Case Study Analysis

in an

Enhancing Education through Technology (EETT)Program Evaluation

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Abstract

This paper describes case studies conducted in a multi-site, multi-method evaluation of a statewide Enhancing Education through Technology (EETT) program. The case study analysis examined grant implementation and outcomes in nine participating school districts through four visits to each district during which evaluators collected information through observations, interviews, and analysis of extant data. Results suggest increased student and teacher access to technology, and teacher engagement in professional development related to technology use and integration. Despite the professional development and support provided by technology staff and peers, the majority of the observed technology use was at the Adoption (Low) level, with a minority at the Adaptation (Medium) level. Teachers used document cameras and Smart Boards to present information and incorporated this technology into existing lessons and activities rather than significantly changing their teaching strategies. Student technology products were most often Power Point presentations, slide shows, or movies. In few cases did student products require higher-level engagement with technology.

Purpose and Conceptual Framework

The U. S. Department of Education has invested in several programs to provide funding to improve access to and improve student performance through technology, most recently through American Recovery and Reinvestment Act's (ARRA) funding for the Enhancing Education through Technology (EETT) program, Race to the Top, and related programs. EETT program funds were intended specifically to target students' learning through technology literacy and innovation. Between 2002 and 2010, states received $3.73 billion in funding through EETT program funds and an ARRA supplemental appropriation (Education Week, September 1, 2011). In addition to EETT, the E-Rate program also supports technology infrastructure growth in schools and libraries that serve populations with high economic needs. The E-Rate Program was established by the FCC in 1996 to subsidize telecommunications services and development of Internet infrastructure (Telecommunications Act of 1996). In 2010, E-Rate provided $2.3 billion in support to applicants (Universal Service Administrative Company, www.usac.org, 2012).

Due to the investments in infrastructure that schools have made over the last two decades, today's schools are digitally connected, an important step toward one of EETT's key program objectives—ensuring equitable technology access in high-poverty, high-need schools. By 2005, 100% of U. S. public schools reported having Internet access, compared to 35% in 1994 and about one computer for every four students (Bausell 2008; National Center for Education Statistices, 2005).

This paper describes the findings of nine case studies conducted as part of a multi-site, multi-method evaluation of the Illinois EETT grant. The evaluation assessed the degree to which districts leveraged technology resources (e.g., connectivity, hardware, and software) to support integrated and sustained teacher and student technology use and the impact of technology use on student, parent, and community outcomes. The case study analysis portion of the statewide evaluation of Illinois' EETT examined grant implementation and outcomes in nine participating school districts. The information informed the participating school districts and the Illinois State Board of Education (ISBE) about the process of technology integration in the selected schools and contributed to the literature about technology use in schools.

Technology Integration

The primary goal of EETT is to improve student academic achievement through the use of educational technologies (U.S. Department of Education, 2007). EETT ARRA funding had the additional specific goals of increasing teacher effectiveness through high-quality professional development, using advanced technology systems to track student progress and foster continuous improvement, implementing technology-enhanced strategies that support rigorous standards and high-quality assessments, and improving access to and effective use of advanced technologies to turn around the lowest-performing schools. The presence of computers and network connections in schools is necessary but insufficient to meet those goals.

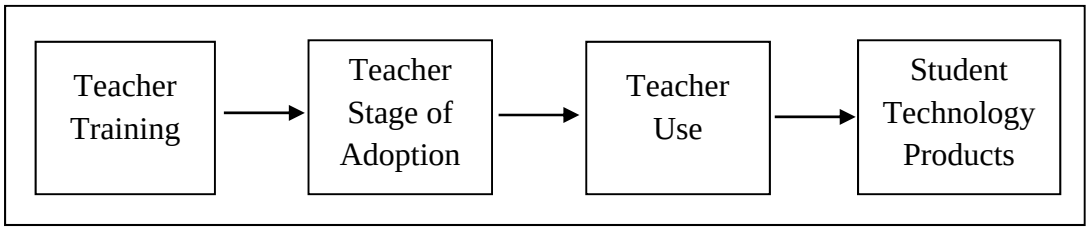
The EETT projects that school districts implemented attempted to address the challenges that teachers and schools face in using technology to improve classroom teaching practices (Cuban, Kirkpatrick, and Peck, 2001; Lim and Chai 2008; Lowther et al. 2008; Ross et al. 2004; Rutherford 2004; Smeets 2005). The grant funding provided staff with access to technology that the district had identified as relevant and useful and also to support by peers or technology staff (Bauer and Kenton 2005; Clark 2006; Davis et al. 2009; Hohlfeld et al. 2008; Hernandez-Ramos 2005; Lumpe and Chambers 2001; Mumtaz 2005; NCES 2000; Norris et al. 2003; Ringstaff and Kelly 2002; Van Melle et al. 2003). In addition to technology support, school districts planned professional development experiences that included training in using specific hardware and software, as well as opportunities for teachers to prepare lessons using the technology (Bauer and Kenton 2005; Bradshaw 2002; Cuban et al. 2001; Earle 2002; Feist 2003; Glazer et al. 2005; Koehler and Mishra 2005). District and school staff worked together to change the school culture to promote technology use and adoption of novel teaching practices. Administrators were expected to participate in and support grant activities, including using data to measure student outcomes and inform school improvement (Davis et al. 2009; Hernandez-Ramos 2005; Lim and Chai 2008; O'Dwyer et al. 2004; Roschelle et al. 2001; Vanatta and Fordham 2004; Zhao and Frank). All of these activities and supports were intended to support teachers' technology use and ensure that teachers were open to change and had positive attitudes about and experiences with technology integration (Chen 2008; Jimoyiannisa and Komisb 2007; Lim and Chai 2008;

Lim and Khine 2006; Lumpe and Chambers 2001; Van Braak et al. 2004; Vannatta and Fordham 2004; Wozney et al. 2006; Zhao et al. 2002).

The conceptual framework for the evaluation was based on prior research on technology integration (See Figure 1) and the theories of action that the grantees identified in their project logic models. The framework posits that teacher training, which includes technology support, time to learn and try new technology, and support of peers and colleagues, leads to changes in stage of technology adoption, which in turn leads to higher levels of technology use, which in turn leads to student technology products that demonstrate student acquisition of 21st century knowledge and skills (Christensen, 2002, Davies, 2011). The highest level of student and teacher technology use is described as phronesis (Davies, 2011), and is technology used to augment learning and focus on authentic tasks. Mishra and Koehler (2006) describe this level as technological pedagogical content knowledge (TPACK) – effectively using technology and understanding why the technology accomplishes learning goals.

