Teacher Leadership Project Final Evaluation Report

1998-2003

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Fouts & Associates, L.L.C

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Carol J. Brown
Amy Rojan

Fouts & Associates, L.L.C

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Executive Summary

The Teacher Leadership Project was designed to assist teachers in their efforts to integrate technology into the school curriculum. Funded by the Bill & Melinda Gates Foundation and administered by the foundation and Educational Service District 189, the program also strived to encourage and facilitate teachers in their efforts to provide technology expertise and leadership in and beyond their schools and districts. An initial cohort of 27 intermediate teachers developed the program in 1997, and between 1998 and 2003 an additional 3,387 teachers were awarded Teacher Leadership Project grants. Data were gathered from several different sources to answer three broad research questions for this summative evaluation of the project. These sources included teachers' reflective journal responses, teacher and student survey responses, classroom observations, TLP training observations, and analyses of technology-enhanced lessons.

Evaluation Questions

Evaluation Question 1: *What impact has the Teacher Leadership Project had on teaching and learning in Washington State classrooms?*

Findings from analyses of teacher and student surveys, case studies, classroom observations, reflective journals, and sample lessons support the potential and positive effects of integrating technology into the curriculum. In these classrooms a student-centered environment is replacing what was, in many cases, teacher-centered instruction, and the role of the teacher is shifting from one of *director of learning* to that of *facilitator of learning*. Interdisciplinary projects requiring students to perform and coordinate multiple tasks have become a primary means of teaching and learning. Because of both the 4 to 1 ratio and the benefits of collaboration, these projects are typically accomplished in small groups, such that lessons requiring students to work in isolation have decreased noticeably. A rich technology classroom allows students to be more actively engaged in their work, a shift that teachers believe will result in authentic, long-term learning with meaningful connections to the world beyond school.

Perhaps one of the most powerful findings of the evaluation was the extent to which technology influenced student motivation and enthusiasm. Both students and teachers have been energized by the addition of computers to the classroom and by the world of learning opportunities they afford. Being in a technology-rich classroom proved so motivating that students stayed in from recess and teachers postponed retirement. Teachers were convinced that this motivation positively influenced student learning. Written and oral communication, problem solving and critical thinking, research skills, and inclination to read were among the areas where teachers reported seeing evidence of student growth. These findings suggest that when coupled with sound teacher training and technological support, the use of technology at a 4 to 1 student to computer ratio can lead to the integration of curriculum, more cooperative learning environments, and a focus on higher order thinking skills.

Evaluation Question 2: ***What impact has the Teacher Leadership Project had on schools and districts in Washington State?***

The impact of the Teacher Leadership Project on schools and districts in Washington State has been significant, based on reports from teachers and administrators. The efforts of teacher-leaders have helped direct various educational reform strategies, including changes in teaching practices, curriculum development, and technology integration. The TLP has also been used as a model for school and district professional development activities. Finally, the program has provided schools and districts across the state with much needed hardware and software, increasing access for both students and teachers.

There is some evidence to suggest that critical mass is an important element in how much a school or district can accomplish with its equipment and training. Those educators who represented technology-rich buildings suggested that having considerable resources – computers, software, and trained teachers – increased the likelihood that those resources would be used to improve teaching and learning across the entire school.

Evaluation Question 3: ***What are the strengths and limitations of the Teacher Leadership Project staff development model?***

Teacher Leadership Project teachers' comments clearly underscored findings from research on effective models of professional development. The programs that tend to have a lasting impact on teachers, classrooms, and schools are those that are sustained over a long period of time, provide opportunities for teachers to engage in relevant, hands-on activities, and incorporate time for practice and collaboration (Darling-Hammond, 1999; Windschitl & Sahl, 2002). Teachers' responses spoke volumes about the effectiveness of the Teacher Leadership Project as a model of professional development. Sound instruction given by practicing classroom teachers, leadership development, access to technology, and a focus on curriculum were all viewed as strengths of the program by TLP participants. On the other hand, they agreed that the model would have been even stronger had it provided continued training and collaboration opportunities and established selection parameters that maximized the power of numbers in establishing "critical mass" at a school.

Conclusions and Recommendations

Findings revealed that the Teacher Leadership Project was a remarkably effective training program that embraced many of the conditions identified in research literature as being critical to successful technology integration. These conditions include in-depth, hands-on training; a focus on curriculum; access to technology; ongoing training; collaboration; and reflection.

Teachers expressed overwhelming satisfaction with the training they received and stressed the value of having a program based on "teachers teaching teachers." The fact that TLP instructors were from the classroom and understood the nature of teaching and

learning at a practical level resonated well among participants. Furthermore, there was strong approval for the substance and structure of the training. Participants appreciated the fact that technical skills were taught in the context of academic content, and the time they were given to collaborate, share, and practice was considered among the most valuable aspects of their training. Finally, teachers were treated as professionals whose work and ideas had worth, a strength of the program that was recognized time and again by participants.

The impact of the Teacher Leadership Project on teachers and the classroom was impressive. Changes in students' attitudes, behaviors, learning, and work products were among those that teachers attributed to their technology integration efforts. Specifically, they noted improvements in student writing, problem solving skills, and in their abilities to conduct research. Students were more motivated about learning, more likely to complete academic tasks, more self-directed, and more collaborative in rich-technology environments – all changes that teachers related to increased student learning. Real world connections made possible by computers and the Internet were viewed as one of the most powerful applications of an integrated curriculum.

It was also found that in TLP classrooms a student-centered environment often replaced a teacher-directed curriculum, and interdisciplinary projects replaced traditional, text-based assignments. Projects that required students to perform and coordinate multiple tasks were becoming important means of teaching and learning, and students worked more often in small groups than they did in isolation.

These changes were not universal, however. Much of the success of the Teacher Leadership Project was related to teacher expertise, and the fact remains that weak teaching was not markedly improved when teachers had access to technology; instruction may have been more efficient, or the quality of student products may have been better, but it was not necessarily true that more learning took place. Strong teachers with sound pedagogical skills were more likely to use technology in ways that transformed student learning than were their less-skilled colleagues. These findings are not unlike those reported in an evaluation of the Intel® Teach to the Future project: "Technology integration by itself is not synonymous with teaching that enhances student learning" (Martin, Gersick, Nudell, & Culp, 2002, p. 10).

The Teacher Leadership Project had a significant impact on schools and districts across the state. The efforts of teacher-leaders have been instrumental in facilitating various educational reform strategies, including changes in teaching practices, curriculum development, and technology integration. The TLP has also been used as a model for school and district professional development activities. Finally, the program has provided schools and districts across the state with much needed hardware and software, increasing access for both students and teachers. This was important to all TLP participants, but particularly to smaller and rural schools and districts.

There was some indication that certain teachers had a predisposition toward leadership, and yet just as often it appeared that the program provided encouragement and

opportunities for teachers to develop that potential. TLP instructors provided structured, supported, and safe opportunities for teachers to develop their own leadership capabilities. Once back in their buildings, teachers were encouraged to share their efforts with colleagues, and because of their technical knowledge and skills, they were often viewed as competent and respected leaders. Many TLP participants also took their knowledge and skills beyond the confines of the project itself, presenting at local, state, and national conferences.

The power of having several TLP-trained teachers in one building was made clear by both principals and teachers. There were indications that these schools were able to move forward more easily in implementing certain reform initiatives such as technology training and curriculum development, and in some cases they used their combined efforts to apply for additional school-wide grants.

Previous research has identified several necessary conditions for successful technology integration, and the results of this evaluation provide further support for those conditions. Teacher training and access to equipment are critical, as are technical support and time for reflection and collaboration. The process of learning to integrate technology into the curriculum can be frustrating and overwhelming, and it does not happen quickly. Teachers' enthusiasm is often diminished when they face technical glitches, student management challenges, and a lack of time for planning. Additionally, without a commitment on the part of schools and districts to maintain hardware, teachers face the prospect of losing equipment to disrepair and obsolescence. Still, the potential of technology to support teaching and learning, under certain conditions, is becoming more and more clear, and the Teacher Leadership Project has moved educators in Washington much closer to realizing that potential.

The Teacher Leadership Project has played a part in addressing some elements of the reform agenda passed by the Washington State legislature in 1993. Furthermore, TLP participants have been active in furthering the restructuring objectives of the Gates Foundation through their efforts in Washington classrooms, schools, and districts. While many viewed the Teacher Leadership Project as primarily a technology initiative, the effects of the program have been far more encompassing than simply training teachers to use computers in the classroom. The Teacher Leadership Project has developed a cadre of teacher-leaders throughout the state who have been trained as thoughtful and intentional designers of curriculum who are also accomplished at using technology to support the curriculum. Technology is but one of the tools they have at their disposal to create sound learning opportunities for their students.

Recommendations

Research on successful professional models suggests that in-depth, sustained training opportunities are more powerful and the effects more long-lasting than are brief, "one-shot" models. The Teacher Leadership Project involved teachers in 11 days of intense, practical, and targeted training over the course of one year. The rigorous initial training, followed by shorter sessions throughout the year, proved to be an excellent model worthy of replication. The work of integrating technology into the curriculum is

alternately exciting, discouraging, and frustrating. Teachers need opportunities such as those provided in follow-up sessions to come together and share successes, frustrations, technical challenges, and questions. Teachers' efforts would be further strengthened by additional training and collaboration opportunities during the second, third, and even fourth years of their work. Any attempts to fund or facilitate such meetings would maximize the money spent on first year training.

As with any new entity, the Teacher Leadership Project evolved over the years and was notably strengthened by several specific changes. First, the TLP listserv provided participants with a venue for sharing questions, successes, and frustrations on an ongoing basis. Many participants utilized this element of the program and found it helpful in sorting out various issues. Second, the TLP also developed a website to which participants could turn to find answers to any number of questions regarding the program, such as meeting times and locations, program requirements, and contact information. As more and more people utilize the web for anytime information access, it is a credit to the TLP that this resource was developed and maintained as a service to teacher-participants. Finally, midway through the project an intentional emphasis was placed on curriculum with the adoption of the Understanding by Design framework. Research supports the use of technology as a means to an end, and not as an end in and of itself, and therefore making curriculum design a focus of the training was, in fact, a prudent decision.

Findings from this evaluation suggest that much of the success of the Teacher Leadership Project was due to the nature of the training sessions and the attitudes of TLP instructors and administration. The fact that teachers were treated as competent and concerned professionals was not lost on participants. They appreciated the training accommodations and the respect with which their questions and comments were received, and many noted that it was the best professional development they had ever attended. Planners of professional development programs should be aware of this in designing various in-service and training conferences. This study found that teachers are willing to work hard and to work seriously when provided with reasonable conditions and high expectations.

Results of the evaluation indicated that teacher collaboration was at the heart of the program's success. Teachers were overwhelmingly positive about the opportunities for sharing and collaboration provided during their training sessions. The importance of collaboration in such change efforts is well recognized in the research literature. There is also some evidence to suggest the benefits of team training and team collaboration. While the TLP selection process did not require team participation, this may be a strategy worthy of consideration in any future planning efforts.

Although many beginning TLP teachers had access to technology directors or technology support personnel, others were left to make decisions about equipment selection on their own. This proved difficult for some, who were not familiar with hardware and peripheral specifications and yet needed to make important (and often expensive) decisions on their own over a relatively short timeline. In some cases teachers rushed to fill purchase orders and spend grant dollars, selecting equipment that turned out

to be less useful than anticipated. Teachers would be well-served by having the opportunity to take advantage of "selection seminars," using the advice and experience of senior participants and technical personnel in making purchasing decisions.

One of the most important elements of the Teacher Leadership Program was the fact that it was developed and taught by practicing classroom teachers. Instructors brought practical experience and practical examples of technology integration to their training sessions, and it was clear that this strengthened the integrity of the program in the eyes of teacher-participants.

The Teacher Leadership Project was influential in moving forward the technology agendas of schools and districts across the state, particularly when several teachers were present in a building. TLP teachers modeled ways to integrate technology into the curriculum and helped direct decision-making efforts in hardware and software acquisitions as well. To that end, selection efforts should focus on building a critical mass of technology-trained teacher-leaders in schools with the interest and potential to support a dynamic technology agenda.

One continuing source of frustration for teachers involved in the project was the lack of time needed to develop and refine technology-integrated lessons. On countless occasions, teachers observed that they had plenty of ideas for projects and lessons but no time to develop them. One of the primary benefits of the follow-up meetings was the fact that it provided a venue and the time to share curriculum projects. This way, as many pointed out, they could share their resources and not spend so much time "reinventing the wheel." One way to address teachers' need for pre-planned curriculum lessons would be for the Teacher Leadership Project to develop a resource library of lessons, cross-categorized by grade level, subject, and timeline, just as an example. Teachers could give and take, refine and share, and ultimately save time in designing sound technology lessons.

While many schools have moved to some type of block schedule, there are still numerous schools that operate on a traditional 50-minute time schedule. This was the source of some frustration to TLP teachers who found it difficult to manage project-based learning and a 4 to 1 student to computer ratio within a 50-minute time frame. These teachers need to be provided with examples of successful models of technology integration under such circumstances.

As the presence of technology in schools increases, there are those who are very interested in knowing how technology is best used in primary classrooms. The Teacher Leadership Project focused considerable attention on this issue, and has important information to offer regarding hardware, software, training, and appropriate use of technology in K-2 classrooms. In whatever ways possible, including sharing at professional conferences, in professional journals, and in the popular press, the Teacher Leadership Project should make efforts to share the wealth of accumulated knowledge regarding technology integration in primary classrooms.

A major and real concern of TLP teachers is the sustainability of their efforts. The dual challenges of aging equipment and budget crises in schools raise the question of how these efforts will be maintained in the future. Given that so much money was spent training and equipping teachers to integrate technology, it would benefit teachers, students, schools, and districts if ways could be found to maintain and update equipment. To whatever extent they are able to do so, it would be useful if the TLP could help facilitate teachers' and schools' efforts to secure additional funding for technology.

One of the most useful strategies in working through the arduous process of change is that of reflection. Teachers who seriously and intentionally reflect on their practice are often able to move forward in the change process more smoothly than those who push ahead without taking time to contemplate their efforts. The Teacher Leadership Project built in two opportunities for teachers to actively and continuously reflect on their practice: (1) monthly journals in which they recorded activities, thoughts, and perceptions; and (2) reflective journals required for the evaluation. While many teachers viewed these requirements as simply "one more thing to do," others took seriously the charge that they reflect on their efforts. Those that did often reported that their reflections provided "ah-ha" moments which in turn informed and improved their practice. It is highly recommended that any future training efforts include some element of intentional reflection as a way of encouraging and supporting the change process.

The emphasis placed on leadership was clearly a strength of the Teacher Leadership Project, as was the way it was modeled by instructors. Teachers took on any number of leadership positions in and beyond their classrooms and were often instrumental in moving ahead a school's reform efforts. While other programs *require* teachers to lead by recruiting and training their colleagues, the TLP was able to accomplish similar results by encouraging and supporting leadership activities rather than requiring them. This appeared to be a sound model for growing committed and skilled teacher-leaders.

It appears that computers have the potential to help teachers create classrooms where students experience *education* rather than schooling, where they *understand* rather than memorize, where they are *active* rather than passive, and where the learning is connected to the *real-world*. However, it is important to note that these changes were not equally evident in all classrooms but were manifested to various degrees. Furthermore, technology alone did not and cannot create these changes. Without the requisite pedagogical skills and without adequate technical support, no amount of technology will transform the classroom. As Pierson (2001) observed:

> A teacher who effectively integrates technology would be able to draw on extensive content knowledge and pedagogical knowledge, in combination with technological knowledge . . . unless a teacher views technology use as an integral part of the learning process, it will remain a peripheral ancillary to his or her teaching. True integration can only be understood as the intersection of multiple types of teacher knowledge and, therefore, is likely as rare as [teaching] expertise. (p. 427)

Similarly, Earle stated:

> The focus of integration is on pedagogy – effective practices for teaching and learning. Teachers need to be able to make choices about technology integration without becoming technocentric by placing undue emphasis on the technology for its own sake without connections to learning and the curriculum. (2002, p. 10)

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INTRODUCTION

The Teacher Leadership Project (TLP) was designed to assist teachers in their efforts to integrate technology into the school curriculum. Funded by the Bill & Melinda Gates Foundation and administered by the foundation and Educational Service District 189, the program also strived to encourage and facilitate teachers in their efforts to provide technology expertise and leadership in and beyond their schools and districts. A start-up cohort of 27 intermediate teachers developed the program in 1997, and between 1998 and 2003 an additional 3,360 teachers were awarded TLP grants. Data were gathered from several different sources to answer three broad research questions for this summative evaluation of the project, including teachers' reflective journal responses, teacher and student survey responses, classroom observations, TLP training observations, and analyses of technology-enhanced lessons.

Program Description

A group of 27 teachers from schools across the state began the Teacher Leadership Project in 1997. This core group was instrumental in defining a vision for the TLP, and based on that vision they developed a model for creating technology-rich classrooms and integrating technology into the curriculum. Their initial efforts were promising, funding was increased, and the project expanded considerably. Between 1998 and 2003 a total of 3,387 additional teachers were trained as part of the Teacher Leadership Project.

Although specific provisions of the grant changed somewhat over the years, each teacher received $9,000 for the purchase of hardware to meet specific standards directed by the ESD189. Based on results of the 2000-2001 TLP evaluation and feedback from teachers, the hardware configuration for primary classrooms was modified such that a greater emphasis was placed on projection hardware, and less money was allocated to student computers. As such, K-2 teachers received a minimum 1000 lumen portable projector, visual/desktop presenter (could include a combination of document camera and projector or all-in-one solution), three classroom computers, and one printer capable of handling the demands of three computers. Funding for grade 3-12 classrooms provided one multimedia computer for every four students, a printer, and a presentation device. As part of their grant each teacher was also provided with Office software, the Encarta Reference Suite, and SchoolKit (for Windows users). In addition, each participant was given a personal laptop computer and was required to participate in 11 days of training over the course of their first year in the program. Training sessions were intended to help teachers (1) develop their technical skills; (2) design curriculum that utilized technology

and aligned with the state's Essential Academic Learning Requirements; and (3) identify leadership opportunities for sharing their knowledge and skills.

