th edition). Washington, DC: Software and information Industry Association.</p> <ul style="list-style-type: none"> • Specific characteristics of the learning environment help to maximize the benefits of educational technology, including: Exemplary computer-using educators benefit from a social network of other computer-using educators at their school (p. 13).
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Teacher: B1; Student: A2, D2: Kozma, R. B. (2003). Technology and classroom practices: An international study. *Journal of Research on Technology in Education*, 36 (1), 1-14.

- “The outcomes reported in our cases suggest that when teachers go beyond these basic practices and use technology to also plan and prepare instruction and collaborate with outside actors, and when students also use technology to conduct research projects, analyze data, solve problems, design products, and assess their work, students are more likely to develop new ICT (information and communication technologies), problem solving, information management, collaboration, and communication skills” (p. 13).

Teacher: B1, D1; Student: A3, B2, D1: Pruitt-Mentle, D. (2009). *National C3 baseline study: State of cyberethics, safety and security awareness in US schools*. Paper presented at the National Meeting of the National Educational Computing Conference, Washington, D. C.

- “The call for a national focus impacting student and educator awareness and knowledge about C3 efforts has surged recently...A comprehensive national approach to responding to the problem would aim to increase the training opportunities for educators, help bridge the gap between existing Internet awareness curriculum partners, call for expanding content to include a broader range of topics covered under the domains-particular safety and security, and include program evaluation. More hands-on training opportunities for educators (not just resources and assemblies), and increased and on-going opportunities for youth throughout the K-12 experience would provide the comprehensive effort needed to close the gap between danger and knowledge.” (p.11)

Teacher: B1, D1; Student: A3, B2, D1: Wright, V.H. (2009). *Cyberbullying: Using virtual scenarios to educate and raise awareness*. Paper presented at the National Meeting of the National Educational Computing Conference, Washington, D. C.

- “At this time, there is a need to raise awareness about the effects of cyberbullying and to create educational opportunities to serve multiple audiences (i.e., teachers, teacher educators, school administrators, school counselors, mental health professionals, students, parents) in the quest to identify and hopefully prevent cyberbullying in the future” (p. 3)

Teacher: C1, C2, F2; Student: A2, B1: CEO Forum on Education and Technology. (2001, June). *The CEO Forum school technology and readiness report: Key building blocks for student achievement in the 21st century*. Retrieved Nov. 10, 2009 from <http://www.ceoforum.org/downloads/report4.pdf>

- “One of the most dramatic ways education technology can make learning more dynamic and engaging is by forging real world contexts for academic exploration. Technology allows educators and students to augment curriculum w/current information and timely study of real-world events” (p.7)
- “The tailored, customized nature of digital content and technology challenges students to think critically; rather than accept info from a textbook, students access their own information through research, evaluate their sources, and arrive at conclusions supported by evidence” (pp. 9-10);

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Teacher: E2: Kalay, P. & Chen, D. (2002). Integrating a decision support system into a school: The effects on student functioning. *Journal of Research on Technology in Education*, 34 (4), 435-452.

- A significant improvement was seen in student achievement, student mobility rates, and dropout rates after the school began using a student information system to plan teaching and learning.... Improvement in student outcomes “shows that objective professional judgment led to an improvement in the quality of the learning environment for most of the students”...and “support the research assumption and the basic perception of adaptive teaching that better adaptation between the student and the learning environment has a positive influence on educational achievement” (p. 449).

Teacher: F2: Sivín-Kachala, J. & Bialo, E. (2000). *2000 research report on the effectiveness of technology in schools* (7th edition). Washington, DC: Software and information Industry Association.

- Studies focusing on science education suggest the benefits of simulations, microcomputer-based laboratories, video to anchor instruction to real-world problems, and software that targets students’ misconceptions (p. 10).

Teacher: F2: Bracewell, R., Breuleux, A., Laferriere, T., Benoit, J., & Abdous, M. (1998). *The emerging contribution of online resources and tools to classroom learning and teaching*. Montreal: Université Laval.

- **Section 3.2:** “...8th graders whose teachers used computers mostly for "simulations and applications" - generally associated with higher-order thinking- performed better on NAEP than students whose teachers did not. Meanwhile, 8th graders whose teachers used computers primarily for "drill and practice" - generally associated with lower-order thinking - performed rather poorly.”

Teacher: F2; Student: A2: Hare, J. C., Ault, M., Niileksela, C. (2009). *Technology rich classrooms: Effect of the Kansas Model*. Paper presented at the National Meeting of the National Educational Computing Conference, Washington, D. C.

- “When focused on higher order thinking skills, integrating technology into teaching appears to have a particularly significant effect” (p. 10).
- “Technology-rich classrooms were more likely to be engaged in higher level cognitive abilities, such as Knowledge Representation or Knowledge Construction” (p. 19).

Student A1, A2, A3, B1, B2, C1, C2, D1: North Central Regional Educational Laboratory. (2003). *enGauge 21st Century Skills: Literacy in the digital age*. Naperville, IL: Author.

--Students who are technologically literate (p. 22):

- Use communication tools to reach out to the world beyond the classroom and communicate ideas in powerful ways;
- Use technology effectively to access, evaluate, process, and synthesize information from a variety of sources.

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	<ul style="list-style-type: none">• “Most experts agree that students should develop technological skills in the context of learning and solving problems related to academic content” (p. 22).• “Browsing, searching, and navigating online have become essential skills for all students, as has recognition of the limits of digital archives...Familiarity with natural inquiry, Boolean search strategies, and organizational systems (cataloguing, abstracting, indexing, rating) is extremely important as student locate information from sources across the globe” (p. 26).• Students who are technologically literate...understand and model positive, ethical use of technology in both social and personal contexts (p. 22).• “...as students access electronic resources, it is critical that they recognize the importance of honoring the intellectual property of others by strictly adhering to copyright and fair use laws” (p. 26).• “Every student should have the opportunity to interact cross-culturally in meaningful ways. Such interaction might include, for example, communicating via e-mail or videoconference with peers in other countries to enhance language proficiency; participating in a shared environmental science project; or sharing viewpoint on international events via moderated, online exchanges...The learning that takes place...can serve as a bridge to openness and appreciation of diversity and other cultures” (p. 28).• “In today’s wired, networked society, it is imperative that students learn to communicate effectively using a range of media, technology, and environments...expertise in the use of these new interactive communication conventions is as essential to students as expertise with phones was a decade ago” (p. 56). <p>Student: C1, C2: Mouza, C. (2008). Learning with laptops: Implementation and outcomes in an urban, under-privileged school. <i>Journal of Research on Technology in Education</i>, 40 (4), 447-472.</p> <ul style="list-style-type: none">• Laptop students became more motivated to complete schoolwork and often went beyond required assignments, thereby improving the quality of their work...Furthermore, students took the initiative to come up with their own classroom projects that made use of technology (p. 463).
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Additional Resources

Kentucky Department of Education *Program of Studies, Revised 2006*

Kentucky Department of Education Academic Expectations

Kentucky Department of Education *Core Content for Assessment, Version 4.1*

Kentucky Department of Education *Standards and Indicators for School Improvement*

Kentucky Department of Education *Guide for Reflective Classroom Practices: A Self-Assessment Tool for Teachers (draft)*