This model focused on the professional development and support that teachers received as part of the project, examined teacher attitudes, and teacher use of technology, and ultimately focused on the extent to which students used technology to accomplish specific learning objectives and facilitate student learning (Davies, 2011).

Figure 1. Model of Technology Integration and Outcomes



Case Study Methods

The overall evaluation of the Illinois EETT grant was conducted using a mixed methods design that included collection of student achievement data, analysis of student technology products, and case studies conducted in nine school districts. The case study portion of the evaluation used a multiple case study approach (Stake, 2006) to examine the context and dynamics of the programs in the selected sites (Darke, Shanks, & Broadbent, 1998). The case studies were intended to generate explanatory results, and thus were primarily exploratory and descriptive (Yin, 2003), intrinsic and instrumental (Stake, 1995), and illustrative (Davey, 1991). The analysis within and between cases was expected to yield insights about the overall project.

Case Study Questions

Table 1 lists the research questions for the case study portion of the Illinois EETT evaluation. The questions were grounded in the four project objectives: support to improve access to and

effective use of advanced technologies; teacher effectiveness; advanced technology systems to collect, manage, and analyze data to track student progress; and technology-integrated strategies to foster continuous improvement.

Table 1. Case Study Research Questions

Area: 1. Access to and use of advanced technologies
What was the quality of technology access and technical support in case study schools? To what extent was technology used in teaching and learning?
Area: 2. Teacher effectiveness
How did professional development and other support systems relate to teachers' technology adoption and use and student demonstration of 21st century skills in case study schools?
Area: 3. Technology systems to track student progress.
To what extent did teachers, schools, and parents in case study schools use technology systems to track student progress?
Area: 4. Technology-integrated strategies to improve school effectiveness
What effective practices and lessons were learned from case study schools that can inform policy and practice related to technology integration in schools statewide?

Case Study Sites

The evaluation team, in collaboration with program staff at the Illinois State Board of Education (ISBE), selected nine school districts that received grants through the statewide EETT program to participate in the case study portion of the evaluation. According to ISBE staff, these nine districts had generally strong implementations and timely reporting of progress. Two case study evaluators visited each school in the nine districts that participated in EETT grant-funded activities. The unit of analysis was the school district.

The nine districts reflected EETT grant projects statewide, including source of funding, geographic location, urbanicity, and racial composition (see Table 2). The sample included districts that were funded in each of three successive rounds of EETT grant competitions. Three grantees received funding through the first round of federal EETT grants, three grantees through the second round of federal stimulus dollars, four grantees through the third round federal stimulus dollars, and one grantee was awarded both second- and third-round funding.

The schools varied in their demographic makeup (see Table 1). Case study districts enrolled between 880 and 3,492 students. Four were K-8 districts, three were K-12 districts, and two were high school districts. Five case study districts were rural and four were urban. Free and reduced lunch rates ranged from 15 percent to 84 percent. In six districts, the majority of students were white, and three districts had more minority students than white students. One district had more Hispanic students than students from any other ethnic group.

Table 2. Characteristics of 2010-2011 EETT Grantee Case Study Districts

District Name	Funding Source	Enroll-ment	Grade Level	Urban / City	Geo-graphic Location	% Caucasian	% African American	% Hispanic	% Asian	% Free / Reduced Lunch
School A	Round 1-EETT	1,125	9-12	Rural (town)	Southern IL	59.8	25.9	4.2	4.8	43.1
School B	Rounds 2 and 3-SRTT	1,463	K-12	Rural (town)	Central Illinois	94.4	1.6	0.9	0.4	37.2
School C	Round 3-SRTT	942	K-8	Suburban	South Chicago suburbs	3.1	75.1	19.7	0.3	84.2
School D	Round 3-SRTT	1,408	K-12	Rural town	East central IL	96.9	0.6	0.6	0.9	27.1
School E	Round 2-SRTT	1,991	K-12	Rural	North central	90.1	1.1	6.1	0.7	15.1
School F	Round 2-SRTT	3,492	K-8	Suburban	STL Metro East	72.7	17.4	2.8	2.8	18.5
School G	Round 3-SRTT	860	9-12	Rural town	North central IL	90.2	0.9	2.8	0.5	27.7
School H	Round 1-EETT	2127	K-8	Suburban	West Chicago suburbs	24.5	5.5	44.3	22.0	23.1
School I	Round 1-EETT	1,126	K-8	Suburban	South Chicago suburbs	6.5	75.6	14.5	1.4	61.2

Data Sources

Evaluators conducted four visits to each school in the 2010-2011 school year. Visitors conducted teacher, principal, and EETT staff interviews; observations; and reviews of extant data.

Case Study Interview Protocol. Site visitors used an interview protocol (see Appendix A) that the evaluation team adapted from the International Society for Technology in Education (ISTE), National Education Technology Standards for Students (NETS-S, 2007), teachers (NETS-T, 2008), and administrators (NETS-A, ISTE, 2009b). The interview protocol asked respondents to reflect on the extent to which the school implemented NETS and 21st Century skills for teachers and students, including how school personnel helped students learn to use technology to communicate and collaborate, think critically and solve problems, gather information effectively, and create products to achieve core subject mastery and be effective lifelong learners. Validity of the interview protocol was supported through triangulation of interview data with lesson plans, student products, project logic models, and action plans as well as a member-checking process with case study district representatives.

TIMMS Technology Integration Classroom Observation Log. Site visitors conducted observations during the site visits using a protocol adapted from the Technology Observation Instrument (Timms, 2002); the CETP Core Evaluation Classroom Observation Protocol (Lawrenz, Huffman, & Appeldoorn, 2002); and the Classroom Observation Tool (ISTE, 2009a). The quality of the development of the TIMMS instrument was documented by Dirr (2003). Content validity is supported through alignment with NETS for students.

Extant Data. School staff provided site visitors with documents that illustrated their program implementation including project logic models, lesson plans, professional development plans, school improvement plans, technology plans, grant documents, and student products.