Background

The presence of computers and related technology in K-12 education continues to grow, and it is estimated that there are currently over 10 million computers in schools across the country (Becker, 2000a). Student access to these computers is increasing, and in 2001 the student to computer ratio nationally was just over 4 to 1 (Skinner, 2002, p. 1). Maine is an example of just how fast educational technology is making its way into the school and classroom: An initiative passed by the legislature provided every 7th grade student in the state with a laptop computer, and plans called for another 16,000 to be distributed over the course of the next school year (eSchool news, 2003b). Access to the Internet is also improving steadily, according to the U.S. Department of Education, and their data indicate that 98% of schools had Internet access in 2000, while 77% of classrooms had such access (U.S. Department of Education, n.d., as cited in National Education Association, n.d.). This has resulted in greater student access to Internet-connected computers, which dropped to 6.8 students per connected computer in 2001. The figures for Washington State are similar, where the student to computer ratio is 3.9 to 1, and the student to Internet-connected computer ratio is 6.5 to 1.

"Although teachers now have the advantage of unprecedented access to technology in their classrooms and schools, we find, paradoxically, little evidence to indicate that teachers systematically integrate technology into classroom instruction."

Technology is a means to an end, not an end itself, and thus access does not ensure that technology will make a difference in teaching and learning. As administrators of one district's technology integration program observed, "Although teachers now have the advantage of unprecedented access to technology in their classrooms and schools, we find, paradoxically, little evidence to indicate that teachers systematically integrate technology into classroom instruction" (Eastwood, Harmony, & Chamberlain, 1998, p. 1). It has been suggested that technology, and the Internet in particular, has had relatively little impact on education because educators do not maximize its power. It is often used for routine tasks and thus "a most powerful and innovative technology [the Internet] is taken and domesticated, or if you want – trivialized, such that it does more or less what its predecessors have done, only it does it a bit faster and a bit nicer" (Salomon, 2002, p. 72). Others share this view. According to a recent report on technology and learning, while computers "can motivate students to take more interest in and control of their learning . . . the potential for technology to increase student achievement goes largely untapped" (Allen, 2001, p. 2).

For their part, teachers often do not feel prepared to integrate technology into the curriculum. According to Meyer (2001), a majority of teachers surveyed reported not being given enough time to learn how to use technology as an instructional tool. Similar concerns were reported in a 1999 study conducted by the National Center for Education

Statistics (NCES; 1999) where it was found that only one in three teachers felt prepared to use the Internet for teaching and learning. In fact, lack of training and lack of time for collaboration and planning continue to emerge as critical factors in any successful technology integration program.

The Evolution of Educational Technology

The computer was introduced to education in the 1970s, and its first use had teachers and students learning to do basic programming. Since that time there has been an evolution of best practice. As software became more sophisticated, the computer became the tutor or surrogate teacher. Students followed the commands on the computer screen and received rewards for correct answers. They also began to learn through playing games and completing simple simulations. Teachers of writing discovered the value of using a word processor, and soon students were writing more and revising with much greater ease. Other teachers saw the value of the computer in creating rich learning environments and had students using databases, spreadsheets, presentation, and research tools across all subject areas. Next, the Internet impacted technology use. Suddenly there was a volume of knowledge available to students with Internet access as well as a network of people throughout the world with whom they could communicate and exchange ideas. Real problem solving in collaborative groups became the norm in some classrooms. Online courses were available and students in rural areas had expanded learning opportunities in a variety of subject areas. Previously abstract concepts could now be illustrated and manipulated because of technology advancements. A whole new learning environment became possible through educational technology.

Technology as a Tutor

Thomas Reeves (1998) has pointed out an important distinction between learning *from* computers and learning *with* computers. Learning *from* computers assumes that the computer functions as a tutor, reviewing basic skills and academic content with students. Learning *with* computers, on the other hand, assumes that computers are a vital part of the broader learning process and not simply a tutor or delivery system. Students learning *with* technology "use the technology as a resource to help them develop higher order thinking, creativity, research skills, and so on" (Kelley & Ringstaff, 2002, p. 2). While this is generally perceived as a more powerful application of computer-based technology, the tutorial function of computers and related equipment should not be dismissed, according to several prominent researchers. In fact, a number of studies have shown that computer-based skill and drill exercises positively influence student learning. According to Henry Becker, who has studied the impact of educational technology for some time:

> the only thing I feel reasonably confident about regarding basic skills is that drill and tutorial software can help with math computation. We've seen enough research in this area to know that this is true. Most research shows effects of 5 to 10 percent over several months of practicing math skills at the computer. (as cited in Salpeter, 2000a, p. 1)

Likewise, Larry Cuban, who frequently cautions against placing too much hope in educational technology, commented, "there is a long research history that shows that tutorial and drill software – the sort of Computer Assisted Instruction (CAI) uses that began in the 60's and 70's - can improve test scores" (as cited in Salpeter, 2000b, p. 4). Gains were found in a number of different subject areas in an Illinois study that examined the effect of basic skills instructional technology (Silverstein, Frechtling, & Miyaoka, 2000). In addition, algebra students who used a "Computer Tutor" outperformed students in traditional math classes in both skill and problem solving exercises (Hubbard, 2000). Furthermore, the results of various meta-analyses conducted between 1985 and 2000 on CAI, Computer Based Instruction, and various drill and skill software programs revealed that students who used computers had higher test scores (Kelley & Ringstaff, 2002, p. 4). Finally, Kulik (1994) found percentile gains on achievement tests of 9 to 22 percent over control groups in the aggregated findings of over 500 individual studies of Computer Based Instruction.

Despite the positive results, however, both supporters and critics of educational technology believe that the potential of computers is far greater than simply allowing students to practice basic skills. As Kelley and Ringstaff noted:

> it would be shortsighted to focus only on how best to have students learn "from" computers – that is, using technology to tutor students on basic skills. Technology has advanced beyond this tutorial function and can do so much more than what is readily measured by standardized tests. (2002, p. 5)

Technology as a Transformational Agent and Learning Tool

In fact, many proponents of the current reform efforts see technology as a vital component of a new educational paradigm in which the curriculum, teaching methods, and student outcomes are re-conceptualized.

Of particular importance to educators is the potential for computers and related technological tools to be used in transforming the classroom such that a student's educational experience is qualitatively improved. In addition to learning *from* computers, there is hope – and limited evidence – of powerful opportunities for students to learn *with* computers. In such instances, students use technology as a tool for problem solving, conceptual development, and critical thinking (Culp, Hawkins, & Honey, 1999; Means, 1994; Penuel, Golan, Means, & Korbak, 2000; Sandholtz, Ringstaff, & Dwyer, 1997). In fact, many proponents of the current reform efforts see technology as a vital component of a new educational paradigm in which the curriculum, teaching methods, and student outcomes are re-conceptualized (Means, 1994). This view was adopted by the U.S. Department of Education at least as early as 1993. In "*Using Technology to Support Education Reform"* (United States Department of Education, 1993) it was stated that "technology supports exactly the kinds of changes in content, roles, organizational climate, and affect that are at the heart of the reform movement." According to Becker, however:

> The proportion of use of the computer for productive thinking, analyzing and communicating has been pretty small. . . .It all relates to what teachers are asked to teach. Traditional theory says that kids need to know discrete skills in computation or reading so that's what teachers teach. That's what's expected and they come to think that's their job. But most of the people who are excited about technology in schools don't believe that's what it's about. They generally care more about having kids do sophisticated writing or engage in complex reasoning or learn to figure things out like adults do. (as cited in Salpeter, 2000a, p. 1)

Educational Technology and School Reform

One of the central components of school reform is the desire for higher academic standards and a stronger focus on higher order thinking, problem solving skills, and learning associated with real world applications. The changing use of technology reflects changes in understanding over the last two decades about how the mind works and how children actually learn. There is a strong base of basic research that supports these ideas. This information is derived from the findings of researchers in developmental psychology, cognitive psychology, linguistics, and neuroscience coupled with the philosophical ideas of constructivism (Duffy & Cunningham, 1996). Taken together they serve as the basis for many of the current beliefs about what and how children should learn in school.

> Our understanding of human learning has. . . evolved based on a wealth of evidence collected over a wide range of different domains and media, from a process based on the passive assimilation of isolated facts to one in which the learner actively formulates and tests hypotheses about the world, adapting, elaborating, and refining internal models that are often highly procedural in nature. (Shaw & President's Committee of Advisors on Science and Technology, 1998, p. 118)

The National Research Council's Committee on Developments in the Science of Learning articulated an idea central to this new understanding of human learning:

> A fundamental tenet of modern learning theory is that different kinds of learning goals require different approaches to instruction; new goals for education require changes in opportunities to learn. . . . These new learning opportunities should take place in learning environments that are student centered, knowledge centered, assessment centered, and community centered. (Bransford, Brown, & Cocking, 1999, p. xvi)

Bransford et al. concluded:

- Because many new technologies are interactive, it is now easier to create environments in which students can learn by doing, receive feedback, and continually refine their understanding and build new knowledge.

- Technologies can help people visualize difficult-to-understand concepts, such as differentiating heat from temperature. Students are able to work with visualization and modeling software similar to the tools used in non-school environments to increase their conceptual understanding and the likelihood of transfer from school to non-school settings.
- New technologies provide access to a vast array of information, including digital libraries, real-world data for analysis, and connections to other people who provide information, feedback, and inspiration, all of which can enhance the learning of teachers and administrators as well as students. (pp. xviii-xix)[1]

Other researchers have noted the relationship between educational technology, school reform, and constructivist teaching. Trilling and Hood (1999) for example, discuss the shift from an "Industrial Age" learning model to a "Knowledge Age" learning model, which is characterized by a number of constructivist practices including *Teacher as Co-Learner, Discovery and Invention, Student-directed Learning,* and *Project, Problem-based Learning*. They point out that:

> Knowledge Age practices do correspond well with modern theory about how we learn. From project-and problem-based learning to collaborative and community-focused activities, from an emphasis on real-world learning in context to the increased focus on learner-motivated actions, Knowledge Age practices are well supported by modern learning theory. (p. 11)

"If technology is to be used in powerful ways – to support student collaboration, inquiry, and interactive learning – then teachers' beliefs about learning and teaching often must change."

Becker proposed that if teachers are encouraged to rethink their goals and move toward more constructivist teaching, then technology could be "incredibly valuable." However, if they continue to focus on individual skills, chances are that the technology will have relatively little impact (Salpeter, 2000a). His experience has shown that when students work on "large, complex projects that involve producing something real, it's much more motivating and lasts longer in your memory than discrete facts and skills" (as cited in Salpeter, 2000a, p. 2). Becker is not alone in suggesting that technology may be a valuable tool in reforming education. Regarding efforts to reform teaching and learning through technology, Kelly and Ringstaff noted, "If technology is to be used in powerful ways – to support student collaboration, inquiry, and interactive learning – then teachers' beliefs about learning and teaching often must change" (2002, p. 16). They cite as an example the study of Apple Classrooms of Tomorrow (ACOT).

> In the ACOT model, text-based curriculum delivered in a lecture-recitation-seat work mode was first strengthened through the use of technology, and then was gradually replaced by more dynamic learning experiences for students, such as collaborative, project-based, interdisciplinary learning. The instructional changes that occurred during these stages were closely tied to changes in teachers' beliefs

[1] Previous section taken from Fouts, J. T. (2000). *Research on Computers in Education: Past, Present, and Future.*

> about classroom management, learning, teacher-student roles, and instructional practices. (p. 16)

Changing teacher practice is not a simple task, however. As Becker (2000c) stated:

> The pedagogy variable may be more intractable. Other research we are conducting suggests that computer technology is having an emancipating effect on teachers who believe in project-based teaching and other constructivist-compatible practices. However changing other teachers' philosophies and beliefs to be more constructivist simply by having them use computers in their teaching may not work. (p. 110)

This has certainly been the case in Washington schools, many of which are attempting to encourage teachers' efforts to use constructivist teaching and learning practices. Change is difficult, particularly when it involves long-held philosophical beliefs about how children learn. "Teachers enter the profession with deeply held notions about how to conduct school – they teach as they were taught" (Sandholtz, Ringstaff, & Dwyer, 2000, p. 257).

Evidence exists as well to suggest that educational technology has more of an impact when it is part of a larger reform effort (Sandholtz et al., 1997). According to Kelley and Ringstaff (2002), "Although technology can support educational change, it will have little impact without accompanying reform at the classroom, school, and district level" (p. 11). Researchers studying a school-business partnership in New Jersey found a substantial improvement in standardized test scores on a state-mandated test. This success was attributed in part to technology and in part to various other restructuring efforts that took place in the school at the same time, including the move to authentic literature, block scheduling, extensive staff development, and greater parent involvement. The researchers concluded, "The magic lay not exclusively in the technology, but in the interweaving of a systematic program of education reform with the judicious use of technology-based resources" (Chang et al., 1998, p. 43). In a study of Washington State schools' restructuring efforts, Fouts (1999) found that the implementation of reforms such as educational technology often had more of an impact when they were part of a broader, school-wide change agenda. Emerging evidence does seem to show that a relationship exists between school reform, constructivist teaching, and educational technology. Proponents of school technology assert that establishing constructivist environments and encouraging constructivist teaching and learning practices can be facilitated with educational technology.

Educational Technology and Student Achievement

Larry Cuban is among those who haven been critical of the rush by schools to jump on the educational technology bandwagon, and has observed that:

> "Techno-enthusiasts" rarely question at all the pervasive story used to justify educational technology – that, unless we have technology in our schools, kids won't be able to get jobs in an increasingly computerized world . . .I believe this is a misguided way to think about schooling . . .there's been a lot of research about CAI and a lot of anecdotal evidence but no body of serious research to measure whether technology will achieve its own goals – whether it can help in areas such as intellectual development. I'm open-minded. We might find that it works. In fact my hunch is that it probably does but we don't know for sure. I remain a skeptic because so many claims have been made without questioning. (as cited in Salpeter, 2000a, p. 4).

Cuban is not alone in asking for evidence to show that educational technology makes a difference in student learning. The Department of Education recently announced plans to conduct a five-year, $15 million dollar evaluation of technology's impact on learning. According to John Bailey of the Department of Education:

> We need to be able to make the case for why . . . technology is going to lead to increased student achievement . . . Everyone is asking "Show me the effectiveness. Show me why it works." In tight budget times this is even more critical . . . Otherwise we're asking people to bank on the promise of technology without proving the effectiveness. (p. 1)

Numerous educators and researchers have also recognized the need for such evidence and yet there is general agreement about the difficulty of gathering such data. According to Becker, conducting valid research is "definitely hard, especially to ask the right questions. It's hard to develop good measures about important and complex concepts and performances" (as cited in Saltpeter, 2000a, p. 2). Part of the difficulty lies in the fact that existing assessments often do not adequately capture the skills that this technology enhances, such as critical thinking, other higher order thinking skills, writing, and problem solving (Honey, Culp, & Spielvogel, 1999). According to a report issued by the North Central Regional Educational Laboratory, the different uses and goals of specific technology applications must be considered. First, researchers must be clear about the type of technology being measured. Computers, video production equipment, and specific software may each impact student learning differently, a factor that should be addressed in attempting to measure the relationship between educational technology and student achievement.

Nevertheless, emerging evidence suggests that under certain conditions, technology can have a positive influence on student achievement. Results of a 10-year study of the Apple Classroom of Tomorrow (ACOT) project, for example, indicated that routine classroom use of technology favored ACOT students over non-ACOT students. Students involved in ACOT classrooms used problem solving, inquiry, and collaborative skills more often than students from traditional programs, according to project researchers (Sandholtz et al., 1997). Students used word processing, database, spreadsheet, hypermedia, and multimedia software on a regular basis, and their classrooms were characterized by interdisciplinary projects and team teaching.

Researchers have also studied the effect of computers on student writing and found that technology can positively impact both the quality and quantity of their efforts. Goldberg, Russell, and Cook (2003) conducted a meta-analysis of 26 studies that examined the effect of word processing on student writing, for example. Their findings showed that word processing did, in fact, positively influence the quantity and quality of student writing, a finding that was stronger for secondary students than for elementary students. In a recent report on the effectiveness of educational technology, Sivin-Kachala and Bialo also cited several positive findings. For example:

> In studies focusing on reading and language arts, technology has been shown to provide a learning advantage in the areas of phonological awareness, vocabulary development, reading comprehension, and spelling. Furthermore, there is evidence that students who use word processing software in combination with carefully sequenced instruction in the writing process or [with] writing tools with built-in guidance in the writing process improve their writing significantly more than students without access to such tools, as do students who write to a real audience via the Internet or e-mail. (2000, p. 4)

Although there is emerging evidence indicating that computer technology may in fact positively impact student achievement, the challenge of measuring those effects remains. As noted by Honey et al.:

> . . .assessing the effect of technology on student achievement is a complex issue. Most research on technology and student achievement has used traditional standardized assessments to measure changes in student performance. This research often has focused on students' knowledge of isolated facts but has paid little attention to how well students think . . .To measure the effect of specific technologies on student achievement, assessment methods and instruments should be appropriate to the learning outcomes promoted by those technologies. (1999, p. 4)

Furthermore, "Because the technology becomes part of a complex network of changes, its impact cannot be reduced to a simple cause-and-effect model that would provide a definitive answer to how it has improved student achievement" (Honey et al., 1999, p. 4). In fact, in studying restructuring efforts in Washington State schools, Fouts (1999) found that while educational technology had an indirect correlation with student achievement, it was rather the broader reform efforts undertaken by a school that significantly influenced student achievement. Technology, while often part of those reform efforts, was not in and of itself related to increased student achievement.

Although there is emerging evidence indicating that computer technology may in fact positively impact student achievement, the challenge of measuring those effects remains.

Educational Technology and Young Children

There is a continued interest among educators and others about the impact of technology on primary-age children, and for the third year the evaluation of the Teacher Leadership Project specifically focused on this area. This was done in an attempt to more fully understand how technology is best used in K-2 classrooms where children are in the early stages of literacy development. In addition, the evaluation was intended to identify specific successes and challenges faced by primary teachers in their integration efforts.