Data Analysis

The case study portion of this evaluation followed an interpretive case study approach (Stake, 1995), using the constant comparative method for data analysis (Glaser & Strauss, 1967). This approach to data collection and analysis allowed for a structured examination of the context and dynamics of the programs in the nine sites (Darke, Shanks, & Broadbent, 1998).

To ensure consistent coding across the nine sites, the evaluators developed a coding schema to analyze the level of technology use, stage of technology adoption, and school supports and context. Pre-established technology taxonomies in these three categories assisted with coding.

Levels of technology use. In order to assess the level of technology use in classrooms and across school districts, the case study evaluators aligned the Levels of Technology Use and Understanding, a single-item instrument developed by Apple Classrooms of Tomorrow (ACOT) (Clark, 2002; Dwyer,199) with the three-level rating of the Technology Observation Instrument

(Timms, 2001) that was used in case study observations. The lowest and highest of the five ACOT levels, non-use and invention, were excluded in this alignment because neither level of use was observed in any of the sites. This adaptation resulted in a simple taxonomy that aligned observation results with interview results (see Table 3). The levels of technology use were rated as Adoption (Low), Adaptation (Medium), or Appropriation (Advanced).

Table 3. Alignment of ACOT and Timms for Coding of Observed Levels of Technology Use

Level of Use		Description
Apple Classrooms of Tomorrow Instrument	**Technology Observation Instrument**	
Adoption	Low	Teacher's technology use is simple, student use is prescriptive or none, topic integration is low.
Adaptation	Medium	Teacher's tech use is moderately complex, student use is somewhat self-directed, topic integration is medium.
Appropriation	High	Teacher's tech use is advanced, students guide and shape learning with technology, topic integration is high.

Stages of technology adoption. In addition to examining the levels of technology use among schools and school districts, the evaluation team was also interested in understanding the level of adoption of technology. To code interview and observation data related to the stages of teachers' technology adoption, the two case study evaluators used the Stages of Adoption of Technology instrument (See Table 4), which has been shown to be well-aligned with the construct of technology integration (Christensen, 1997; Hancock, Knezek, & Christensen, 2007).

Table 4. Stages of Adoption of Technology

Adoption of Technology Stage	Description
Stage 1: Awareness	I am aware that technology exists but have not used it - perhaps I'm even avoiding it. I am anxious about the prospect of using computers.
Stage 2: Learning the process	I am currently trying to learn the basics. I am sometimes frustrated using computers. I lack confidence when using computers.
Stage 3: Understanding and application of the process	I am beginning to understand the process of using technology and can think of specific tasks in which it might be useful.
Stage 4: Familiarity and confidence	I am gaining a sense of confidence in using the computer for specific tasks. I am starting to feel comfortable using the

	computer.
Stage 5: Adaptation to other contexts	I think about the computer as a tool to help me and am no longer concerned about it as technology. I can use it in many applications and as an instructional aid.
Stage 6: Creative application to new contexts	I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum.

School supports and context. In order to analyze information related to changes in key areas such as professional development and assessment practices, the case study evaluators used the *MILE Guide Self-Assessment Tool* developed by the Partnership of 21st Century Skills (2009). This tool describes early, transitional, and 21st century milestones for the areas of student outcomes, education support systems, educational leadership, policymaking, partnering, and continuous improvement. Table 5 illustrates the milestones for the two areas for which the tool was used, professional development and assessment

Table 5. MILE Guide Self-Assessment Tool: Professional Development and Assessment

Stage	Professional Development	Assessment
Early	• PD to improve teaching of core academic content • Up to 25% of PD available regardless of time or place (e.g., access to self-paced, technology-enabled PD) • Some PD focus on 21st century skills/themes.	• Up to 25% of student work assessed at classroom level for mastery of 21st century skills.
Transitional	• 25-75% of PD to improve teaching of core academic content to enhance 21st century skills • 25-75% PD available regardless of time or place • PD customized & personalized, integration of 21st century skills available and showcased.	• 25-75% of student work assessed at the classroom level for mastery of 21st century skills. • Capstone projects and portfolios used in select circumstances to assess student performance.
21st Century	• Over 75% of PD to improve teaching of core academic content to enhance 21st century skills • Job embedded, customized, collaborative & technology-infused	• Comprehensive, balanced assessment approach to measure student progress in mastering core /21st century skills . • Classroom level evaluation of

Stage	Professional Development	Assessment
	PD; formatively & summatively assessed; available regardless of time or place • All educators have access to & use capacity building learning communities, professional coaches, technology infrastructure and instructional tools to enhance student mastery of 21st century skills.	student work for mastery of 21st century skills using variety of assessment strategies. • Students actively record/understand classroom performance to guide and refine their work. • Educators, students, parents have access to range of 21st century skills assessment data to inform and improve skills mastery in real time. • Transparent / aligned measurement system supports improvements in student learning

Data Analysis

The site visitors used a focused coding approach (Glaser, 1978) to code the classroom observations, comments from the teacher interviews, content from the collected instructional materials, and notes from research memos through a method of constant comparison (Glaser & Strauss, 1967). In first cycle coding, the evaluators coded data using an open, holistic coding process (Saldana, 2009) as well as coding along the pre-determined categories. The evaluators chunked text into broad topic areas, as a first step in examining the information (Bazeley, 2007). In this first stage of coding, the evaluators also refined the initial coding categories.

Each site visitor individually coded the data and then the two evaluators discussed discrepancies or revisions to the categories to reach consensus and to identify the overarching similarities and differences between cases. After applying procedural and evaluative taxonomies and open coding methods in the first cycle of coding, the evaluation team examined patterns (Merriam, 1998) and engaged in focused coding (Saldana, 2009). During this second cycle coding, the evaluators pulled the codes into more meaningful and parsimonious units of analysis around emergent explanations to summarize major themes; analyze relationships; and to cluster and integrate initial codes (Merriam, 1998).

Given the importance of creating a formal case study database (Yin, 1992), the case study evaluators developed an NVivo archive to hold all coded interviews, observations, extant documents and other data sources gathered during the case study site visits. These data were organized at district, school, and teacher levels.

Results

Access to and Use of Advanced Technologies

What was the quality of technology access and technical support in case study schools? To what extent was technology used in teaching and learning?

Technology Access. Student and teacher access to technology increased in all site visit schools. The school districts purchased hardware and software, and improved networking capabilities. Despite the increased availability of hardware, not all site visit school districts had sufficient networking and computing capacity to allow all students to simultaneously use computers to complete classwork or for teachers to effectively use interactive whiteboards. Not all districts had realistic plans to maintain and replace technology in the future.

Several site visit districts implemented one-to-one computing programs. The implementation of these programs varied, with several districts allowing students to take computers home to use after school and others requiring students to store computers in the school building during non-school hours. Students in the schools that allowed students to take their netbooks home, were more comfortable with and proficient at using the netbooks during the school day. They were quickly able to access the programs that they needed and were more adept at using the programs for learning. In schools where students only used the computers during the school day, students required teacher direction and support to access and use the technology during classroom learning. Students and teachers in several districts reported slow network speeds, especially during peak use of 1-to-1 computing technologies.

Several districts purchased premium licenses for one or more educational software or Web resources for teacher use but the majority of the districts promoted use of free software and Web-based resources such as Photo Story and Movie Maker, and free versions of online resources such as Glogster, Quizdom, and Wikis. In many cases, these free or low-cost resources effectively met students' instructional needs. In a number of cases, teachers chose free resources because they seemed interesting or unusual, but did not consider how these resources would help them to meet instructional goals or students' needs. The drawbacks of several of the free resources as compared with licensed editions of the same products, included limited abilities for use as content management systems and for administrators to coordinate their use.

Technology Support. Districts used different methods to provide effective technical support for teachers and students. Often, peer networking within a grade level or content area was used at an initial level of support and assistance, lessening the need for central support. In some districts, teachers actively used internal email systems to share technical or curricular problems and solutions more widely. One district used department-based peer mentors to resolve most technical support issues. Another created an effective one-to-one computing support system, with a full-time technician and features such as a netbook exchange program to provide students with replacement machines while theirs were being repaired. Computer teachers and library media staff often played important support roles in schools where these staff members were

available to assist with grant activities. Use of trouble ticket systems for technical issues was also fairly common. Grant leaders actively monitored traffic on these systems to identify common issues that might necessitate technical bulletins or professional development.

In general, districts underestimated the amount of support that would be needed for technology integration. Some districts had decreased technology and media staffing to balance budgets, leading to longer technology support wait times that frustrated teachers, and diverted the attention of technologists from effective technology integration to basic support issues. The most successful districts had clear plans, dedicated staff, and a system to analyze whether teachers and students had the support that they needed. Successful districts were flexible in modifying the elements of the support system to meet stakeholder needs.

Technology Use. For the most part, districts achieved desired results in the targeted schools, in that teachers increased basic technology integration skills and students the ability to use technology to demonstrate 21st century skills. In all districts, teachers were observed regularly using technology in instruction. The type of technology that districts purchased and teacher comfort with technology influenced the degree of teacher-led or student-led instruction. Teacher-led instruction most often included the use of interactive whiteboards, projection of textbook content with a document camera, and electronic markup on the whiteboard by students and teachers. Also frequently used were student response systems (SRS) that allowed students to respond to teachers' questions and for teachers to assess student content knowledge. Several brands of interactive whiteboards, student response systems, document cameras and projectors were observed.

Some of the use of technology was very proficient. However, in several cases, administrators and teachers underestimated the extent to which teachers were effectively using technology, particularly interactive whiteboards, to provide highly integrated and student-led instruction. Often administrators were unaware of the principles of effective technology integration.

Student-led instruction was observed more often in case study districts that had received third round grants focused on 1-to-1 computing. The most frequent technology observed in these classrooms was student use of netbooks and laptops, iPod Touches, Flip video and other digital cameras, calculators with emulators, tablet computers, and iPads. Student levels of proficiency with the hardware and software varied among districts, schools, and even classrooms. One district in particular had created an effective 1 to 1 computing program, in which all teachers and students were proficient at using technology for authentic learning. In the other districts, the level of teacher and student proficiency and comfort was not universal across the school or districts, but rather based on specific teacher skills, knowledge, and attitudes.

Teacher Effectiveness

How did professional development and other support systems relate to teachers' technology adoption and use and student demonstration of 21st century skills in case study schools?

The case study districts sought to implement comprehensive staff development programs for technology integration. Staff professional development was essential for effective use and integration of technology. Professional development systems typically included most of the following components:

- training in basic technology integration, including use of new grant-funded technologies;
- training in advanced, student-centered technology integration, including student digital products;
- training in research-based curriculum models;
- training in outcomes-based assessment; and
- training in development of curricular units designed to facilitate student-centered learning around key learning outcomes, as demonstrated and assessed through student digital products.

Only a few case study districts addressed every professional development component. One small district outsourced most of its technology integration training to Learning Technology Center 5 (LTC5), while a mid-sized district incorporated LTC 5 training. Training by LTC 5 appeared to effectively address all areas of teacher needs except for basic technology use.

One of the more effective models of professional development was the use of an existing course that introduced teachers to technology integration and offered opportunities to practice those skills. Another district used a three-tier staff development system to teach technology, basic integration, and advanced integration skills. Through professional learning communities and regular weekly professional development sessions focused on technology, teachers worked with peers to improve their technology use and integration and to support each other's' efforts. Teachers often collaborated to develop curriculum and offer colleagues feedback.

In several districts, teachers developed personal growth plans for technology integration. Often these plans were based on assessments that measured baseline teacher technology proficiency, included follow-up evaluations to monitor teachers' progress in meeting their goals, and incorporated a re-setting of personal goals. While these plans appeared useful, it is unclear whether separate growth plans for technology integration activities alone are sustainable.

Many districts sought to incorporate peer teacher leaders into their training and support models. Train-the-trainer models worked best when they followed the organic structure of each school and teachers were selected by peers. In districts where train-the-trainer approaches did not work as well as expected, these systems were replaced or supplemented with direct training. Lack of

peer recognition for teacher leaders was an issue, especially in department-based middle and high schools. Also, even if early adopters were willing to take on peer leader roles, other teachers did not always follow their lead. Teacher leaders were most effective when their peers recognized them as experts and were willing to seek their help. Otherwise, direct training for all target teachers was more effective than using a train-the-trainer model.