It is still the case that there are no definitive answers to the many questions about the use of technology in K-2 classrooms, although discussion of the issues continues. "Much of the controversy revolves around the specific needs of young children, and whether technology can support those needs, or will take away from essential developmental experiences" (Van Scoter, Ellis, & Railsback, 2001, p. 1). This is particularly problematic given the limited amount of time primary teachers have to develop students' basic literacy skills.

Jane Healy has written several books on young children and learning and believes "An atmosphere of hysteria surrounds the rush to connect even preschoolers to electronic brains" (1998, p. 20). A case in point is the increasing number of software programs available for young children, toddlers, and even babies. *Jump Start Baby*, *Reader Rabbit Baby,* and *Baby WOW 2000* are just a few examples of educational programs designed for children. Healy is one of a growing number of professionals raising concerns about the impact of placing such sophisticated technology in the hands of preschool and primary age children. She suggests teachers and parents give serious consideration to *when* and *how* technology is introduced to young children.

> If the computer can accomplish the task better than other materials or experiences, we will use it. If it doesn't clearly do the job better, we will save the money and use methods that have already proven their worth. In the case of the child under seven, there are few things that can be done better on a computer and many that fail miserably by comparison . . . [they] are better off spending this valuable time in a physically and linguistically enriched environment (Healy, 1998, p. 218).

Proponents of technology in primary classrooms believe there are benefits for even young children, provided "the computer use does not replace time spent on the important foundation skills of the early years."

Proponents of technology in primary classrooms believe there are benefits for even young children, provided "the computer use does not replace time spent on the important foundation skills of the early years" (Northwest Educational Technology Consortium [NETC], 2001). Results of a study done by the National Research Council on brain development and learning revealed, for example, that "because many new technologies are interactive, it is now easier to create environments in which students can learn by doing, receive feedback, and continually refine their understanding and build new knowledge" (Bransford, Brown, & Cocking, 1999, p. xix). Susan Haugland, who

has written frequently on issues dealing with children and technology, agrees. "Their motor skills, mathematical understanding, creativity, problem solving and critical thinking skills are potentially improved when young children have access to technology" (1999, p. 29). Proponents also believe that the opportunities for young children to collaborate when using computers can be valuable. Additionally, it has been suggested that use of the keyboard gives young children greater freedom of expression (writing and drawing) since they are not constrained by their limited fine motor skills.

According to a statement by the National Association for the Education of Young Children (NAEYC; 1996), there are two important conditions to effectively using technology with primary-age children. First, the teachers must be skilled in making good decisions about which technology to use and in supporting children in their use of technology to ensure that potential benefits are achieved. Van Scoter et al. noted:

> The teacher's role is to set up the environment and activities, matching technology use to the curriculum as well as to the children's needs and interests. The teacher is less involved in directing the activities, and more involved in monitoring student activities, intervening as necessary to guide and pose questions that encourage thinking. (2001, p. 7)

Evidence has revealed, however, that teachers are not given sufficient relevant training, nor do they feel prepared to use technology judiciously with their students (Gatewood & Conrad, 1997; Meyer, 2001).

Furthermore, teachers should use their knowledge of child development when evaluating and choosing primary software (NAEYC, 1996). According to Haugland, "It is easy to become distracted by glitzy packaging and promises from manufacturers, losing sight of what is truly important: providing children with a sound educational tool for learning" (2000, p. 13). Recommendations for age-appropriate software include identifying programs that (1) encourage exploration, imagination, and problem solving; (2) reflect and build on what children already know; (3) involve many senses and include sound, music, and voice; and (4) are open-ended, with the child in control of the pace and the path (NETC, 2001).

The following statement has been made by Early Connections, a part of NETC, regarding technology use by young children:

> Children receive the greatest benefits from technology when these elements are present:
>
> - The lesson or project is directly connected to the curriculum
> - The technology allows for active learning, with students making the decisions
> - The software is interactive or discovery-based
> - The lesson or project is open-ended, allowing learners to proceed at their own pace
> - Technology is applied to real problems with a real-life connection

- The setting is designed to allow children to interact while working at the computer
- Computers are included in the curriculum within the classroom rather than set apart in a separate room or lab. (NETC, 2001)

In the end, questions remain about the most appropriate use of technology in primary classrooms. While a number of concerns have been raised about the impact of technology on children's social, emotional, physical and cognitive health, there are also reasons to believe that children may benefit from early exposure to technology. "Computers are reshaping children's lives, at home and at school, in profound and unexpected ways. Common sense suggests that we consider the potential harm, as well as the promised benefits of this change" (Cordes & Miller, 2000, p. 3).

Critical Factors in Technology Integration

As more schools across the country commit themselves to some sort of technology agenda, greater efforts have been made to determine the impact of such technology on teaching and learning. Are computers and related technologies being used to transform student learning? Larry Cuban, for one, has argued that computers are a mismatch with the requirements and conditions of teaching (Cuban, 1986, 2000), and even those who are convinced that we are "on the verge of the dawn of a golden age for educational technology" (Goldberg, 2002, p. 32) suggest that technology has not yet lived up to its promise. Still, clear patterns are emerging which document the benefits of technology-rich environments, including positive changes in student attitude and behavior, classroom dynamics, the role of the teacher, student learning and student work. The benefits of integrating technology into the curriculum are not the result of simply placing large amounts of technology in the classroom, however. Researchers are discovering a number of conditions that are critical to a sound technology program, including appropriate access, teacher training, and technical support. When such conditions are not met the chance of realizing these benefits is greatly reduced.

Researchers are discovering a number of conditions that are critical to a sound technology program, including appropriate access, teacher training, and technical support. When such conditions are not met the chance of realizing these benefits is greatly reduced.

Teacher Training

At the heart of successful technology integration is teacher training. Researchers and educators alike agree that technology will have relatively little impact unless teachers are adequately trained. A recent review of research on educational technology reported that teacher training is the most important factor influencing how teachers use computers. Skinner noted:

> Having the best computer, the fastest connection, and the latest software will not make a difference in the classroom if teachers are not trained in how to use them.

> Beyond access, teaching teachers and students to use computers to enhance learning is a critical step in integrating technology into the curriculum. (2002, p. 4)

A report prepared by the National Center for Education Statistics (1999) indicated that teachers who feel prepared to teach with technology use it more often and are more likely to have their students use it in exercises and lessons that require higher-level thinking. A review of research conducted by Sivin-Kachala and Bialo documented the benefits of technology in improving student achievement, students' attitudes, and the learning environment. Their conclusions, however, stressed the role of the teacher. "The decisions made by well-trained educators [necessarily] determine the computer's ultimate instructional effectiveness" (1995, p. 17). In a more recent review of the impact of educational technology, Sivin-Kachala and Bialo stated, "Educators are an essential element in the effectiveness of technology" (2000, p. 4). They also pointed out that students of teachers with more than 10 hours of training significantly outperformed students of teachers with 5 or fewer training hours (2000, p. 4). Others researchers agree about the importance of teacher expertise:

> The focus of integration is on pedagogy- effective practices for teaching and learning. Teachers need to be able to make choices about technology integration without becoming technocentric by placing undue emphasis on the technology for its own sake without connections to learning and the curriculum. For both pre-service and in-service professional development, this means providing experiences, primarily in instructional design, media selection, modeling exemplary practices, clinical activities, resource sharing, and extensive and sustained training and practice. (Earle, 2002, p. 10)

Still, training in using computers is not enough. According to Kearsley, training teachers to use computers without recognizing the importance of content and pedagogy proves "a distraction (on a grand scale) from what matters most – effective learning and good teaching" (1998, p. 47). "Teacher training . . . must be extensive and sustained and must focus on content (p. 49). A study of teachers' pedagogical expertise and technology integration underscored the importance of knowing *what* to teach and *how* to teach (Pierson, 2001). Findings indicated that in addition to possessing technical skills, teachers needed to be knowledgeable of content and pedagogy to maximize the potential of technology. Pierson explained her conclusions as follows:

> Researchers (Berliner, 1986; Leinhardt & Greeno, 1986; Shulman, 1986; Wilson, Shulman, & Richert, 1987) agree that expert teachers possess both *content knowledge* and *pedagogical knowledge*, the intersection of which is described as *pedagogical-content knowledge*, or knowledge about specific learning, curriculum, and the various and most useful ways to represent the particular subject matter being taught. The findings of the present study suggest another component to the model, that of *technological knowledge*. This knowledge would include not only basic technology competency but also an understanding of the unique characteristics of particular types of technologies that would lend

> themselves to particular aspects of the teaching and learning processes. A teacher who effectively integrates technology would be able to draw on extensive content knowledge and pedagogical knowledge, in combination with technological knowledge. The intersection of the three knowledge areas, or *technological-pedagogical-content knowledge* would define effective technology integration. (p. 427)

Pierson proposed that "unless a teacher views technology use as an integral part of the learning process, it will remain a peripheral ancillary to his or her teaching. True integration can only be understood as the intersection of multiple types of teacher knowledge and, therefore, is likely as rare as [teaching] expertise"[2] (p. 427).

What, then, are the critical elements of a sound technology professional development agenda? Researchers have concluded that three factors are key to an effective program: (1) training; (2) time; and (3) access.

Training

It is becoming clear that "one-shot" training sessions and in-services are only minimally useful in preparing teachers for the hard work of integrating technology into the curriculum. Support for in-depth teacher training can be found in the research literature. For example, an increase in eighth-graders' test scores was linked to the use of technology in cases where trained teachers used the technology in pedagogically sound ways (Kelley & Ringstaff, 2002). Still, in many cases it is more typical for schools to offer brief, skills-based in-services rather than in-depth training in technology integration that is part of a larger technology plan. While skill sessions are necessary, they often leave teachers wishing for more. Means, Penuel and Padilla (2001) found this to be true in a study of technology use in six public high schools.

It is becoming clear that "one-shot" training sessions and in-services are only minimally useful in preparing teachers for the hard work of integrating technology into the curriculum.

> Many more teachers were themselves comfortable with computers than used them in their teaching. Most of the younger teachers had used technology in college, and many older teachers had been introduced to technology by their adolescent or adult children. Many teachers knew how to use general applications programs, such as word processing, spreadsheets, and e-mail, for their own purposes (e.g., composing tests, tracking grades) but did not know of worthwhile uses of technology in teaching the particular subjects for which they were responsible . . .The implication of these observations is that providing teachers with generic training in how to use technology tools may be helpful but probably will be

[2] "Expertise" or "Exemplary teaching" is defined by Pierson based on a framework from Berliner (1994). "Identifies seasoned teachers who posses the intuition to recognize patterns across unrelated activities and have contingency plans for the unexpected. Exemplary also describes those few highly motivated learners who interpret their environment in fluid, almost subconscious ways and act in anticipation of what is needed."

> insufficient to bring about a major shift in their practice toward student-empowering uses of technology. (p. 201)

The need for in-depth and ongoing training is clear. According to the *Report to the President on the Use of Technology*:

> The substantial investment in hardware, infrastructure, software, and content that is recommended in this report will be largely wasted if K-12 teachers are not provided with the preparation and support they will need to effectively integrate information technologies into their teaching. (Shaw & the President's Committee of Advisors on Science and Technology, Panel on Educational Technology, 1998, p. 17)

In addition, "Professional development takes time and must be conducted over several years for significant change in educational practice to take place. Substantial change in school practice typically takes four to seven years, and in some cases longer" (Speck, as cited in Rodriquez, 2000, p. 5).

Collegial learning

In addition to a thorough training program, teachers preparing to integrate technology into the curriculum need opportunities to learn with and from colleagues. Reflecting on new learning, exchanging ideas and strategies, and sharing expertise and skills are all critical in facilitating teachers' efforts to effectively use technology for teaching and learning. In a study of laptop classrooms, Windschitl and Sahl (2002) found that one of the most powerful ways in which teachers increased their proficiency in using technology for teaching and learning was through regular collaboration with their peers. In addition, educators from a Connecticut middle school reported that providing teachers with opportunities for "social support" was one of the primary reasons their technology-training program was so successful (Saylor & Kehrhahn, 2003). The authors noted that:

> The Technology Change Facilitator . . . organized question and answer sessions and after-school get-togethers for reflective dialogue, action research, and collaboration . . . In addition, the TCF set up problem solving sessions for individuals and teams who were implementing common goals, initiated support groups to address particular roadblocks [and] linked teachers who doubted their ability to use technology with mentors who had a higher comfort level . . . As teachers learned more about each other's expertise, they asked one another for help on specific technology tasks. Some teachers formed their own informal implementation teams based on individual concerns, goals, and curricular problems . . . Teachers often talked about common goals and offered each other encouragement in reaching their goals (p. 3).

Time

Finally, the need for *time* continues to emerge as one of the most important factors in developing the ability to successfully integrate technology into the curriculum. Acquiring and practicing skills, trying new ideas, and developing new strategies and

content requires large blocks of time. Research exists to support the need for teachers to have planning time when learning to integrate technology into the curriculum. For example, it has been reported that "82% of teachers said they were not given enough time outside their regular teaching duties to learn, practice, or plan how to use the computers and other technologies" (Meyer, 2001, p. 50). According to Glennan and Melmed (2000):

> Teachers engaged in reform universally complain about the shortage of time in which to develop the plans and new skills needed. The problem is that many of those skills must be learned at the same time teachers are carrying out their teaching functions. Many of the reforms enabled by technology require collaboration among teachers rather than simply allowing teachers to make the changes in the isolation of their own classrooms. If ways cannot be found to provide collective time for such activities without it all being done on the teachers "own" time, it is unlikely that the reforms we are discussing can take place. (p. 64).

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Access

Although teacher training is a key factor in successful technology integration, it is of little consequence without access to adequate hardware and software. Although there are conflicting opinions on the optimal number of computers needed for effective technology integration, research does indicate that ready access to computers is important. Becker (2001) has suggested that six to eight computers per classroom is the minimum needed for meaningful use by students. There is no doubt that schools are acquiring more and more computers. A recent report in Education Week (Edwards, Chronister, & Bushweller, 2003) noted that the ratio of students per Internet-connected computers was 5.6 to 1 in 2002, and the ratio of students per instructional computer was 3.8 to 1. Despite such increases, however, teachers across the country continue to report a shortage of computers. This is due in part to the obsolescence of school technology and in part to slow Internet connections, both of which limit the usefulness of available classroom equipment.

Beyond the practical issue of hardware, however, is the issue of equitable access to computers. Educators and researchers have documented the disparity of technology access and the effects of such disparity. Cuban (2000), for example, presented the following statements regarding student access to computers.

- Students from high-income families have far more access to computers than peers from low-income families. Minority students and those whose native language is not English use computers in schools less than their classmates do.
- Low-achieving student are les likely to use machines to enhance reasoning and problem solving and more likely to use them for drill.

In a report addressing the use of educational technology, the President's Committee of Advisors on Science and Technology stated:

> Educational technologies have the potential to either ameliorate or exacerbate the growing gulf between advantaged and disadvantaged Americans, depending on policy decisions involving ways in which such technologies are deployed and utilized on behalf of various segments of our country's student population. . . . The panel feels strongly that access to knowledge-building and communication tools based on computing and networking technologies should be made available to all of the nation's students, regardless of socioeconomic status, race, ethnicity, gender, or geographical factors, and that special attention should be given to the use of technology by students with special needs. (Shaw and the President's Committee of Advisors on Science and Technology, 1998, pp. 9-18)

There is evidence that progress is being made in these efforts. Data presented in a recent report on the state of educational technology indicated that:

> Gaps between statewide access to computers and access in high-minority and high-poverty schools are closing across the country. In 2001, there were 8.1 students per Internet-connected computer in high-poverty schools, and 8.5 students per Internet-connected computer in high-minority schools. A year later, those ratios decreased to 6.3 and 6.7 respectively. (Ansell & Park, 2003, p. 44)

Technical Assistance

In addition to training and access, the importance of adequate hardware and technical support is becoming clear as well. Teachers must be assured of timely, effective assistance in trouble-shooting technical glitches. When schools do not make provisions for maintaining and replacing technology, the promise of long-term success is greatly reduced. Rodriguez noted:

> When teachers are trying to use technology in their classrooms and they encounter difficulties, they need immediate help and support. Technology that is not easily accessed and implemented will not be used. Teachers will return to more traditional ways of teaching if the problems they encounter cannot be solved quickly and efficiently. (2000, p. 6)

Cuban (2000) has observed that integrating technology into the curriculum requires teachers to have

> infinite patience . . .Ask even the most dedicated teacher users how often these machines break down. Most schools can't afford on-site technical support. When they do have coordinators and eager students who troubleshoot problems and do the repairs, there are still software glitches and servers that crash, torpedoing teacher lessons repeatedly. Then new software and upgraded ones require more memory and speed from machines that are sorely limited in their capacity. More

> breakdowns; more pulled hair. These caring and techno-enthusiastic teachers . . .ask: What did I do to deserve this? (p. 4)

Too often teachers are forced to rely on their own resourcefulness to resolve technology problems. Indeed, according to the director of technology for the Abington (Pennsylvania) School District, the hardware and technical glitches can be serious barriers to true transformation. He stated:

> To have a truly transformational impact on education, technology must become ubiquitous. It must be always available, mobile, and flexible. It must be intuitive, reliable, and user-friendly to the point of being no more difficult to operate than a chalkboard, textbook, or overhead projector. It must be seamless and nearly invisible. At the moment, educational technology isn't any of these things. (Goldberg, 2002, p. 32)

The degree to which any technology integration program successfully prepares teachers to infuse computers into the curriculum is highly dependent on how thoroughly these factors are addressed. Honey et al. noted:

> Teachers need in-depth, sustained assistance not only in the use of the technology, but in forms of ongoing support that addresses a range of issues, including teachers' changing practices and curricula, new technologies and other resources, and changing assessment practices. This time spent ensuring that teachers are using technology to enrich their students' learning experiences is an important piece in determining the value of technology to their students. (1999, p. 6)

As those involved with one district's technology integration program observed,

> It is not surprising that only about five percent of instructional technology programs succeed or endure beyond a three-to-five year period. Several factors erode efforts a district might make to sustain an effective technology program: a focus on hardware rather than on processes, the recurring obsolescence of hardware, a weak planning process that fails to meet the needs of teaching and learning, little or no staff development, and no long-range plan for sustained effort. (Eastwood, Harmony, & Chamberlain, 1998, p. 1)

"Technology that is not easily accessed and implemented will not be used. Teachers will return to more traditional ways of teaching if the problems they encounter cannot be solved quickly and efficiently."

Other Technology Integration Models

The Teacher Leadership Project is one of several large-scale technology integration training programs intended to support teachers and schools in their efforts to

use computers for teaching and learning. Descriptions of three models are provided to establish a context for this report.

Ameritech

In 1999 the Ameritech Foundation began funding the Ameritech Technology Academy[3], a program intended to provide teachers with ways to use technology more effectively in the classroom. The stated purpose of the Academy is to "increase educators' technology skills for the benefit of Michigan students. The program seeks to help educators integrate the use of technology into their curriculum and instructional strategies. The program is built on a train-the-trainer model."

The Ameritech Technology Academy focuses on technology integration and professional development. The importance of teamwork is made clear throughout the ATA application process, which includes a team essay and a commitment to the team process. Prospective applicants are asked to explain their school's readiness "to participate in and benefit from a professional development program emphasizing integrating technology across the curriculum." Teams must include at least one building administrator, preferably the building principal, and all members are expected to act as leader/change agents in the school. Each team member also agrees to provide a minimum of 10 hours of training to building colleagues.

Initial Ameritech Technology Academy training takes place over two days. The first day is devoted primarily to technology, with an emphasis placed on hardware, software, and the rationale for using technology to support student learning. Among the outcomes expected of team members are the following:

- Identify and evaluate what good integration looks like
- Explore uses for Inspiration, HyperStudio, PowerPoint
- Put research into presentation format

To accomplish these goals, participants are guided through several structured curriculum projects and are introduced to a number of hardware and software products. In addition to such practical sessions, participants consider the appropriate role of technology in education.

The focus of the second training day is professional development. Teams are expected to create an agenda for sharing the fundamentals of technology integration with other building staff members. Their efforts are directed toward the following outcomes:

- Develop a building plan using District, State, and National Standards as guides
- Identify resources for staff to use
- Create a practical plan to use with staff

[3] Information taken from www.ataacademy.org

The final product of the ATA training is a professional development plan to be used for school and/or district level technology in-service. ATA provides support for building teams during the year following their training, both in the form of a site visit and online resources. Visiting ATA trainers meet with building teams to discuss their successes and challenges and to review their professional development plans. Additional support and assistance is available to ATA participants through an online clearinghouse of technology-related resources, online courses, a listserv, and a weekly e-mail update.

Intel© Teach to the Future

The Intel© Teach to the Future program[4] is described as "a worldwide effort to help teachers integrate technology into classrooms to enhance student learning." The goal of the program is to "provide professional development for classroom teachers, enabling [the teacher] to integrate the use of computers into [their] existing curriculum to meet state and national standards." Intel© Teach to the Future has been offered in numerous locales throughout the United States, and selection into the program is based on successfully meeting several criteria.

The Intel© Teach to the Future program utilizes a train-the-trainer model. Intel participants, referred to as Master Teachers, are typically expected to train a certain number of Participant Teachers from their schools and/or districts as a part of their commitment to the program. This PT (Participant Training) consists of 10 four-hour modules, and a suggested timeline is provided by Intel to ensure that the training is accomplished in a timely manner.

Intel© Teach to the Future is a five-day training program that offers 10 four-hour modules designed to provide each participant with opportunities "to collaborate with other teachers and discuss ideas for both introducing and using technology in their classroom." In addition, they have the opportunity to "develop a specific unit based either upon material they are currently teaching or material they would like to teach in the future. The goal in the end is for teachers to have a technology product they can take back to their school, one that allows them to raise the level of excellence in their classroom and meet important learning objectives."

Teaching and Technology Coaching Initiative (T2CI)

The Teaching and Technology Coaching Initiative (T2CI)[5] is a program funded by a U.S. Department of Education Technology Innovation Challenge Grant with support from the Puget Sound Center for Teaching, Learning, and Technology, TechCorps™, and from local school districts (Seattle, Shoreline, Edmonds, and Mukilteo). The initiative is intended to "empower at least 150 teachers to coach and provide assistance to colleagues who are working toward integrating technology into their classroom curriculum to enrich and enhance learning." It is expected that powerful technology integration will improve student achievement. The program emphasizes:

[4] Information taken from www.intel.com/education
[5] Information taken from http://www.pugetsoundcenter.org/t2ci/

- Hands-on creation of curricular project and evaluation tools that address state and district curricular and technology standards and develop technology skills
- Development of coaching skills and strategies through hands-on activities
- Ongoing support through the use of a series of powerful online tools designed to assist coaches and participating teachers
- Connecting T2 coaches and teachers to community resources by matching them with corporate volunteers provided by TechCorps™

Summary

As schools dedicate more and more resources to technology, questions remain about the impact on teaching and learning. While many believe that progress is being made in developing and implementing effective technology integration programs, there is general agreement among educators and researchers that such efforts are still in their infancy. Goldberg (2002) noted:

> It may take a few more years for attitudes and technologies to mature to the point that the transformation is possible – but it will happen. Ubiquitous technology will have such an explosive impact on education that its results will become clearly visible to the naked eye, in stark contrast to today's inconclusive empirical studies. (p. 34)

In response to Larry Cuban's contention that computers will play a minor role in changing student learning, Becker (2000b) acknowledges that while there is the potential to transform education through technology integration, it has not happened yet.

> In a certain sense Cuban is correct – computers have *not* transformed the teaching practices of a majority of teachers, particularly teachers of secondary academic subjects. However, under the right conditions – where teachers are personally comfortable and at least moderately skilled in using computers themselves, where the school's daily class schedule permits allocating time for students to use computers as part of class assignments, where enough equipment is available and convenient to permit computer activities to flow seamlessly alongside other learning tasks, and where teachers' personal philosophies support a student-centered, constructivist pedagogy that incorporates collaborative projects defined partly by student interest – computers are clearly becoming a valuable and well-functioning tool. (Becker, 2000b, p. 29)

While many believe that progress is being made in developing and implementing effective technology integration programs, there is general agreement among educators and researchers that such efforts are still in their infancy.

Research on educational technology, including qualitative studies, anecdotal reports, program evaluations, and a limited number of relevant quantitative studies,

suggests that there are benefits when technology is integrated into the curriculum. Students' attitudes, work products, and learning, as well as classroom dynamics and the role of the teacher are changed when technology is meaningfully infused into the teaching and learning process (Brown, 2003a, 2003b; Brown, Fouts & Rojan, 2001; Brown & Rojan, 2002; Fouts & Stuen, 1997, 1999; Stuen & Fouts, 2000). On the other hand, there is mounting evidence of certain critical conditions that must be met for technology to be successfully integrated into the curriculum (Becker, 2000b; Earle, 2002; Eastwood, Harmony, & Chamberlain, 1998; Glennan & Melmed, 2000; Honey, Culp, & Spielvogel, 1999; Kelley & Ringstaff, 2002; Rodriguez, 2000; Salomon, 2002). These include teacher training, access to hardware and software, and time.

The Teacher Leadership Project was designed to train and support teachers in Washington State in using technology to improve student learning. The effectiveness of the program over the past five years can be measured in part by the degree to which it successfully addressed these conditions. This evaluation of the Teacher Leadership Project assessed the program and the extent to which this was accomplished.

EVALUATION DESIGN

The evaluation of the Teacher Leadership Project focused on understanding the impact of the program between 1998 and 2003 in terms of teachers' attitudes, technology-integration competence, and professional development efforts. Additionally, the study attempted to document the broader impact of the Teacher Leadership Project on students, classrooms, schools, and districts throughout the state. The following three broad research questions guided the study:

Evaluation Question 1: ***What impact has the Teacher Leadership Project had on teaching and learning in Washington State?***

Evaluation Question 2: ***What impact has the Teacher Leadership Project had on schools and districts in Washington State?***

Evaluation Question 3: ***What are the strengths and limitations of the Teacher Leadership Project as a model of professional development?***

Over the course of the five-year evaluation of the Teacher Leadership Project, both qualitative and quantitative data were gathered to address the three questions, and included teacher reflective journals, classroom observations, TLP training observations, teacher, student, parent, principal, and administrator interviews, lesson analyses, and teacher and student surveys. A brief description of each data source is provided in Table 1.

Table 1. Data Sources for the Teacher Leadership Project Evaluation 1998-2003

	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	Totals
Reflective Journals (*n*)	852	1,019	5,371	3,763	1,523	**12,522**
Classroom Visits, Interviews and Observations (*n*)		7	21	30	114	**142**
Survey Responses-Teachers (*n*)	141	321	893	834	1,854	**3,902**
Survey Responses- Students (*n*)	2,671		11,400	678		**14,749**
Parent Telephone Interviews (*n*)	50					**50**
Curriculum Lesson Analyses (*n*)	8	224				**232**

Teacher Reflective Journals

Teachers in all five TLP cohorts were required to submit regular reflective journals in which they responded to a series of specific questions regarding their technology integration efforts and their leadership activities. The following selection of

reflective journal questions illustrates the type of information that was gathered through journal responses.

1. In what ways have you integrated technology into the curriculum so far this year? *(Consider subject areas, projects or units of study, programs and applications)*

2. How have students, parents, and/or administration responded to your technology integration efforts?

3. What has gone well in your integration efforts? *(Consider specific projects and activities, student reaction and participation, support, etc.)*

4. What challenges have you faced? *(Consider technical issues, time and space issues, student management, support, etc.)*

5. What aspects of your TLP training have been helpful to you as you've integrated technology into the curriculum? What additional training would be useful?

6. What evidence, if any, do you have that suggests students are learning differently and/or more because of the addition of technology to the curriculum; that is, how is their educational experience better because of their access to technology?

7. In what, if any, leadership activities have you and/or your students been involved? *(Consider presentations, demonstrations, classes taught, etc.)*

A breakdown of journals received by cohort is shown in Table 2. Because requirements varied each year, figures are unique to each particular cohort. For example, Cohort 1 participants (160 teachers) were required to submit journals twice each month over the course of their first year. Teachers in the Cohort 3, on the other hand, were required to submit journals seven times during their first year, twice during their second year, and once during their third year. Journals were submitted electronically and analyzed for patterns related to usage, challenges, student perceptions, and the impact on teaching and learning. Responses were analyzed by cohort and by grade band in an effort to understand differences related to teachers' length of time in the program and students' developmental levels, abilities, and skills.

Table 2. Teacher Leadership Project Reflective Journals Submitted 1998-2003

Journals Submitted	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003 (Web)	2002-2003 (e-mail)
Cohort 1 (1998-1999) (*n*)	852				53	
Cohort 2 (1999-2000) (*n*)		1,019	79		118	
Cohort 3 (2000-2001) (*n*)			5,292	643	422	
Cohort 4 (2001-2002) (*n*)				3,120	533	
Cohort 5 (2002-2003) (*n*)					718	1,523

Technology Surveys

Several different surveys were used to gain insight into the ways in which teachers and students used their technology in the classroom and to understand their perceptions and attitudes regarding the benefits and challenges of using educational technology. During the first two years of the project, pencil-paper versions of surveys were administered, while web-based surveys were administered between 2000 and 2003. The TAGLIT (Taking A Good Look At Instructional Technology), a web-based survey, was developed for use with the *Principals as Technology Leaders* program, offered through the University of North Carolina Center for School Leadership. TAGLIT was used in various Gates evaluation projects including the Teacher Leadership Project during 2000-2001. General information regarding the TAGLIT can be retrieved from: http://www.taglit.org/taglit/login.asp.

During the 2001-2002 and 2002-2003 school years, web-based surveys were made available to current and former TLP participants to gather feedback on their perceptions of the Teacher Leadership Project and on their use of technology. During 2002-2003 a total of 1,854 valid responses were submitted. A copy of the 2002-2003 Technology Use Survey for Teachers can be found in Appendix A.

A total of 3,902 surveys were returned or completed online by teachers between 1998 and 2003, while students of TLP teachers completed another 12,078 surveys. As with information gathered from teacher journals, survey data were used to better understand how teachers and students used technology in the classroom, how they perceived the benefits and challenges of educational technology, and how they shared their knowledge with colleagues. Moreover, survey data was used to confirm or refute qualitative journal responses.

Classroom Observations and Participant Interviews

To provide further evidence of how teachers and students used the grant technology and to explore teachers' perceptions and attitudes at a deeper level, researchers conducted a number of visits to Teacher Leadership Project classrooms.

These visits were undertaken to get a first-hand look at "technology in action," in an attempt to better understand the ways in which student learning, student work products, and teaching strategies were influenced by the addition computers and related equipment. Classroom visits were viewed as an opportunity to talk with teachers about the integration process, about their successes, and about their challenges. Some classrooms served as case studies, where teachers were visited several times over the course of a school year or across several years. A total of 142 classroom observations, interviews, and observation/interviews were conducted between 1998 and 2003. Detailed information regarding the visits and interviews can be found in Table 3.

Table 3. Observation and Interview Data Sources

	Observations and Interviews 1998-2003
Teachers	153
School Administrators	20
Technical Personnel	3
TLP Administration	2

Technology Lesson Analysis

One of the more pressing questions related to technology integration programs is the degree to which computers change how teachers teach and how students learn. In an effort to understand the transformation that takes place, Teacher Leadership Project participants were asked to submit "T-lessons" during 1998-1999 and 1999-2000. The T-lesson is one that compares various aspects of a given curriculum lesson before and after the infusion of technology. The goal of the T-lesson study was to determine any perceived or actual changes to student learning. Teachers submitted 224 T-lessons from which a sample of 34 was selected for detailed analyses to identify changes, if any, in traditional student outcomes. A set of standards developed by Newmann, Secada, and Wehlage (1995) as part of a larger study on the effects of restructuring schools was used to complete the analysis of T-lessons. Results of that analysis are available in the 2000 Evaluation Report of the Teacher Leadership Project (Stuen & Fouts, 2000).

Parent Interviews

Finally, to understand the parent perspective regarding the integration of technology into the curriculum, telephone interviews were conducted with 50 parents of students participating in TLP classrooms during the 1998-1999 school year. Each TLP teacher was asked to submit the names of two parents with varying levels of awareness of the Teacher Leadership Project. A random selection of 50 parents was drawn from the final list, with no more than one parent from each class. Phone calls were made to those fifty parents selected. After three unsuccessful attempts to reach a parent, a replacement parent was selected from another classroom. This process was continued until fifty parents of children from fifty separate TLP classrooms were contacted and interviewed.

Approximately 20% of the sample had either worked in the classrooms as volunteers on a regular basis or had some other close contact with the classroom and therefore had extensive knowledge of the program. Another 65% of the sample had general knowledge of the program gained through parent night activities and through conversations with their children. Finally, 15% of the parents had only vague or no knowledge of the program.

A semi-structured interview protocol was used and interviews centered on the following three general questions:

1. What do you know about the Teacher Leadership Project?

2. How has the infusion of technology impacted your child this year?

3. What is the importance or appropriateness of technology for the classroom and for student learning (including concerns)?

Complete results of the parent study can be found in the 1999 Teacher Leadership Project report (Fouts & Stuen, 1999).

Taken together, data from these various sources were used to assess the impact of the Teacher Leadership Project each year from 1998 to 2003 and were also used as the basis for this summative Teacher Leadership Project Evaluation Report.

RESULTS

Evaluation Question 1:
What impact has the Teacher Leadership Project had on teaching and learning in Washington State classrooms?

A primary goal of the Teacher Leadership Project was to support teachers in their efforts to improve classroom teaching and learning. An analysis of the various data sources found that the Teacher Leadership Project did in fact influence both teachers and students in a number of ways. Teachers, for example, found that pedagogy, classroom structure and environment, student motivation, and student-teacher roles were all affected as a result of their participation in the TLP training. Students also perceived changes in roles, motivation, collaboration, and quality of work.

Classroom Use of Instructional Technology

Over the five years of the Teacher Leadership Project, patterns of technology use remained noticeably stable. Early TLP cohorts reported that they generally found word processing and presentation software to be most useful in the classroom and typically they integrated these programs into language arts or social studies lessons. However, use of the Internet for various research projects increased rapidly as schools and classrooms got connected to the Internet. Results of the 2002-2003 survey revealed that the Internet (82.2%), Word (81.6%), and PowerPoint (68.1%) were used "often" by TLP teachers. Differences were somewhat more evident when examined by grade level (Table 4), although the general patterns remained the same.

Table 4. Percent of teachers using specific applications "often"

	Presentation (PowerPoint)	Research (Internet)	Word processing (Word)	Data Analysis (Excel)	Skill Software
Kindergarten	9.1%	27.3%	36.4%	9.1%	72.7%
First Grade	37.5%	32.5%	62.5%	22.5%	67.5%
Second Grade	48.9%	65.9%	79.5%	52.3%	44.3%
Grades 3-5	66.6%	85.2%	83.4%	62.1%	41.4%
Grades 6-8	73.3%	87.5%	83.9%	74.2%	27.5%
Grades 9-12	69.0%	81.4%	80.0%	67.7%	27.1%

Technology Use in Grades K-2

While there is a general assumption that all children are enriched by a technology-enhanced education, there was considerable interest in understanding the implications of placing computer technology in primary classrooms. During the 2000-2001 school year primary teachers were selected to participate in the TLP for the first time. An in-depth evaluation of 125 K-2 classrooms (Brown, Fouts, & Rojan, 2001) found important benefits to placing technology in the hands of young children. These included:

- **Technical benefits:** Primary children developed the ability to manipulate and navigate a number of computer programs and tools.
- **Academic benefits**: Although difficult to quantify, there was evidence to suggest that student writing was improved, as was their ability to access and use information. In addition, it appeared that the quality and quantity of student work was changed for the better because they had access to technology.
- **Student attitude**: Computers proved motivating to primary students and appeared to lead to more on-task, academic behaviors.