Peer networking was another important source of learning and support for staff. Some districts formally encouraged peer networking through release time or common planning periods. Teachers collaborated with colleagues to develop and share activities, find relevant websites, and review the effectiveness of new lessons and activities. However, this approach was not sufficient for teachers who had only basic knowledge of, comfort with, or intent to use technology for instructional purposes. Teacher colleagues were unable to always provide the level of support or provide support in a timely fashion to their peers. Only in districts with staff dedicated to providing support for use and integration of technology, did teachers receive the level of support. Even in these districts, teachers were sometimes frustrated with the length of time they had to wait for help with technology issues.

Technology and library media staff provided support for technology integration in several of the site visit school districts. However, some districts had cut back on these positions, and dedicated support was limited. Lack of resources diverted the attention of some grant leaders from effective technology integration to providing basic technology support.

The effectiveness of case study district professional development and support approaches varied. Training in basic uses of technology and new technologies appeared straightforward and fairly effective. However, training and support of teacher cohorts in technology integration and curriculum development was more challenging to provide, and had mixed results. The districts that did not provide systematic, sustained staff development to train teachers in technology use and integration appeared less successful in terms of teacher proficiency and student outcomes.

Consistently high levels of technology integration across the faculty were not observed in any case study district. Often staff development and the resulting teacher lessons focused on use of a technology-enhanced activity to supplement or replace existing classroom activities. Although these technology activities were often student-centered, the resulting student digital products were generally low-level. In districts in which teachers made the greatest progress integrating technology into instruction, appropriate technology tools were combined with effective training and support, and teacher focus was on learning outcomes and student demonstration of mastery through digital products.

Challenging student digital products were the exception, not the rule. The technology products were simply reports or presentations that students completed using word processing tools rather than handwritten reports. In some cases, students used computers for research, but there were few examples of multi-faceted, authentic technology use by students.

In general, teachers and administrators were pleased with student products that were not challenging or high-level. Overall teacher ratings of student technology proficiency and quality of student technology products were higher, often markedly, than the results of student performance on objective measures of technology skills. These findings suggest that either the assessments did not measure the same constructs or teachers grossly overestimated students' skills.

Teachers who provided positive support and motivation for well-planned student-directed learning, and who set high expectations for student development of engaging, challenging technology products most successfully achieved strong student outcomes.

Use of Technology Systems to Track Student Progress

To what extent did teachers, schools, and parents in case study schools use technology systems to track student progress?

The majority of districts had implemented school wide assessments and parent portals prior to receipt of the grant. The EETT grant allowed teachers and administrators time to become more adept and focused at using these systems. One district encountered concerns among teachers and administrators about the accuracy and security of student data on the parent portal, which delayed rollout. Parent emails and logins needed to be verified and updated. There was no clear way to measure parent use.

Several districts effectively increased parental awareness and support through online access to digital student products or student presentations at community events. Districts that sought to make parents and the community aware of student outcomes and products via stand-alone technology nights in school computer labs found generally low interest in such events in a world of ubiquitous mobile technology access.

Increasing the capacity of teachers to obtain and use data effectively in classroom assessment was a focus in several case study districts. The grant funds supported teacher collaboration and professional learning communities focused on assessment and data tracking, including staff or colleagues assigned to provide leadership around data analysis and assessment. Support of team leaders or data coaches who had release time or were paid to take on this role was helpful for teachers to understand how to collect, manage, and use classroom data to drive instruction and the impact that the data could have. Tools—even simple tools such as Excel spreadsheets that provided tallies, charts, and graphs—helped teachers to understand the implications of the assessment data that they had collected and made the process more manageable.

Use of Technology-Integrated Strategies to Improve School Effectiveness

What effective practices and lessons were learned from case study schools that can inform policy and practice related to technology integration in schools statewide?

Grant leadership significantly affected project outcomes. Grant planning and implementation were most effective when the grant leader had strong knowledge of technology integration and curriculum development, in addition to knowledge of technology operations. Effective grant leaders were seen by staff as effective and knowledgeable, and provided teachers with specific guidance about how to effectively integrate technology into instruction. Effective leaders were not focused solely on issues of hardware and software use, but on how teachers were using the technology tools to improve instruction. The extent to which technology use and integration were central to the district's mission and the level of support from administrators were important for grant success. The strongest digital products and student results were generated by districts, grant leaders, and teachers that set high expectations for student products.

One of the issues that districts had to consider in implementing the grant was addressing technology infrastructure issues related to the technology purchases made by schools, a large portion of grant funds. Districts that considered the planned use of new technology; compatibility of new technology with existing technologies; and how best to implement, support, and manage 1-to-1 computing technologies made the most effective use technology purchases and offered the most effective support.

Conclusions

This study contributes to the literature on technology integration practices by examining the professional development, support, technology integration, and student technology use in nine school districts that implemented the EETT grant in Illinois. The districts selected for case study participation provided a reasonable cross-section of statewide grantees, representing a wide range of grant types, student demographics, poverty levels, and district sizes. The results of the study showed that the case study district grantees as a group implemented their action plans fairly effectively and mostly as planned. That is, hardware and software were purchased; teacher professional development offered; and student and teacher use of technology for teaching, learning, and monitoring outcomes was observed. All of the districts were pleased with their implementation, and with the growth that their teachers and students had made with regards to using technology.

In the majority of site visit districts, basic electrical infrastructure and district and school bandwidth and connectivity were sufficient to meet the needs of new instructional and 1-to-1 computing technologies. Technology purchasing was most effective when districts considered

the function that the technology was to fulfill, compatibility with new and existing district technologies, and potential contribution to desired student outcomes. Several districts underestimated the level of bandwidth and connectivity needed to support 1-to-1 computing. Although access to technology was increased as a result of the grant, several districts did not have sufficient hardware to meet the needs of all students. Although districts purchased new hardware through grant funds, teachers also often relied on outdated or non-working equipment in aging computer labs or mobile carts. The majority of districts did not have specific plans for replacing aging hardware or providing ongoing support for the new equipment after the end of the grant period.