On the other hand, the same evaluation identified concerns and challenges to placing computers and related technology in K-2 classrooms. While some of challenges were similar to those faced by intermediate and secondary teachers, others were unique to younger children. For example, primary teachers had to consider their students' developmental limitations when planning technology-integrated lessons. The fact that young children were in the early stages of writing and letter and number recognition limited what they were able to accomplish with the computers. Additionally, their lack of fine motor skills made keyboarding and mouse control more difficult. Management of primary students was challenging as well. While young children were surprisingly competent in learning technical skills, they were not completely independent, and several teachers questioned how computers could be used effectively in primary classrooms without additional help. The study also identified a need for more developmentally appropriate software and for a training program focused exclusively on the requirements of primary teachers and young children.

For these reasons, the 2000-2001 evaluation included several recommendations regarding the K-2 component of the Teacher Leadership Project. It was suggested that modifications be made to the hardware and software requirements and the training sessions. Based on these recommendations and feedback from primary teachers, the K-2 component of the TLP was in fact restructured in several important ways. First, since questions remained about *best practice* at the primary level, the number of K-2 teachers selected to participate during the 2001-2002 school year was decreased significantly, from 125 to 25. Hardware and training criteria were modified as well:

- Hardware modifications: K-2 classrooms were to be equipped with a minimum 1000 lumen portable projector, visual /desktop presenter (could

include a combination of document camera and projector or all-in-one solution), three classroom computers and one printer.

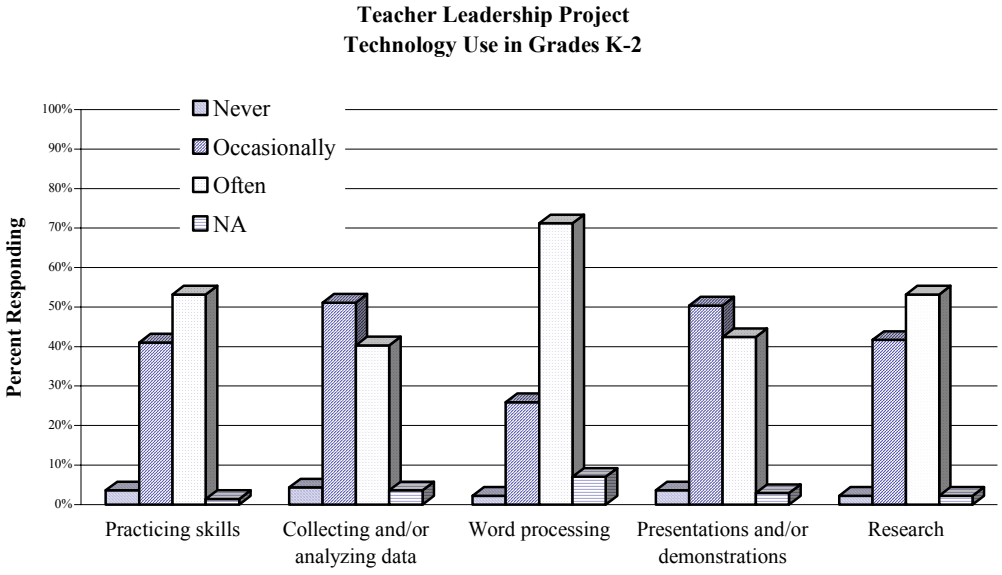
- Training: K-2 teachers were placed in one group for training purposes, and instruction and materials were focused at the primary level.

An evaluation of the TLP based on the modified criteria (Brown & Rojan, 2002) indicated that the changes were, in fact, overwhelming positive. The degree to which teachers used the document camera and projector for instruction more than made up for reduction in student computers they received. Teachers were also enthusiastic about the modified training format targeted specifically for primary interests. Thus, the number of K-2 teachers selected for the 2002-2003 school year was increased to 125.

These teachers found a number of ways to use their technology for teaching and learning (Figure 1). Writing was accomplished with Word, KidPix, and Kidspiration; PowerPoint was used for presentations; and the Internet, Encarta, and Golden Books were used for gathering information. Skill development software (Reader Rabbit, Bailey's Bookhouse) and Accelerated Reader were helpful as well. There was less use of SchoolKit and Excel.

Generally, students used the computers to write and illustrate stories, journals, and letters; to make pages for class books; and to complete teacher-developed templates. However, while similar programs were used, the complexity of the tasks was very much dependent on the abilities of the child. Lessons and projects in second grade classrooms often looked much different than those done in kindergarten classrooms. Kindergarten children who were just learning their letters and numbers and who had less developed fine motor skills were found to perform at different levels than second graders who had mastered the alphabet, were reading independently, and could solve basic math problems.

Figure 1.



Many primary teachers used Accelerated Reader with their students, and reports on the benefits for students were positive. Both highly capable and less able students found the program motivating and challenging, and typically read more and "harder" books. Teachers expected the benefits to be deep and lasting, and they predicted that gains in reading scores would become evident in coming years.

While primary teachers had success with their curriculum lessons and projects, the most enthusiastic responses were related to the benefits of the projector and document camera.

Teachers used Excel less often at the primary level for several different reasons. First, the highly interactive, hands-on nature of primary math programs does not provide an easy avenue for integration. Second, a number of teachers commented that they would need more training with Excel before they would feel comfortable using it with students.

While primary teachers had success with their curriculum lessons and projects, the most enthusiastic responses were related to the benefits of the projector and document camera. With few exceptions teachers felt that their instruction was considerably enhanced when they had access to the camera and projector, and these perceptions grew stronger over years. The following quotes are representative of K-2 teachers' responses:

> *As before I am finding that I am using the technology in my classroom for instruction more than they are actually using it . . . (For example) when I introduce a new letter of the week. I take them to a web site children's dictionary where they look at all of the things that start with that letter. I first show it to them using my laptop and projector and then they use the classroom computers to explore on their own. The final task is for them to draw and label if they can pictures which start with that letter in their ABC books. They write their names, practice writing numbers and draw pictures and write using Kid Pix. They then can print these pages. I am going to use some of the number writing pages as part of an assessment for our progress reports.*

> *My students LOVE the things we've been able to do with the Elmo/projector/ laptop combination. The chance to have their work shown 6 feet tall on the screen is very motivating. We use it for sharing, writing instruction (to include letter formation where it is far superior to any other means of presentation), display and teacher modeling of writing and math . . . Parents are amazed and impressed.*

> One teacher reflected on "Elmo's" influence on a specific student:

> *Since the introduction of the "elmo" and its partner projector, [the student] has written sentences that are more legible and include good ideas of interest to classmates. So where this writing activity had been one of problems and alienation for him, he is now motivated to participate in learning a skill considered necessary for academic success.*

The following two examples profile typical technology-enhanced lessons in primary classrooms.

Profile ~ Kindergarten

For the last two months the kids have been making a slide show in KidPix. One of our big kindergarten units is "Trees," using the FOSS science curriculum. One of the suggested activities is to have the children draw a picture of a tree in each of the four seasons . . . I had them also write a sentence describing the tree and they used the textbox icon to type it into the slide. The children are now adept at using KidPix and also have a solid understanding of how trees change with the seasons.

Profile ~ Grade 2

I have integrated technology across the curriculum. I use the Elmo document camera with projector daily in all subject areas. It has worked great to demonstrate math activities, science such as planting and growing new plants, to read books, show maps, show and tell, students showing their work to the class and the list goes on and on. The students use the computers daily to write and illustrate their work. We just finished a slide show we named "I have a dream" with the Kidpix deluxe program. My next goal is to have them create a PowerPoint presentation celebrating diversity.

Benefits to K-2 Students

Primary teachers were enthusiastic about the potential of technology to improve student learning. In fact, over 90% of teachers agreed or strongly agreed that "Integrating technology into my curriculum improves student learning" (K = 90.9%; 1st grade = 90%; 2nd grade = 97.7%). This is a critical finding since, as Healy (1998) noted:

> If the computer can accomplish the task better than other materials or experiences, we will use it. If it doesn't clearly do the job better, we will save the money and use methods that have already proven their worth. In the case of the child under seven, there are few things that can be done better on a computer and many that fail miserably by comparison . . . [they] are better off spending this valuable time in a physically and linguistically enriched environment. (p. 218)

Several key benefits emerged regarding the positive influence of technology on primary students.

A learning tool. First, teachers suggested that computers are "another educational tool" for helping students learn. As one teacher commented, "Technology is like one more intelligence, and for some kids it can be a motivating factor in their success." For example, when young children are learning to write their name they practice with crayon, pencil and paper, play-doh, or paints. The computer offers them one additional means of practice. Primary-age children also spend a good deal of time learning math facts. This is

done with flash cards, worksheets, math manipulatives, and other game-type activities. Computer programs such as Math Blasters give students a chance to learn their facts in another format, and K-2 teachers agree that this was an important factor in the learning process.

Motivation. Another benefit of integrating technology into the curriculum was the way in which it motivated students to participate in learning activities. All students are generally enthusiastic about using computers, and primary students were no exception. They enjoyed practicing skills, sharing their work, and even watching "direct instruction" lessons when they were presented with technology. Several teachers connected the motivation to student learning, suggesting that engagement led to exposure and exposure led to learning.

Writing. Nearly every primary teacher discussed the advantages of having computers available for writing activities, and many suggested that writing was indeed greatly improved when students used the word processor. This is interesting since a number of teachers also reported that students' general lack of keyboarding skills limited what they could accomplish on the computer. Writing with pencil and paper can be a laborious task for young children with limited fine motor skills, and in many cases the computer offered these youngsters an easier and more motivating way to record their thoughts, regardless of their keyboarding skills. Besides writing more, teachers reported that students paid more attention to writing conventions when their work was done on a word processor. For example, they noticed punctuation, upper and lower case letters, spacing, and the like. When they knew their writing would be projected in front of an audience they paid particular attention to the details. While the lack of keyboarding skills limited their writing to a certain extent, it was often no more of a handicap than the tedious process of composing with pencil and paper, and in fact the motivation factor inspired students to spend more time and pay more attention to the fine points of writing.

Problem solving. Teacher responses also suggested that students' problem solving abilities were improved as they spent more time using computers. Specifically they were more inclined to think creatively, were more patient and persistent in solving problems, and were more apt to stick with a task. These behaviors may have been due in part to the collaborative nature of computers. More than that, however, there was something inherently engaging about the computer that inspired students to "stick with it." As one first grade teacher noted, "The students are less intimidated by frustrating tasks when they are allowed to use technology as a tool." A kindergarten teacher found that "children are better able to deal with problems with less frustration. They also are more willing to try new things."

"The students are less intimidated by frustrating tasks when they are allowed to use technology as a tool."

Results of the 2002-2003 survey supported teachers' journal reflections and interview responses. They found students were more motivated (92.8 %), collaborative (88.5%), and interested in learning (94.2%). They also felt that the quality of student work was better (90.6%) and that they were better able to accommodate different learning styles and abilities (95.0%) when technology was available.

Challenges and Concerns to K-2 Technology Integration.

Primary teachers faced any number of challenges in integrating technology into the curriculum, many of which were similar to those faced by their intermediate and secondary peers: lack of time for planning, lack of technical support, and server malfunctions. They also faced challenges that were unique to their primary status, however, including cognitive and physical developmental limitations. For example, much of the integration that took place in intermediate and secondary classrooms involved searching for and reading information from the Internet. This required reading and comprehension skills that were generally beyond those of most of kindergarten, first, and second grade students. This being the case, one of the most effective means of utilizing computers in upper grades was of only limited use in primary classrooms.

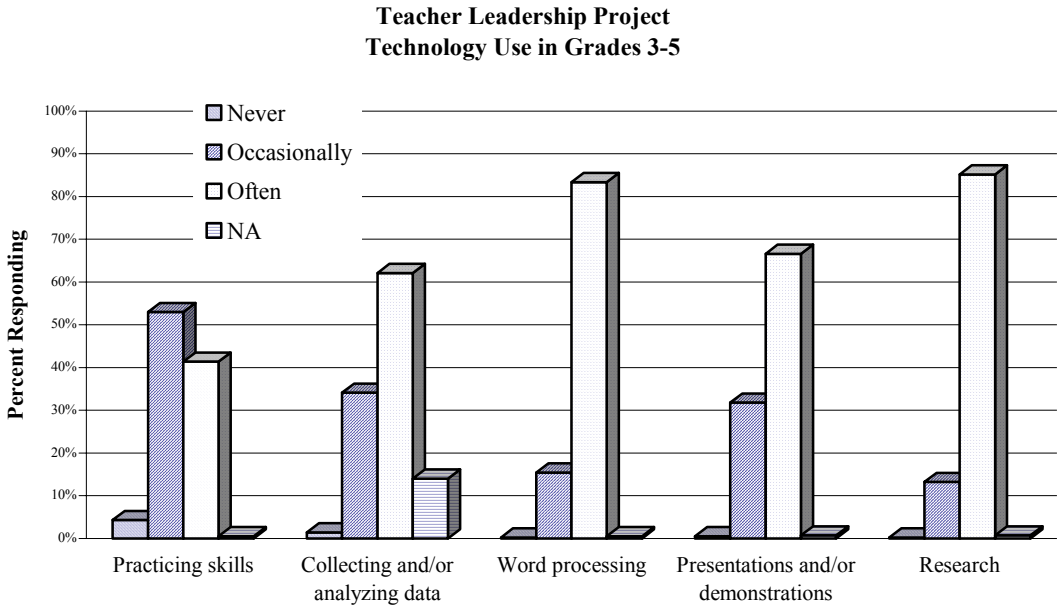
In addition, while their abilities were certainly impressive, younger children sometimes struggled with keyboarding and controlling the mouse. Because of this, computer activities tended to take a long time, and teachers had to decide whether the outcomes were justified by the time. In some cases they were, in others they were not.

Lastly, young children often had not reached a level of independence where they could complete computer projects without assistance and direction. Their ability to follow multi-step directions and to problem-solve technical issues limited the nature and complexity of tasks they were able to accomplish. Teachers discovered that computer time was often more successful when parent helpers, classroom aides, or intermediate "buddies" were available to work alongside their students.

Technology Use in Grades 3-5

In intermediate classrooms, computers were used for writing (Word, Inspiration), gathering information and studying current events (Internet, Encarta), and developing reports and presentations (PowerPoint). Excel was valuable for data analysis and creating graphs, and Publisher, Clip Art, and Word Art were used for producing brochures, newsletters and book reviews. Use of technology in intermediate classrooms is summarized in Figure 2.

Figure 2.



Teachers also used SchoolKit activities to develop conceptual knowledge and practice skills. In addition to these programs, teachers and students found ways to extend the curriculum with digital cameras and camcorders, scanners, document cameras, and projectors. Like their primary colleagues, intermediate teachers and students were impressed with the teaching and learning possibilities offered by Elmo.

An example of technology use in the intermediate classroom is shared in the following profile.

Profile ~ Grades 3-5

Now that May is here and we have had our computers since November, I can look at our classroom and see that we have truly come a long way. Most of the students can sit up to the computer and independently open a word processing document, edit their writing using spelling and grammar checking tools, transfer files from Alpha Smarts to the computer and save their work in their desktop folder. They can access Encarta and the Internet for research searches. They have used PowerPoint and School Kit scaffolding units to demonstrate their knowledge and teach others about explorers and digestion. They are currently engaged in a more extensive biographical research project and they are using the computers, along with other sources, to research their topics, type up their reports and create a PowerPoint presentation to share their information with the class. The computers are tools that are used everyday to expand our communication possibilities, answer our burning questions and pique our curiosity.

The computers are tools that are used everyday to expand our communication possibilities, answer our burning questions and pique our curiosity.

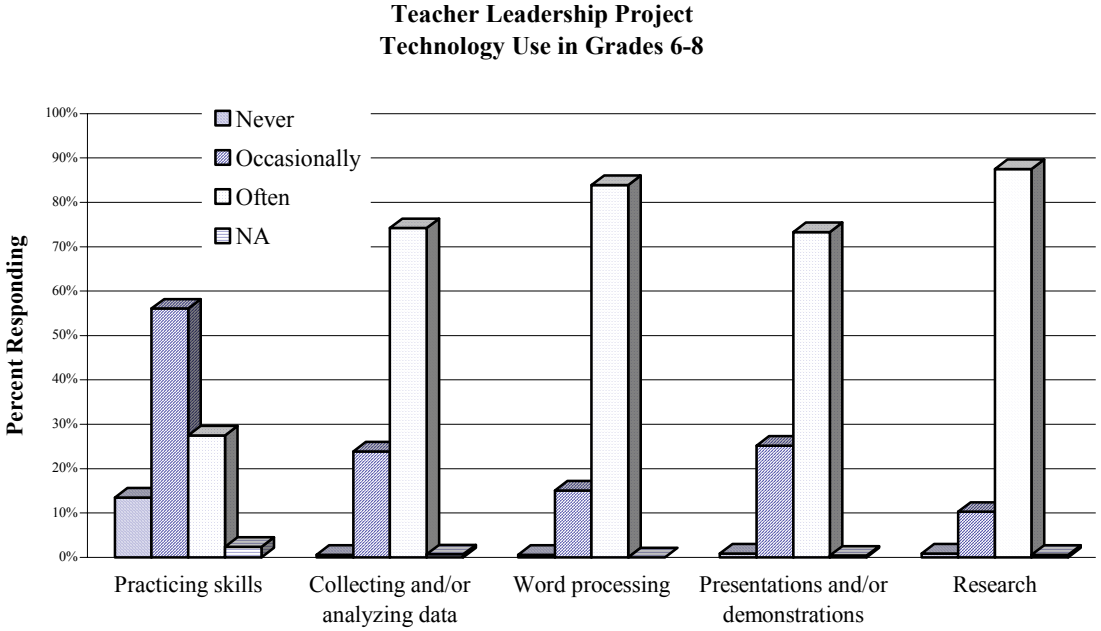
Technology Use in Grades 6-8

Middle level teachers used many of the same programs as their elementary counterparts (Figure 3). Word, Encarta, the Internet, and PowerPoint were used most often for writing projects, information access, presentations, and publishing. Digital cameras allowed students to enhance their projects with relevant photographs. Publisher, SchoolKit and Accelerated Reader were utilized in middle school classrooms as well. Use of Excel was more varied in the middle grades, where they analyzed data and constructed graphs and also made use of function and formula keys in math lessons. A profile of technology use in the middle school follows.

Profile ~ Grades 6-8

In my exploratory class, my students have used the technology to create data tables, graphs, and final reports too. Their data has been collecting water testing results from 4 local rivers and comparing their findings. They have also incorporated their own personal water samples to get more of a personal connection to their results. In this class, I have also had my students create a PowerPoint presentation on the Hydrologic Cycle. They worked in groups of 4 to research the cycle on Encarta and then created a PowerPoint presentation for the rest of the class. This turned out surprisingly well, considering not many of them had ever used this program before.

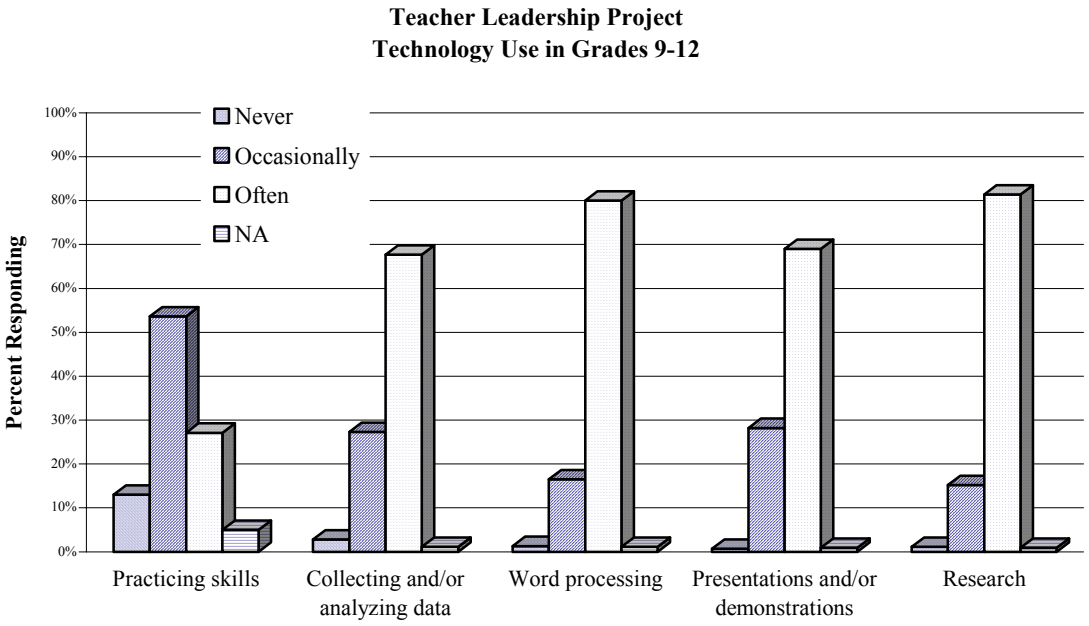
Figure 3.



Technology Use in Grades 9-12

Like their middle and elementary school counterparts, high school teachers used Word, Encarta, the Internet, and PowerPoint most frequently (Figure 4). More high school teachers reported using PowerPoint for instruction and as a visual aid for classroom presentations and lectures than did lower grade teachers. Excel, SchoolKit and Publisher were used across all subject areas. Peripheral equipment such as digital cameras, scanners, digital video recorders, and projectors were used in all classes as well. Examples of technology use in various subject areas are shared in the following profiles.

Figure 4.



Math. Many math teachers incorporated Geometer's Sketchpad into their lessons and commented on how it appeared to improve student's conceptual understanding of the material. Various SchoolKit lessons were also used in the classrooms, as was graphing software. Teachers found Excel effective for graphing and calculating formulas, functions, and probability. Math teachers also found ways to utilize the Internet, PowerPoint, Tesslemania, Green Globs, and Accelerated Math.

Profile ~ Math Grades 9-12

My geometry students …are currently working on a large two-chapter project that is done mostly using sketchpad. There are several investigations they must do to eventually discover the Euler line of a triangle. My Algebra students have used the program Graphing Advantage to graph and interpret several parabolas and lines. This has been a valuable tool for them, because it allows them to change certain numbers in the equation and look at what happens without having to go

through the tedious process of manually graphing everything. My Pre Algebra students have used the computers to study translations and size changes. It has been a real valuable tool for them as it helps keep them interested in the subject matter as well as showing several examples in a short amount of time.

Social Studies. Social Studies teachers found PowerPoint and the Internet to be the most powerful programs for their students. The Internet was used primarily for research and for providing depth to their studies. Webquests were useful in this regard as were Word, Publisher, Encarta, and Excel programs.

Profile ~ Social Studies Grades 9-12

We have used the Internet extensively for our "Health of Nations" project. The goal is for students to gather both statistical and anecdotal evidence to make decisions as to whether their assigned nation is exhibiting positive "healthy" trends or raising red flags signaling caution, danger or decline. Data sites included CIA World Factbook, and the State Department's Background Notes. World newspapers and magazine sites proved very helpful in developing anecdotal evidence. Also sights like Human Rights Watch and Amnesty International, APEC, etc.

Science. As in other subject areas, PowerPoint, Excel, and the Internet were used frequently in science classes. Word was also used for publishing research papers and lab reports. In addition to these programs, high school science teachers found Vernier probes, SchoolKit, and Publisher to be worthwhile. Teachers learned through experience with Vernier probes that data gathering was more manageable and more effective when the student to computer ratio was no higher than 4 to 1.

Profile ~ Science Grades 9-12

Geology students are working on a GRASP project on plate tectonic disasters. They are using a shareware program on seismology and volcanism, various internet sites and will put the whole thing into PowerPoint. Physical World students used the motion sensor to measure the speed of battery powered cars, and they are working on a final project on the geology of the National Parks. This involves using Excel, PowerPoint and topographic map software. They also wrote memos about weathering and erosion using Word.

Language Arts. Not surprisingly, language arts teachers used Microsoft Word, PowerPoint, and the Internet regularly in their classrooms. Along with Word, Publisher was valuable to students in creating final products. Students created PowerPoint presentations of book reviews, as reviews of topics covered in class, and to enhance oral presentations. The Internet was used primarily for gathering information for research papers. SchoolKit and Webquests were used less often than in other subject areas. Many language arts teachers began keeping electronic portfolios for their students to show growth over time and for assessment.

Profile ~ Language Arts Grades 9-12

I worked with the teacher of our computer technology classes to create an integrated project. My students wrote fairy tales and worked with a partner from the computer class to publish their work. Publications included clip art, original scanned art, photo draw, and various fonts and enhancements available through the Internet and Microsoft programs. We will use the video camera to film student rap songs and the digital cameras to enhance student created PowerPoint and video productions.

Profile ~ High School Math

Students worked in teams of two. They were given six different project options and were required to complete three of the six. Each project required the students to research background information on the topic and summarize their findings, gather information either through experimentation or research, make predictions about the data, analyze and display the data including graphs and formulas, and use the results to make predictions of future behavior. Each of the projects required use of real life data such as world population, turnpike tolls, and carbon dioxide pollution . Students were required to represent data in written, graphical and numeric forms. Students were provided with a rubric. The software used was TI-Interactive and Internet Explorer.

Example Provided by the Teacher
World Population 1950-2050
The goal of this project was to find world population data and fit an appropriate equation model to the data. Students found both actual and projected population data on the Internet and created a scatter plot of the data. They used their calculators to determine which equation model fit the data best and then developed an equation for the data by hand. The data was then analyzed through a series of questions such as "What is the y-intercept of this model?", "What is the real world meaning of it?", "Does there appear to be a limit to the world population?" and "Why do you feel the model you chose fits the data better than others?" Use your model to predict what year the world population will be 10 billion people.

The students were highly engaged in these projects. The level of discussion between group members demonstrated a deep knowledge and understanding of the mathematical principles involved. Students also demonstrated superior technology skills with both the computers and calculators. As the students were working the teachers were monitoring, helping and probing students.

Teacher Leadership Project and the Impact on Teaching and Learning

Most TLP teachers reported that their teaching was changed to some degree as they learned to integrate technology into the curriculum. The instructional strategies they used, planning efforts, student management, their role in the classroom, and even their

professional motivation were among the changes that were affected by their participation in the Teacher Leadership Project.

Pedagogy

A number of changes in teacher practice were attributed to the Teacher Leadership Project training and to the infusion of technology into the curriculum. Teachers' planning and curriculum development efforts were strengthened, the nature of the classroom changed, and instructional strategies were modified based on the training and equipment they received. Furthermore, teachers reported that their expectations of students changed because of their access to technology. Teachers believed that technology was a powerful classroom tool: results of the 2002-2003 teacher survey indicated that fully 90% of those who responded agreed or strongly agreed, "It would be difficult to accomplish my learning goals without the technology" (Figure 5).

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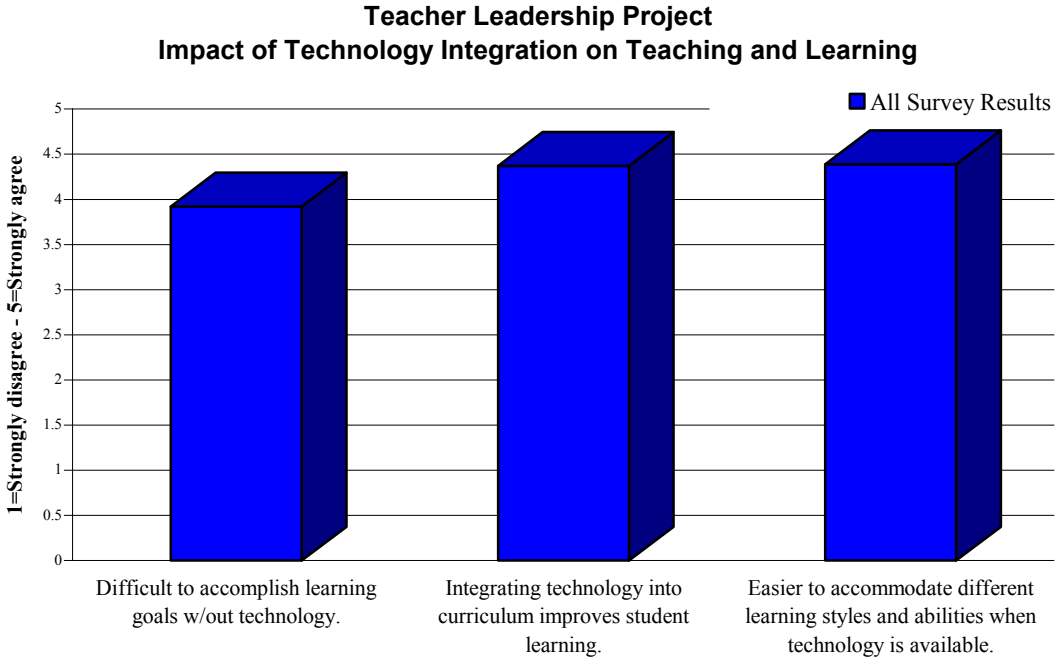
Figure 5.



The nature of the classroom

A clear shift in pedagogy was seen in the form of student-centered, project-driven classrooms. Teachers reported that the TLP training and the added technology encouraged their use of in-depth, academic projects. Some discovered, in fact, that projects had become a necessary and predominant instructional model, since, as one teacher remarked, "You just can't teach the same way as before when you have access to technology." The degree to which this was a significant change for a given teacher

depended on the degree to which they relied on project-based instruction prior to their involvement in the TLP. Teachers who were fairly new to the profession suggested that they had been trained to use a more student-centered approach, so the transition was relatively minor. For those teachers who were more accustomed to direct instruction and lecture, the transition to project-based instruction was at times rather dramatic. In any case, although teachers struggled initially with the student management inherent in a 4 to 1 student to computer ratio, many found that ultimately it provided positive opportunities for students to work and learn together on research projects, presentations, and various other assignments. Students became more adept at collaboration, at organizing and focusing their time, and experienced a much greater degree of interaction with the content.

Discovery learning, active participation, and collaboration were elements of these student-centered classrooms, and together supported many of the tenets of constructivist teaching and learning. Similar results were found in an evaluation of the Intel® Teach to the Future program where it was reported that "many more teachers are beginning to make use of more project-oriented teaching strategies than they had previously" (Martin, Gersick, Nedell, & Culp, 2002, p. 13). Research on how people learn has suggested that active engagement, opportunities for discovery, integrated curriculum, and knowledge construction are more powerful learning strategies than more traditional strategies such as the memorization of discrete facts and processes. The pedagogical shifts reported by TLP teachers appear to be strongly related to these constructivist practices. In creating classrooms oriented around projects, teachers perceived that they had given their students numerous opportunities to use technology as a powerful tool for problem solving, higher order thinking, and conceptual development. The following excerpts are taken from teachers' journals and reflect some of the pedagogical shifts they made.

Where do I begin? Technology access in my room has changed everything. Every student regardless of ability or background is motivated to do their best on computers. It levels the playing field, as they say. As for my teaching style, I am able to offer more project-based learning, active inquiry, student directed tasks. Technology in my room allows every student equal access to tech as a tool, not just for those students who have it at home.

Where do I begin? Technology access in my room has changed everything.

It [the TLP] helped me on my journey to change from a very teacher centered classroom to a student centered room!

Students have been able to incorporate up-to-date information and current technologies on a daily basis. Given that learning ought to be constructive, my students have been able to manipulate, process, and personalize biology concepts in engaging ways. There is a significant affective difference in learning while using current technologies and primarily using text-based (old style) methods.

In overt and subtle ways, TLP has taught me the value of constructivist learning. Using UbD as a guide, I've learned how valuable project-based learning can be. It frees students to discover and explore, rather than remember and recall. It shifts students to creators and thinkers. I'm now a facilitator of learning, not the all-knowing expert who must depart my wisdom on my students.

My classroom is becoming more student centered and driven.

It has allowed me to make my classroom increasingly student centered rather than teacher centered.

It has changed the way I teach. I now use technology to produce lessons which incorporate many visuals and interactives. I have been able to produce lessons which are more efficient and provide regular opportunities for student centered activities.

In some cases it was the technology that influenced teachers to experiment with more constructivist practices; in other cases it appeared that the technology allowed teachers with philosophical leanings towards constructivism to put their beliefs more fully into practice. Whether by design or by default, it was clear that technology influenced the degree to which their classrooms became more student-centered and project-driven.

Curriculum planning

The Teacher Leadership Project placed a strong emphasis on curriculum design in an attempt to help teachers focus their efforts on teaching and learning rather than on technology. The TLP was designed on the assumption that technology is a means to an end, not an end in and of itself, and thus a significant part of the TLP training was devoted to the Understanding by Design framework (McTighe & Wiggins, 1999). Understanding by Design is not specifically related to the integration of technology; however the essential elements of the framework were used to facilitate the development of sound lessons that could be *enhanced* by technology. Of those teachers that incorporated elements of Understanding by Design into their lesson planning efforts, most suggested that the framework had a positive impact on their teaching. Essential Questions, GRASPS projects, Enduring Understandings, and Backward Design proved to be powerful strategies for planning and implementing integrated lessons. Teachers shared examples of ways in which the Understanding by Design curriculum planning framework compelled them to be more intentional and focused about lesson design. They reported being more aware of what they were teaching, why they were teaching it, and what they expected students to know.

I LOVE UBD! I have been using the UBD framework for each new unit I have designed since I first started learning about it in my regional meetings. My ultimate goal is to have every unit designed with the framework. When I design

my lessons this way, I feel more focused on what to teach, and find it easier to integrate technology with a purpose.

For me the Understanding by Design has been a saving factor in all my teaching, not just integrating technology . . .I don't feel like I'm making it up as I go along and I have really taken a hard look at the activities I've done in the past to see how it fits into the large scheme of things.

Half of those who responded to the technology use survey (50.6%) agreed that Understanding by Design proved to be a "somewhat useful" tool, while another 30.8% felt that it was essential to their planning efforts. Those that did not find it useful generally reported that it required too much time and thus was an unrealistic planning tool.

The Understanding by Design book was a complete waste on me. It has helped in the sense that I now think more of the overarching questions I want students to answer throughout or at the end of a unit. Otherwise, the program seems so time consuming and laborious. I don't have the time to spend 60 hours planning each and every unit that I do with the children. Just trying to read through the book is a chore. It seems like a wonderful program that would work well for many people, just not for me.

Technology-enhanced lessons

Perhaps the most compelling finding was the degree to which primary teachers used a document camera to project lessons on the big screen. They used "Elmo" to demonstrate handwriting lessons and art projects while their students were able to share and explain their writing (journals and stories), solutions to math problems, and artwork. Projection devices allowed all students to see the screen and increased their attentiveness. Those intermediate and secondary teachers who had access to document cameras used them in many of the same ways.

I have been able to model activities with the three-dimensional cubes using the Elmo [document camera], that I never could before with an overhead projector…Excitement level was high during our science lessons on insects. Students were able to easily observe as larvae metamorphosized into pupa, caterpillars formed chrysalises, and butterflies emerged from cocoons. The teacher was happy because this eliminated children crowding around the insect containers and jostling for position amid cries of "I can't see! I can't see!"

I have had my equipment since October. I still believe my most useful tool is the Elmo presentation device. We use Elmo for everything. I model journal writing and then the kids share. I give directions for assignments and model how to play games. The kids have become more independent using the computers. They have been challenging themselves to take more Accelerated Reader tests. We also listen to books on tape. I haven't implemented any projects at this point. I have also been using the projector to model how to use forms. I have created a form letter

for the different word families. The kids will go to the computers during reading groups and print their answers.

Although intermediate and secondary teachers were not provided with a document camera as part of their grant, they did find numerous other ways to support and extend their lessons with technology. For example, many teachers found that they were able to develop engaging lessons using PowerPoint and the projector that they could easily save and modify and which students found more interesting than traditional lectures. Teachers also took advantage of powerful software programs to reinforce student learning. Geometer's Sketchpad, for example, allowed students to accomplish in-depth explorations into various aspects of geometry not available through traditional resources.

In Algebra 2, students used Excel and Graphic Analysis software to learn about exponential equations through exploration. [They] also recently used Geometer's Sketchpad's trace feature to explore the definitions of conic sections. In Algebra 1, students developed pamphlets to advertise the cell phone plans that they developed. They used Publisher to do this. [They] also used Excel to develop graphs in an effort to mathematically justify their cell phone plans to both the potential customers and to their boss. Students in all of my classes regularly use the computers to look up things on the internet and to type short papers.