In terms of professional development, staff in all nine districts engaged in training to use the new technologies that the district had purchased through the grant. One of the more effective models of professional development was the use of an existing course that introduced teachers to technology integration and offered opportunities to practice those skills. Using an effective existing course allowed the trainers to focus on teacher needs, not on creating new course materials. Also, this course addressed concerns that teachers do not have time to practice using new technology and create lessons and activities for their classrooms (Bauer and Kenton 2005; Bradshaw 2002; Cuban et al. 2001; Earle 2002; Feist 2003; Glazer et al. 2005; Koehler and Mishra 2005). The districts in the case study that provided training and expected that teachers create a lesson or activity saw the benefit in that teachers created lessons that fit with their curriculum and that they would use in their classroom.

Another successful professional development model was a three-tier staff development system to teach technology, basic integration, and advanced integration skills. Teachers and staff developed personal improvement plans for technology use and integration. Professional development focused on teachers' plans and its effect was measured through objective technology proficiency tests. Teachers could receive just-in-time training at the level that they needed, resulting in a more efficient and effective professional development delivery system.

Although individual growth plans and proficiency assessments were successful, managing the paperwork and evaluation requirements was time-consuming. Developing and managing such a system would need to be factored into grant and sustainability planning.

Professional learning communities and regular weekly professional development sessions related to technology provided teachers opportunities to work with peers to improve their technology use and integration. These sessions provided teachers time to collaborate on curriculum development and offering colleagues feedback about the activities and methods. However, the usefulness of these types of activities relies on peer leaders or technologists that are knowledgeable about how to effectively use and integrate technology into authentic learning experiences. Often teachers used new technology to complete the same types of tasks and activities as in previous years. Staff professional development was essential for effective use and integration of technology and the districts that did not provide systematic, sustained staff

development or that did not effectively train teachers in best practices of technology integration were less successful in terms of teacher proficiency and student outcomes.

Train-the-trainer models to produced teacher leaders to train and mentor their peers were variably successful. Teacher leaders who were nominated and recognized as such by their peers, and who received “train the trainer” staff development provided effective peer training and support in specific technologies within their departments or content areas. However, when peer leaders did not have release time, were not supported by administrators, or not seen by peers as viable resources, direct training provided stronger outcomes that the train-the-trainer model of support.

In the majority of schools, staff members were pleased with the technology support provided by grant coordinators, technology support staff, and colleagues. Those who were frustrated, were primarily staff who themselves were uncomfortable with the technology that they were asked to sue and with changing their instructional practices. Teachers also expressed frustration when they were unable to receive support in a timely manner, particularly if they had planned an activity that they could not complete because of a technology issue. Technology support was often focused on learning to use hardware and software, and less frequently on issues related to technology integration or planning effective student technology products. In districts with dedicated technology staff and teachers with higher levels of skill and interest, support with technology integration, and challenges to use technology more effectively were more often observed.

For the most part, districts achieved desired results in the targeted schools, in that they increased the basic technology integration skills of teachers, and the abilities of students to use technology to demonstrate 21st century skills. However, in most case study districts a very limited number of teachers were observed implementing advanced technology integrations that supported achievement of key student learning outcomes. Overall, a majority of the observed instruction was teacher-led in nature, including use of instructional systems such as interactive whiteboards and student response systems.

Even when all components were present in staff development, the extent to which teachers adopted and implemented these practices varied considerably. The grants were typically a year or two in length, which may not have been long enough for teachers to learn and demonstrate the new practices required for the most effective classroom implementation. As a result, the impact of the grants on long-term student achievement may be limited unless districts can sustain the new practices introduced through the technology grant initiative. Additional training, including refresher trainings in advanced technology integration and in development of research-based curricular units, might increase the number of teachers who successfully implement high-level technology integration. Sustained support is also needed, as teachers refine their technology integration skills over time through repeated classroom integrations.

Higher levels of technology use were observed in districts that established expectations for all teachers to rise to a certain level of technology skills and technology integration proficiency. Districts in which teachers and administrators understood that the goal of the grant was effective technology integration by teachers, not just basic technology use, had better success overall in demonstrating teacher proficiency. The use of personal improvement plans allowed early adopters to keep growing, and other teachers to emerge as active integrators. Districts often began this process by setting baseline teacher proficiency. They used a variety of technology proficiency assessments for this purpose.

In general, 1-to-1 computing technologies were associated with higher levels of technology integration in the case study districts. A greater degree of student-led instruction was observed in the case study districts that had implemented one-to-one computing programs although variability was observed among these districts as well. In very few districts did teachers and students use computers seamlessly to augment learning and focus on authentic tasks to reach phronesis (Davies, 2011) and technological pedagogical content knowledge (TPACK) (Mishra and Koehler, 2006).

In terms of teachers' assessments of student technology proficiency, teachers' pass/fail ratings of technology products posted to the Illinois Data Portal (IDP), were generally and significantly higher than students' pass/fail performance on the IDP technology proficiency assessment. This suggests that either the two assessments were not measuring consistent constructs or that teacher expectations and conceptualization of effective student technology use was lower than an objective assessment of student knowledge. Further staff development to learn how to define and encourage the creation of strong student products to support learning outcomes may be needed for teachers as well as administrators, who seemed generally pleased with student products that were not challenging or high-level.

The intensive activity and focus in these nine case study schools around technology use and integration resulted in increased comfort with and use of technology. However, technology use was often focused on becoming familiar and comfortable with new hardware and software, and although observed in these nine school districts, less often on methods for high-level technology integration that increased authentic learning and expected learning outcomes. Skilled technologists, comfortable with challenging teachers' practices, offering support at the level that teachers' needed, supporting higher-level technology use among all teachers, providing effective professional development, and creating teacher learning communities were critical in achieving the most successful outcomes. These findings are consistent with previous studies indicating that teacher comfort and confidence to integrate technology (NCES 2000) and who are supported by collaborative learning communities (Van Melle et al. 2003; Valcke et al. 2007) and effective professional development that helps teachers implement technology to enhance student learning and how it can be used in a variety of core content areas (Dexter et al. 2006; Holland 2001; Newhouse 2001 are critical components of technology integration efforts.