The following T-lesson summary illustrates how one teacher was able to use technology to enhance a "traditional" lesson and how those changes benefited students.

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Comparison of a Lesson Taught Without (Pre-) and With (Post-) Technology

Lesson Title: Ocean Floor Profile
Subject Area: 7th Grade Earth Science

EALRs:

2.1 Develop abilities necessary to do scientific inquiry

- ***Explanation – use evidence from scientific investigations to think critically and logically to develop descriptions, explanations, and predictions***
- ***Communication – communicate scientific procedures, investigations, and explanations orally, in writing, with computer-based language of mathematics***

3.1 Understand the nature of scientific literacy

- ***Evaluating the methods of investigation – describe how methods of investigation relate to the validity of scientific experiments, observations, theoretical models, and explanation.***

Overview of the lesson: In this activity, you will construct a profile, or side view, of the features of the ocean floor between New Jersey and Portugal. To make your profile, you will interpret a table of data that were collected by a depth-sounding technique similar to the sonar technique described earlier.

Ocean Floor Profile Worksheet:

1. Copy and paste Excel chart of the ocean floor in the space below.
2. What ocean-floor features would you infer occur between 160 and 1050 km from the coast of new Jersey?
3. You have constructed a profile of the ocean floor along the 39 degree latitude north parallel. If a profile is drawn to represent an accurate scale model of a feature, both the horizontal and vertical scales will be the same. What is the vertical scale of your profile? What is the horizontal profile?
4. Compare and contrast your profile with the actual ocean floor. See figure 12-15 in your book. How accurate do you think it is? Explain. How could you make your profile more accurate? Explain.

Lesson Prior to Technology	Lesson With Technology
Textbook lab	Textbook lab
Graph paper	Computer and Excel
Students worked individually	Student groups of 4 at each computer
Verbal instructions on creating the graph	Few verbal instructions
Inaccuracies in graphs made inference difficult	All students involved
High achieving students were successful;	Accurate and professional-looking graphs
Lower-achieving students had difficulty	Easier to make inferences about data
Many students did not complete the lab	More students completed the lab
Creation of graph took most of 2 periods	Most students were successful with the lab
Little time left for discussion	Led to in-depth, substantive discussions
	Lab completed on Day 1; Day 2 used for further discussion

Comments: Overall, the lab was a lot easier for both me and the students than the past four years I taught it. Because some of the students had very little computer competency at the time, I made a set of very detailed instructions, complete with graphics, as to how to do the chart in Excel. In the past, students became easily frustrated when creating the graph. With Excel, students were less frustrated because the technology made the graphing part easy. The students enjoyed the lab, the graphing exercise was much easier, and the students received instant gratification with professional results. Students received immediate feedback if there was a mistake in entering the data. It also led to discussions as to the outcomes of charts in relation to the amount and accuracy of the data.

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Roles of Teacher and Student

Just as the nature of the classroom was changed by technology integration, so too were the roles of teacher and student. There was strong agreement among TLP teachers and students that technology-rich classrooms influenced their traditional roles. Teachers consistently referred to themselves as "facilitators" or "guides on the side" rather than the more typical "sage on the stage." They reported that much less time was spent in front of the class talking than in their "pre-technology" days, a finding similar to that of researchers studying the Ameritech program (Tiene & Luft, 2001-2002). TLP teachers instead spent more time working with individual students or with small groups of students, answering questions and guiding their learning efforts. These teachers often found themselves learning along with the students, an experience most found refreshing. One teacher remarked in jest, "I may just be working myself out of a job here . . .sometimes the students are just working away and don't even know if I'm here or not." Other teachers shared examples of how their roles had evolved.

It appeared true that as teachers became more entrenched in technology integration they realized that infusing technology effectively and efficiently require a change in practice, if not in philosophy about teaching and learning.

I have become a much better teacher. You rarely find me in front of the room, but you also rarely see my students not thoroughly involved in their work.

I like that a visitor can walk into my classroom and have to work to identify me. I am usually found sitting among my students posing questions and prodding them into more challenging directions. I'm not the sage on stage . . . Students are the reason that I am in the classroom and they must be the center of my classroom. Now, instead of lecturing at them or presenting them with worksheets (two practices that I believe lead to lazy learning), I am more inclined to give them a blank piece of paper and pose some broad question. They get to wrestle with ideas and concepts. They get to learn!

My role has changed in that I don't just stand in front of the class and lecture them and expect them to take notes and memorize something and spit it back to me. I am able to interact more with the students on an individual or group basis. I've gotten to know my students' strengths and weaknesses better and have been better able to help those that are struggling students.

I think this has enabled me to be more of a facilitator of children's inquiry, as well as a teacher of content, using technology when appropriate and efficient. My focus has shifted to looking at the deeper processes and skills children need to meet state standards, to support them as life-long learners and world citizens.

This role shift was easier for some teachers than for others. Those who were used to controlling the learning environment often found it difficult to give up control and to admit that they did not have "all the answers." Furthermore, some teachers found the

management of student-directed learning to be challenging: there was often more movement, more noise, and more activity in general. It did appear to be true that as teachers became more entrenched in technology integration they realized that infusing computers effectively and efficiently required a change in practice, if not in philosophy, about teaching and learning.

Student Learning

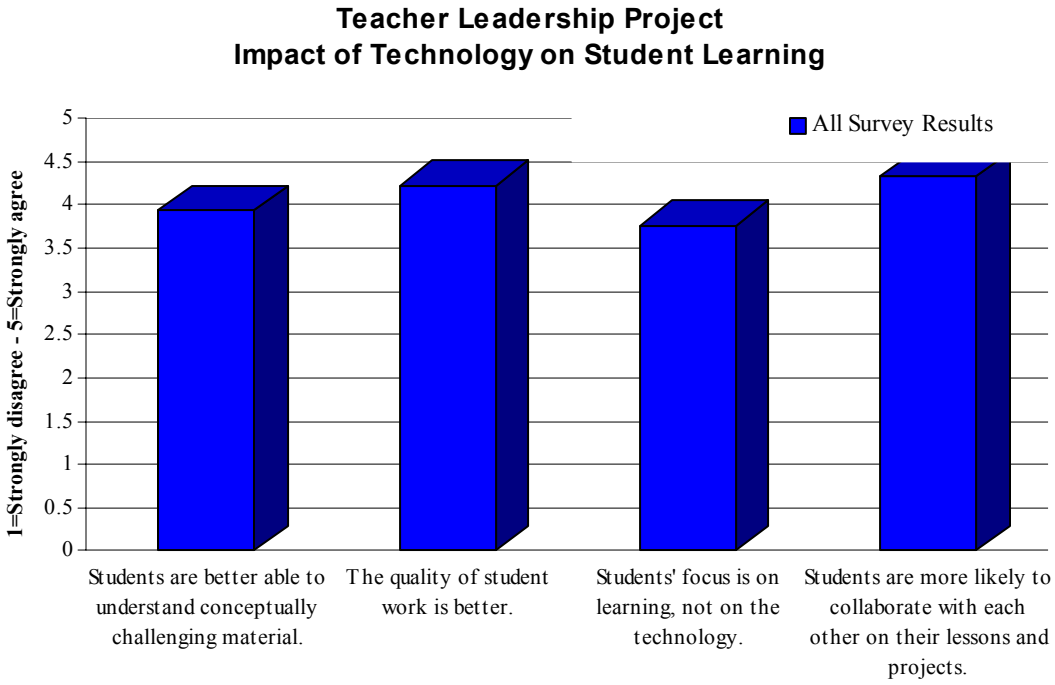
Data gathered from both teacher journals and surveys indicated that, according to teacher perceptions, students in technology-rich classrooms learned *more* and learned *differently*. They offered as evidence the tendency of students to read, write, and collaborate more, and to share their learning and engage in research more often. As several teachers commented, "The kids are more involved in their learning. They are more excited about school. Why *wouldn't* they be learning more?"

Results of the 2002-2003 survey show quite clearly the perceived links between technology and student learning (See Figure 6). A majority of teachers agreed or strongly agreed that "Students are better able to understand conceptually challenging material" (78.3%), and that "Integrating technology into my curriculum improves student learning" (93.6%). In addition, a survey of students done in 2001-2002 indicated that 74% of students believed that they learned more when they had access to technology. Similar findings have emerged from other studies. For example, teachers that participated in the Ameritech program at Kent State University suggested that their students' higher order thinking skills and test scores were improved when they learned in a technology-rich environment (Tiene & Luft, 2001-2002, p. 4). In another study, researchers reported a "minimal but positive effect on student acquisition of higher order thinking skills" resulting from technology integration (Hopson, Simms, Knezek, 2001-2002, p. 114). The following comments are representative of those made by TLP teachers

> *I just received the results of our ITBS testing yesterday. In looking over the scores I noticed some key things. I have never seen scores this high on the ITBS, and only one of my students is performing below where he/she would be expected to perform. That student happened to join my classroom one week prior to the test. Many of my students are out-performing their expected achievement level, and the areas in which they are doing this most often are math problems, and reading comprehension. This could be due to our Everyday Mathematics curriculum, and the use of Accelerated Reader. But I also think that both of those areas are areas in which the students are required to think and process information, and I think it is possible that the technology, in addition to the curriculum has given them a boost in that.*

> *Using technology as a tool to enhance learning experiences provides students with a rich learning environment that integrates reading, writing, listening, speaking, math, social studies and science. Students are more engaged in the learning process while using technology than they are using more traditional tools such as books, paper and pencils. Because students are more engaged, their learning experiences and understanding are deeper.*

Figure 6.



Access to Information ~ Research

Teachers were nearly unanimous in their agreement about the power of information access and the impact on student learning. Many pointed out that their school libraries lacked current and relevant printed materials, and they were convinced that computers provided students with research opportunities that would otherwise be unavailable. To be used effectively, however, teachers discovered that students had to be taught how to do efficient and effective searches, and many teachers found it necessary to reinforce this skill throughout the school year. Once students understood the power of an effective search, however, a whole new world of information was available to them. One of the benefits of using the Internet for research, according to teachers, was the need for students to analyze information to determine not only its authenticity but also its relevance to the lesson or task. For this reason, and because of the sheer amount of information available, many teachers suggested that their students were learning more because of their immediate access to information. Another benefit, according to many TLP participants, was that they had "the world at their fingertips" and could maximize those teachable moments that occur in the classroom from time to time by immediately and directly accessing relevant information sources. Even though primary students were less able to conduct information searches on their own, they saw the benefits of immediate

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access through their teachers. All in all, TLP teachers reported that one of the most powerful elements of a rich technology environment was the fact that students had immediate and independent access to a world of information.

> *One small example of the power of the Internet is access to primary sources. The Zimmerman telegram (an intercepted communiqué between Germany and Mexico that helped push us into World War 1) is on the Internet in coded and decoded form. Access to this letter not only helps drive home the concept of primary sources but also brings alive one of the factors that led us to World War 1. As a follow up another site has ready-made forms available for analyzing primary sources of every conceivable form.*

> *My classroom is more like the real world. When we need info, we go to the computer. When we need to type something, we go to the computer. When we want to explore an interest, we go to the computer. This is what life is like for people who live in a technology dependent world. Students have greater access to information through the computer. If we did not have the computers, they would be dependent on a few books from our library, and a set of encyclopedias.*

> *How do my students benefit? Let me count the ways!!! Students in a technology-rich classroom have the world at their fingertips! For example, in a classroom unit on creating an environment for zoo animals, students explored zoos from around the world through visiting zoo web sites. They were able to identify elements of a "good" zoo environment and compare them with a "bad" one. They used these zoo web sites and their links to study animals and their natural habitats; they researched animals using information from ENCARTA; they visited our local zoo, took pictures with the digital camera, and went back to school to create our own E-Zoo by writing reports and posting our photographs on our classroom web site. Family and friends from anywhere in the world could then visit our E-Zoo and see what these children had learned. The world is at their fingertips! And this is only one example of reaching out to explore it!*

Problem Solving

Many teachers believed that students engaged in problem solving and higher order thinking exercises more often when they were in technology-rich environments. Students were presented with opportunities to analyze and synthesize information and to search for patterns. They were also faced with technical glitches that forced them to use creative problem solving skills to work through the difficulties. Beyond that, teachers also commented that a project-based curriculum required students to identify, implement, and present their ideas, necessitating any number of problem solving and higher order thinking exercises. As one teacher noted:

> *Students in my classroom use technology as a tool for problem solving and as a means for developing new ways to communicate. I emphasize problem solving from their first encounter with computers in my classroom, particularly with*

Excel since I teach science. By three months into the school year a majority of my students can open a blank file, enter data, enter formulas, and create graphs/charts to better understand their results.

Results of a 2001-2002 survey of TLP teachers indicated that 75% of all participants agreed or strongly agreed that students' problem solving skills were improved when they had access to classroom technology.

My students are benefiting by having technology available to use as a learning tool. They are learning problem solving, higher level thinking skills, risk taking, research skills, and creativity. They are finding that they can find answers to their questions and their enthusiasm for learning using technology is greatly enhanced.

Students in my classroom use technology as a tool for problem solving and as a means for developing new ways to communicate. I emphasize problem solving from their first encounter with computers in my classroom, particularly with Excel since I teach science. By three months into the school year a majority of my students can open a blank file, enter data, enter formulas, and create graphs/charts to better understand their results.

Written and Oral Communication

The analysis of journal reflections over five years indicated that teachers found both quality and quantity of student writing to be positively impacted when students had access to technology. Teachers suggested that particularly as they developed their keyboarding skills, students were inclined to write longer and more creative pieces when they had access to technology. This was due almost exclusively to their ability to "painlessly" edit and revise. Many teachers recounted the "old days" when revising a paper usually meant starting from scratch. This might happen once during the writing of a story or essay, or it might happen multiple times. Whichever, it was a laborious and universally disliked task among students, and it inevitably limited the work they were able to produce. The difference when students had access to computers was significant, teachers reported. When they knew that they would be able to edit and revise a document without having to start over each time, students were willing to write more *and* to make necessary changes. This was true across the board, but especially for students who struggled with fine motor skills. Keyboarding, except for primary-age students, was often faster than writing with pencil and paper, and being able to make spelling and formatting changes on the computer was much preferred to doing hard-copy drafts. All in all, teachers reported that the impact of technology on the writing process and product was considerable.

All in all, teachers reported that the impact of technology on the writing process and product was considerable.

I know I've said this before, but I'm extremely pleased with how much easier it is to teach writing using technology. My lessons are clearer and better paced using the laptop and projector to teach. The kids are much more motivated to write knowing that their final product will be a "thing of beauty." Revision and editing

is much less of a struggle—they are willing to put forth the effort knowing that they'll get the chance to word process once they have polished their piece.

Computers continue to generate an enthusiasm for learning and allow a flexibility that is not visible with paper and pencil learning. My students seem more willing to edit a piece written on computer through several drafts than that written with paper and pencil. This really allows for the teaching of language skills and fine-tuning that were only seen in the top percentage of achieving students.

When they have typed a draft on the computer, students seems much less reluctant to go further with the revision process when writing, especially longer pieces. I've seen many of them realize how easy it is to make changes and therefore look a little more closely at their own writing in order to add more description, details or make ideas clearer. Papers have less spelling errors and students with some physical writing challenges are better able to get their thoughts and ideas down on paper.

This is the first time in the last two years that I can say that my students are better writers because of technology, but I believe it is true. My fourth graders were given the opportunity to learn keyboarding on a classroom set of Alpha Smart computers. The keyboarding skills that they have picked up (which are still not real great for some of them) have made composing and/or editing on the computers a different task than it was two years ago. Revision has always been a difficult thing for 10 year olds to do, but now that they are able to use their word processing skills, it no longer seems such an obstacle. Students are more willing to revise and edit pieces when they know that they don't have to rewrite the whole thing over again.

I have also noticed that when the children are typing using MS Word, they are more aware of spacing, punctuation, grammar, and spelling. They are actively engaged in wanting to edit and self-correct their work. I truly see technology enhancing their learning, and I say this even though I have not even begun to utilize all that I learned this year.

I also saw much better revision/editing in the writing process. I think they realized it wasn't as hard to go back and make changes to improve their writing (which they are often resistant to when written out by hand). I have tried to stress/emphasize that it's a regular process real writers use all the time and that they go through many more drafts than we normally do. I think they really saw and understood more about how the whole writing process works. They had to turn in all the parts (web, hand draft, typed draft, editing sheet (self and peer) and their final copy) of the process.

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Support can be found in the research literature for the positive effects of word processing on student writing. For example, a meta-analysis of the research on computers and student writing found significant effects both in the quantity and the quality of students' efforts (Goldberg, Russell, & Cook, 2003). The findings indicated that across the fourteen studies, "students who write with word processors tend to produce longer passages than students who write with pencil and paper" (p. 13). Furthermore, their writing was also of higher quality when students used computers as measured against dimensions such as mechanics, style, voice, tone, purpose, and grammar (p. 14).

> *I also see increased motivation when the kids know they will publish their work using word processing or graphing software. They take the time to edit and produce quality work when they know their work will be made into a hard copy and shared with others. When the students know they will be sharing their work on the Elmo/projector they take their time to make it legible and neat. They also take more time to understand what they are doing.*

> *I have also been fortunate enough to have a document camera now. I love it! I have had students give speeches where they can show how they have analyzed a piece of writing by using the boxlight and ELMO. It is fantastic, and the kids enjoy using it.*

As students did more PowerPoint presentations, oral communication was also improved, according to teachers. The more students used PowerPoint as a visual outline for sharing information, the more they learned about the appropriate balance between text, graphics, sound, and talk. As many teachers noted, students only had to watch and listen to a few presentations to appreciate the fact that even the sound of screeching tires gets old. Teachers stated that using PowerPoint as an outline for oral presentations also encouraged students to actually *learn* rather than just *report* the material they were studying. The fact that they were actively engaged in gathering, summarizing, and organizing the information appeared to lead to deeper learning. The following journal selection illustrates how teachers perceived these benefits of presentation technology:

> *Students who in the past have spoken very quietly and had typical nervous behaviors, seemed much more at ease sharing with the help of the computer. It made it easier for other students to be good listeners with the visual to focus on while they were listening…I believe they also became very aware of what quality work looks like in PowerPoint. We focused on enhancing their words with appropriate pictures and limited sounds. I tried to emphasize with them how sounds are often quite a distraction. Only three or four of them seemed to miss that point and still included the typewriter sound or others with their transitions or as the text built. I felt like almost all of them understood how to enhance without bells and whistles.*

Achievement Gains

While relatively few in number, there were some teachers who attempted to quantify the effects of technology on student learning in terms of improved test scores.