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APPENDIX A: 2010-2011 INTERVIEW PROTOCOL: ILLINOIS EETT SITE VISITS

1. OBJECTIVE 1: INCREASED ACCESS TO AND EFFECTIVE USE OF ADVANCED TECHNOLOGIES (ACCESSIBILITY & INTEGRATION)

1.1. Instructional Leadership - Vision

Administrators/Teachers

1.1.1. What is your vision for how students should be using technology and demonstrating 21st Century skills?

1.1.2. To what extent is there a shared vision in the school for using digital age resources to meet learning goals, improve instructional practice, and improve administrative performance? [NETS-A, 1a[1]]

1.1.3. What barriers have challenged your ability to focus on 21st C skills and NETS for students?

- *What does the school do to promote, support, and communicate a vision of NETS and 21st Century skills for teachers and students[2]? Is this a goal?*
- *What does the school do to support the progress toward this goal for your students?*
- *What is your role?*
- *How does your school prioritize which advanced technologies should be emphasized?*

1.1.4. To what extent are teachers helping develop the vision of digital age learning/21st century skills by participating in shared decision making and community building, and developing the leadership and technology skills of others? [NETS-T, 5b]

1.2. Instructional Leadership - Systemic Improvement

Administrators/Teachers

1.2.1. How would you describe your district/school's approach to partnering with outside organizations?

- *How much partnering does the district do, and with whom?*
- *To what extent does school staff participate in local, national and global learning communities that stimulate innovation, creativity, and digital-age collaboration?* [NETS-A, 2e] [NETS-T, 5a]
- *Has the district established or leveraged strategic partnerships to support systemic improvement related to technology?* [NETS-A, 4a - 4e]

Administrators

1.2.2. Describe how district administrators are using information and technology resources to improve the organization [NETS-A, 4] and achieve learning goals.

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[1] *International Society for Technology in Education, NETS-S (2007); NETS-T (2008), NETS-A (2009)*

[2] *NETS and 21st Century skills for teachers and students - helping students learn to use technology to communicate and collaborate, think critically and solve problems, gather information effectively, and create products, in order to achieve core subject mastery and be effective lifelong learners*

1.2.3. How would you describe your district's approach to continuous improvement in the implementation of digital age/21st century skills?

- *How robust is your technology infrastructure, in terms of supporting school management? School operations? Teaching? Learning?* [NETS-A, 4e] *What does the district do to maintain a robust technology infrastructure over time?*
- *what extent does staff participate in data-driven decision making -- collaborate to establish metrics, collect and analyze data, interpret results, and share findings to improve staff performance and student learning?*
- *Is technology proficiency a district priority in recruiting and hiring staff?*

1.3. **Curriculum Development Process**

Administrators/Teachers

1.3.1. Describe the extent to which your curriculum provides opportunities for authentic learning experiences and assessment with contemporary tools and resources to maximize content learning consistent with the NETS•S. [NETS-T, 2]

- *How do teachers in your school use digital resources to promote learning and creativity?*
- *Do students have opportunities to make decisions about educational goals or manage their own learning or assess their own progress? To what extent?*
- *How do you adapt the curriculum to address students' diverse learning styles, working strategies, and abilities using digital tools and resources?* [NETS-T, 2a-c]

Administrators / Curriculum development team members

1.3.2. What have administrators done to align district curriculum with NETS for students[3]?

- *Has the curriculum changed or have the plans changed since the start of the EETT grant?*
- *What have you done to support changes to the curriculum?*
- *What are the biggest challenges?*

1.3.3. What are some of the human and policy resources you draw upon in supporting and promoting a 21st Century curriculum using digital technologies?

- *Dedicated staff - Do you have adequate staff assigned to manage technology integration into the curriculum? (teacher training and technology maintenance)?*
- *Collaborative staff. Do you have collaborative processes for including multiple stakeholders in technology-integration related decisions?*
- *Do you have established policies that support technology integration. For example, policy for purchasing or replacing technology aligned with the needs of the curriculum?*

Administrators / Teachers

1.3.4. Describe your district's technology support.

[3] Helping students learn to use technology to communicate and collaborate, think critically and solve problems, gather information effectively, and create products in order to achieve core subject mastery and be effective lifelong learners.

- *How do teachers get help with technology integration into the curriculum? With technical issues? How much help do they get? How long does it take to get help?*

Artifacts: Technology Plan ____, School Improvement Plan ____, Other ____ (list) _____

2. OBJECTIVE 2: INCREASED TEACHER EFFECTIVENESS (COMMUNICATION, TECH LEADERSHIPS AND ASSISTANCE)

2.1. Professional Growth

Administrators

2.1.1. How does the school administration promote excellence in professional practice? [NETS-A, 3]

- *How do you allocate time, resources, and access to ensure ongoing professional growth in technology fluency and integration among teachers?*
- *Do you facilitate or participate in learning communities that stimulate, nurture, and support administrators and teachers in the study and use of technology?*
- *How do you promote or model effective communication and collaboration among stakeholders using digital-age tools?*
- *How do you stay informed of educational research and emerging trends regarding effective use of technology?*
- *How do you encourage or promote the evaluation of new technologies for their potential to improve student learning?* [NETS-T, 3a-3d)

2.1.2. How do you support teachers to continuously improve their professional practice? [NETS-A, 3]

- *How do you support teachers to participate in local or global learning communities?* [NETS-A, 2e]
- *Are teachers given time or resources to evaluate/reflect 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?* [NETS-A, 3a; NETS-T, 5c]
- *How does the district use resources to support teachers' self-renewal as educators?*

Administrators/Teachers

2.1.3. Describe the capacity of teachers in your school to transfer current knowledge to new technologies and situations.

Teachers

2.1.4. How do you work to continuously improve your professional practice and model lifelong learning? [NETS-T, 5a)?

- *Do you participate in local or global learning communities?* [NETS-T, 4d)
- *What major sources do you use to evaluate and reflect on current research and professional practice on the use of emerging digital tools?* [NETS-T, 5c]
- *How do you use what you learn to improve your own practice?*
- *How often are you able to do this?*

2.1.5. To what extent do teachers in your school participate in local and global learning communities to explore creative applications of technology and improve student learning? [NETS-T, 5a]

2.2. **Professional Development – Quality and Access**

Administrators

2.2.1. Describe the PD requirements for district teaching staff. For support staff? For administration?

- *What is the availability of technology-enabled PD in your school/district?*
- *How much PD have you yourself attended this year?*

Teachers

2.2.2. Describe your *access* to PD that supports your on-going professional growth in technology fluency and integration? [NETS-A, 3a]

- *Comment on the adequacy of time, resources, and quality of PD generally / for EETT?.*
- *Did you have release time for professional learning?*
- *Were there time constraints/stress in completing PD generally? PD for EETT??*
- *Did you participate in online PD?*

2.2.3. Describe the *quality* of the EETT PD.

- *What was the focus of EETT PD in terms of content knowledge in core subjects? On teaching critical thinking, communication and higher-order thinking skills?*
- *Do you feel more prepared to integrate technology effectively?*
- *Do you feel more prepared to teach digital age/21st century skills?*

2.3. **Professional Leadership**

Administrators

2.3.1. How does your district support and promote teacher leaders in modeling digital age and 21st century skills? What is the district vision for this?

- *Is there a formal effort to develop teacher leaders' leadership and technology skills?*
- *How does the district promote a vision of technology infusion among teacher leaders?*
- *Is there shared decision making and community building with teachers leaders around technology issues?*

Teachers

2.3.2. Are there teachers in your school who you would consider leaders or models in using technology and teaching 21st century skills? If so, who?

- *Is there a formal effort to develop teacher leaders for technology infusion?*
- *How are teachers chosen for this leadership development?*
- *How successful has it been? What have been its outcomes?*

2.4. **Teacher Collaboration / Communication**

Administrators/Teachers

2.4.1. To what extent do teachers in your school use a variety of digital tools

- To *collaborate* with students, peers, and parents in support of student success? [NETS-T, 3b].
- To *collaborate* with partners outside of school?
- To *communicate* with students, peers, parents and others [NETS-T, 3b].

3. OBJECTIVE 3: INCREASED USE OF TECHNOLOGY SYSTEMS TO COLLECT, MANAGE, ANALYZE DATA TO TRACK STUDENT PROGRESS

3.1. **Student Assessment**

Administrators/ Teachers

3.1.1. Describe your technology systems for tracking student progress.

- *To what extent is there a culture and support for data-driven decisions at the student, classroom, building, and district level?*
- *What is the nature of collaboration around data? How does technology support this? Is there adequate support for teachers' use of formative assessment in instruction?*

3.2. **Information Access**

Administrators

3.2.1. To what extent can parents and students access student information online?

Teachers

3.2.2. Do students/parents have online access to class information, assignments, and grades?

- *To what extent do students and parents access this information?*
- *What support have parents/students required to use these online tools?*

4. OBJECTIVE 4: INCREASED USE OF STRATEGIES THAT SUPPORT STANDARDS SUPPLEMENTED WITH HIGH-QUALITY ASSESSMENTS (STUDENT ACHIEVEMENT AND SCHOOL REFORMS)

4.1. Curriculum Elements - Learner Outcomes

Administrators

4.1.1. Describe how teachers define learner outcomes related to the use of digital tools and resources to promote the NETS in student learning? What is your role in supporting this? *(Relevancy, Appropriateness, Differentiation)*

- *What processes do you use to establish learner outcomes aligned with the Common Core or state Standards?*
- *How do you support teachers to balance focus on conceptual understanding with factual knowledge?*
- *What processes exist to support outcomes that are appropriate for students' age and grade level?*
- *Are there any review processes in place to consider appropriateness of outcomes, focus on higher□level thinking abilities, or synthesis of skills or areas of content?*

4.2. Curriculum Elements - Student Technology Products

Administrators

4.2.1. Describe how teachers use digital tools and resources to assess NETS for students using student technology products? *(Relevancy, Appropriateness, Differentiation)*

- *What processes do teachers use to design authentic, real-world contexts and highly significant questions for STPS?* [NETS-T,1b], [NETS-S, 4a]
- *How do you support teachers to design STP tasks that are collaborative, engaging, and purposeful?* [NETS-S, 2]
- *Do your curriculum articulation processes include vertical and horizontal alignment for STPs for content or technology proficiencies?*
- *Is there a formal process for designing STPs to ensure opportunities for student originality and inventiveness?* [NETS-S, 1a]

4.3. Curriculum Elements - Assessment

Administrators/Teachers

4.3.1. Describe how teachers use assessment to formatively and summatively assess student learning. What is your role in supporting this? (NETS-T, 2d) *(Relevancy, Appropriateness, Differentiation)*

- *What processes do teachers use to align assessments to stated learner outcomes?*
- *How do administrators support teachers to include assessments that allow students to apply what they've learned?*
- *Do your curriculum articulation processes include assessments aligned vertically and horizontally?*
- *Is there a formal process for differentiating assessments in terms of reading levels or differing learning modalities?* [NETS-S, 2c]

4.4. **Curriculum Elements - Teaching / Learning Events**

Administrators/Teachers

4.4.1. Describe how teachers have designed or adapted learning experiences using digital tools and resources to promote the NETS in student learning. What is your role in supporting this? *(Relevancy, Appropriateness, Differentiation)*

- *What processes do teachers use to align teaching and learning events to stated learner outcomes?*
- *How are teachers supported to include teaching and learning events that are student centered and foster student engagement and interest?*
- *Do your curriculum articulation processes include teaching and learning events aligned vertically and horizontally for content or technology proficiencies?*
- *Is there a formal process for differentiating teaching and learning events in terms of reading levels or differing learning modalities?*
- *What kinds of instructional strategies do teachers use to introduce new concepts?*
- *How do teachers re-teach concepts to which students have been previously exposed?*

Improving Technology Education. To help prepare students for future employment in a world where technology literacy is a critical skill, many schools are striving to make computer programming a larger part of their curriculum. One powerful way to do this is to attach programming tasks to non-computer science subjects. For example, students can use Scratch, a programming language designed for adolescents, to create an app that solves a particular math equation or tells an interactive story based on a work of literature theyâ€™ve been reading. The Horizon Report includes examples of schools in the The purpose of this report is to provide descriptive information about educational technology practices related to the core objectives of the U.S. Department of Educationâ€™s Enhancing Education Through Technology (EETT) program.Â 3 A larger sample of teachers was drawn for the 2005 data collection to provide robust, schoolwide estimates of technology use (rather than estimates of individual teachersâ€™ use of technology) to inform case study selection for a NETTS substudy. vii.Â Technology-related teacher professional development: To provide professional development opportunities for teachers, principals, and school administrators to develop capacity to effectively integrate technology into teaching and learning.