Primary teachers documented Accelerated Reader test scores, while others saw growth in student performance on levels tests. As researchers know all too well, however, it is difficult to attribute improvements in test scores directly to the integration of technology.

> *We recently completed a Levels Test for second grade students at our school. My students scored very well! I have four special education students as well as five more students who qualified for special help in reading. I was very pleased with their test results. Of course, I cannot say that this was only because of the technology assisted learning they have been exposed to, but perhaps it was part of the reason.*
>
> *The evidence of increased learning will be evident when we get our Accelerated Reader testing scores back next week. I know that there will be outstanding growth shown because of the computers and the motivation that they provide to complete a book and take a test!*

Special Needs Students

Integrating technology into the curriculum appeared to have a positive impact on special needs students. For those who found it difficult to focus, had limited fine motor skills, specific learning deficits, or whose behavior interfered with day-to-day classroom activities, technology seemed to provide both the motivation and the vehicle to improve their performance. Teachers shared numerous examples of special needs students who blossomed during the year, in large part because of their access to technology. For ADD and ADHD students, computers proved to be the tool that led to increased time on task. Students who struggled with pencil and paper activities such as writing and drawing found that various computer applications allowed them to express themselves with much less effort. Finally, there were cases where students who were unaccepted by their peers for various reasons proved to be very capable users of technology. The fact that they were skilled "technicians" seemed to pave the way for collaborative experiences.

Teachers shared numerous examples of special needs students who blossomed during the year, in large part because of their access to technology.

Affective Dimensions of Technology

One of the most significant ways in which student learning looked different in technology-rich classrooms was in the attitudes they brought to school, according to teachers. Reports indicated that the integration of technology resulted in rather dramatic changes in student interest and enthusiasm for learning: they came to school early, they stayed in for recess, and they stayed after school. One teacher made the following observation about students and their motivation to use technology: "Trust me, if you are sicker than a dog, you will be in school on your computer day." Teachers shared countless anecdotes in their journals over the past five years alluding to students' increased motivation, perseverance, self-direction, independence, and confidence. Technology access

"Trust me, if you are sicker than a dog, you will be in school on your computer day."

allowed teachers to reach students who may otherwise have "fallen through the cracks." Survey results supported teachers' journal reflections, as 94.6% of all teachers agreed or strongly agreed that "Students show greater interest in learning" when they have access to technology. Furthermore, 87.4% agreed or strongly agreed that "Students are more motivated to complete their assignments" in technology-rich classrooms. Similar findings have emerged from related studies. In a review of 311 research reports and reviews, Sivin-Kachala and Bialo (2000) found that technology had a positive effect on student attitudes towards learning, self-confidence, and self-esteem. More than simply being excited about having lots of computers, teachers believed that they were excited about *learning* because of access to computers. It was not uncommon for teachers to share anecdotes about students doing independent research, going beyond the requirements of an assignment, working on assignments at home, during recess, and before and after school. Kids have always asked "why?" of course, but did not necessarily have the desire or motivation to pursue an answer, even when resources were available. Access to the Internet and other electronic resources have dramatically changed this scenario. When students, regardless of age, had a question, they wanted to find the answer. If there is indeed a relationship between motivation, meta-cognition, and learning, as Sternberg (1998) suggested, then the motivation factor inherent in computer use may indeed be a significant factor in transforming teaching and learning.

The relationship between motivation and learning was not always so clear to TLP teachers, however. Early in the project it was somewhat difficult for them to determine if students' enthusiasm was related simply to the "fun factor" or if it was in fact related to learning. An examination of the data gathered from students and teachers since 1998 indicated quite clearly, however, that the motivation to use computers remained long after the fun factor faded. Teachers believed that the relationship between motivation and learning was a strong one. Over the years, they have found that the more engaged students are in a lesson or project, the more likely they will actually master the stated objectives and "own" the learning.

The motivation to use computers remained long after the fun factor faded.

> *The motivational factor is still a powerful argument for the integration of technology into the curriculum. Students who formerly stayed out in the halls until the last bell, now arrive early and begin using the computer for a variety of interests . . .*
>
> *My students LOVE being in a technology-rich classroom… They are much more motivated to complete academic tasks, try new ideas, research, check out any type of information, and practice skills. In turn, I believe they make more progress, learn more, and become better citizens.*
>
> *Student motivation is by far the greatest benefit. The students are so much more willing to do a project or research with the computers. The 6th grade teachers have commented that hey see a difference in my students that they get.*

> *Students are on task more; motivated to work on their computer projects and do online research; excited about each new project; and writing more (minimum of 2 pages on essays). Some students want to write as much as 5 pages when using the computer for word processing, rather than writing by hand*.

Collaboration; Hands-on Learning; Self-directed Learning

While motivation was the affective change mentioned most frequently, the degree to which students collaborated on academic tasks was noted only slightly less often. Teachers were surprised at first, and convinced, over time, of the value of computers in facilitating collaborative behavior in students. From kindergarten to high school, students were more inclined to work together when technology was involved. Furthermore, students were more likely to work with peers they might normally have avoided. While this change was often initially related to technology, in some classrooms the tendency to work more collaboratively transferred to other situations and other settings.

> *Most of all, my classroom this year is truly a collaborative place because of technology. My students have learned not only how to share information but how to share with others their expertise in certain areas. With technology each child can learn something tangible that they can teach to someone else. Their excitement to learn and share is even more evident because of these computers in the classroom*.

The hands-on nature of computers was also cited by teachers as having a significant impact on students' engagement and participation in the learning process. Composing, editing, and publishing written work using computer technology proved far more appealing to students than using pencil, paper, and a dictionary. The keyboard, the mouse, the screen, and the wide range of tools available on the computer provided ways for students to be constantly "engaged" in their learning.

Students exhibited other positive behavior changes in the classroom, according to teachers. Integrating technology into the curriculum caused them to focus more attention on their schoolwork and to stay focused for longer periods of time. This was due, at least in part, to the fact that they were actively engaged in what they were doing, but also due to the *real world* nature of the tasks that were accomplished on the computers. Students took more responsibility for their own learning and became more self-directed in their approach to assignments. All in all, a majority of teachers reported a number of positive attitudinal and behavioral changes in their students due to the infusion of technology. Most students had been in classrooms where one or two computers were used for playing games and practicing skills; many expected the Gates computers to be more of the same. Although initially disappointed when this proved not to be true, students became, over the course of their time in a TLP classroom, even more excited about the academic potential of computers, and teachers were convinced that student learning was positively impacted.

> *Students continue to maintain high interest in anything related to technology. Their comfort level with the different applications and tasks has been enhanced,*

and they look forward to trying new things. There seems to be a higher level of confidence and greater ability to stay focused. Students have a more open approach to discovering ways to solve problems or to tapping a wider variety of resources. Students of differing academic abilities interact comfortably when working on a computer project. It is not always the brightest who know what to do.

Another benefit is the working together as a team. As we only have 6 computers in the room the students have had to learn how to share and help each other. The helping part has truly been wonderful. The kids have helped each other with the different programs. It gives each student a chance to shine.

Teacher Motivation

Students were not the only ones motivated by technology integration. While the process of infusing technology into the curriculum was alternately time-consuming and frustrating, it was also refreshing for many teachers and gave them a new outlook on their work. The reasons for this were several. First, most teachers eventually became comfortable with the role of instructional facilitator and found that they enjoyed learning along with their students. Second, they found it motivating to see students working collaboratively and seriously on academic learning tasks. Third, teachers' efforts to design and deliver a rigorous curriculum were strengthened by the principles of Understanding by Design, a fact that many found validating. One veteran teacher spoke for a number of TLP participants in observing that, were it not for the TLP grant, she would have retired. As it turned out, she can't wait to come to school each day to see what new learning will take place in her technology-rich classroom. Additional comments capture the enthusiasm shared by many in their reflective journals.

I am a born again teacher who can't imagine (and doesn't want to) what it would be like to have to go back to teaching before TLP.

Best teaching years of my life. Students became problem-solvers, critical thinkers, [and they are] way more enthusiastic and creative!

I learned and utilized different types of curriculum planning, performance assessments, rubrics, teaching methods, and resources. I became more of the teacher I wanted to be. I also found greater job satisfaction.

I probably wouldn't still be teaching without the grant.

There was a perception among many Teacher Leadership Project participants that students were learning more and differently when they had access to computers. Observations, interviews, and journal reflections provided some evidence to suggest that there were, indeed, situations in which student learning appeared to be transformed by the technology. On the other hand, there was also evidence suggesting that a number of teachers used the technology for low-level, traditional tasks that left its potential unrealized. For example, teachers agreed that one of the most powerful uses of

technology was for information access, where students tapped the Internet to gather research. Classroom observations did find instances where students were, in fact, engaged in rigorous research projects. Just as often, however, observations documented cases where students spent more time clicking, scrolling, looking at pictures, or, in the case of older students, visiting non-academic websites. Younger students often did not have the reading ability, nor the patience, to process the information they accessed, and older students had a tendency to do "cut and paste" research. The potential was there, certainly, but without thorough planning, clear and reasonable expectations, and teacher involvement, students' efforts were often little more than exercises in web-surfing. Similar findings emerged from an evaluation of the Intel Teach to the Future program. Researchers noted:

> Many of the activities we observed involved students conducting Internet research . . . Simply bringing technology into a lesson, however, did not ensure that the lesson effectively facilitated student learning. Some of the least successful lessons we observed were those in which Internet research was the centerpiece and students were given very little instruction on how to conduct research. . . .The use of the Internet as a research tool was more successful when Internet research figured as one component of a larger, structured activity. (Martin et al., 2002, p. 16)

The following excerpt from an evaluation of the Intel Teach to the Future project is not unlike lessons that were observed in some TLP classrooms.

> In one class we observed in which student were giving PowerPoint presentations on different topics related to World War II, it was apparent that many had copied and pasted significant portions of their information directly from the Internet. The text included words the students did not know how to pronounce and some of the images and audio had only a tangential relationship to their topic. One group appeared to have written most of the text in their presentation themselves. However, when questioned about their presentation, the students admitted, "[The teacher] thinks we got that from the Internet, but we just made most of it up." A teacher in another class explained that the format of Internet searching was not always conducive to careful study of a topic. He noted that the students rarely spend much time on any one site, often did not read the information they accessed and equated finding information with learning information. (Martin et al., 2002, p. 16)

> As Fullan (2000) observed:

> Technology generates a glut of information but it has no particular pedagogical wisdom – especially regarding new breakthroughs in cognitive science about how learners must construct their own meaning for deep understanding to occur. This means that teachers must become experts in pedagogical design. (p. 82)

The following classroom observation accounts of less than effective integrated TLP lessons illustrate the importance of the teacher's expertise in utilizing educational technology.

> *Students in this 4th grade classroom were beginning a unit on Disasters, and had been instructed to use both traditional and computer resources to gather information. Those that were assigned to computers were allowed to use Encarta and several websites that had been bookmarked by the teacher. The rest of the class worked at their desks searching for information in library books, encyclopedias, and almanacs. Little was accomplished at the computers; students moved quickly from one website to another, one screen to another, seldom pausing long enough to read any information. The pictures were fascinating as were the sounds, graphics, and other "bells and whistles,' but only two of ten students wrote down any information that might be used in a report. Not once did the teacher check on students to see what they were accomplishing. Rather, he spent the time working with small groups of students on a writing project. Students seemed to enjoy the opportunity to work on the computers, and were quite skilled at maneuvering the mouse and keyboard, but in terms of student learning, little was accomplished.*
>
> *In another example, high school students in a social studies class were preparing to present their reports on various aspects of the Roman Empire, most using PowerPoint. The first presentation – Cleopatra – was comprised of a series of five slides that included "Interesting Facts," "Relating Cleopatra to Rome," and "How Rome and Greece is [sic] Still Present Today." One member of the team read information from note cards while the other advanced the slides. At the end of their presentation, the teacher called for questions. One student asked how old Cleopatra was when she died. Neither of the presenters knew, and the teacher moved on to the next presentation, Roman Gladiators. The "Gladiators" presentation was similar both in format and in lack of content. At the end the teacher asked two questions, neither of which the presenter could answer.*

A number of observations of TLP classrooms involved PowerPoint presentations where students shared the results of their research efforts. A comparison of two lessons provides an interesting contrast in how technology is used to support student learning. The first observation involved a 6th grade class in a public school with rich technology access, including laptop access both at school and at home. Students had been studying the classification of the animal kingdom. Each pair of students gathered information on an assigned phylum, information that they subsequently summarized in a PowerPoint presentation. Each group taught their subject to the rest of the class using PowerPoint. The three presentations that were shared during this classroom observation were similar: presenters read their information directly from the screen. They struggled with both pronunciation and syntax to such an extent that it appeared most of their information had been taken directly from research sites with no effort to understand it. After reading each screen, the presenters would pause while their classmates copied, word for word, the information on the screen. When they had finished, presenters gave the class a self-

developed quiz consisted primarily of low-level questions. There appeared to be little understanding on either the part of the presenters or the rest of the class.

In the second instance, a 5th/6th grade class had worked on a similar project: students researched and presented information on geographical and cultural features of Washington State. Students worked in groups of three to develop their presentations. In this case the slides were well laid out and contained substantive information. Presenters were "authorities" on their topics and facilitated their classmates in taking notes – recording key information – on a map of the state. Time was built in for the audience to ask questions throughout the presentation. At the end of the lesson, the teacher asked a few students to share what they viewed as the key points from the presentation. There was an obvious understanding of the subject matter on both the part of the presenter and the audience.

While the exercise was much the same, the set-up and execution of these two lessons were much different, and there was little doubt in the mind of the observer that the second lesson was the stronger of the two and the more likely to engage students in real learning. The first lesson illustrated that weak teaching cannot be saved by technology, while the second lesson showed that technology can be an effective tool to support good teaching.

Challenges to Technology Integration

The challenges teachers faced in integrating technology into the curriculum remained much the same over the five years of the project, and included technical problems, lack of technical support, lack of time for exploring and planning, network and server problems, student management issues (the 4 to 1 ratio), and space and wiring constraints.

Hardware, software, and set-up challenges

In the beginning of the school year, the major challenge for teachers was related to equipment. Ordering issues, set-up problems and various technical glitches were among the most common difficulties they faced. Many schools were not built or wired for multiple computers. Neither did they have tables for the computers. A large number of teachers either purchased tables with their own money, or "scrounged" for leftover tables that were not being used. Finding space for all the equipment was a hurdle as well. Again, the physical constraints of classrooms did not allow for an ideal arrangement. Teachers were often limited by the location of outlets or other built-in features. In many cases the computers had to be placed along one wall of the classroom, which limited the amount of cooperative work that was possible.

Once the computers were set up, teachers were faced with any number of technical challenges including malfunctioning printers, software problems, computers that would freeze or crash, and inconsistent district servers. Teachers with Macs were particularly vulnerable to network glitches. A number of teachers were plagued with

laptop problems as well. Over the course of the first year, many of these problems were resolved, or at least became less frequent as teachers learned to provide technical fixes on their own. Network and server issues were also troublesome, especially when districts update their systems. Some participants in recent years spent much of their time dealing with NT 2000 glitches and security barriers.

> *Many technical difficulties. One of my computers doesn't work. They never seem to shut down properly. We never know when the printer will work, or which computers will print. [My laptop] freezes up all the time. I have had to call the HP tech support hotline because it read every document as a Paint file.*
>
> *. . .have had nothing but problems with ACER laptop.*
>
> *To this point, I have not had all of my computers working at the proper capacity. I can't write down all of the issues I have had to deal with, but I will honestly say I have shed tears out of absolute helplessness and frustration!*
>
> *An area of frustration for all the TLP teachers in our district is having new computers that are intended to run on Windows 2000 or XP but are being forced to run on Windows 98, because it is the only accepted OS in our district. The new computers do some strange things every so often, and our tech specialist seems to think it is because of this OS discrepancy. It also seems that there are a lot of things the computers could do if they were running on 2000 or XP that they cannot do because of the Win98 OS. It seems like a waste of newer, more advanced computers.*

Technical Support

Access to adequate technical support was an important factor in teachers' success in technology integration. While their training provided some background in fixing technical problems, most teachers did not find this an area of strength and thus relied on school or district technical support for anything beyond the most basic problems. Depending on the availability of support personnel, teachers might get immediate help, or they might wait for days and even weeks for needed assistance. Teachers felt especially disillusioned about the lack of support since the TLP grant stipulated this as a requirement of participating districts. Comments about technical support changed very little over the course of the Teacher Leadership Project.

> *My first challenge was to personally install all of the software on my new computers. This challenge came with many ups and downs and trying to find drivers that were compatible for each operating system. Another challenge was trying to network all of my computers and getting my printer set up. The biggest challenge that I have faced with these problems has been a lack of technical support at times, in which I have had to personally figure things out for myself by trial and error.*

It is difficult to rely on our technical support in our district. Our tech guy is always so busy. I have had a printer since the beginning of my TLP grant, but it is still not online or able to use. It is hard to have the materials and not be able to use them because of lack of tech support. It causes me to learn more on my own and have to try to figure ways around the technical problems and be innovative in ways to print or retrieve materials or software we need.

I have Macs. If I could choose again I would choose PCs. My district has dropped the ball. My students can't even access the server this year. Last year we could. Nobody seems to be able to fix it or cares. My partner had grant and has PCs so he ends up being responsible to have kids save to server. He is my saving grace.

It was wonderful to receive administrative support the first two years of TLP. It is near nonexistent at this point. The computers are collecting dust more than anything else at this stage. It has been extremely difficult to find someone to update and make repairs on the TLP computers. The demand for technological support is so great in the district; I believe the TLP computers are seen as dinosaurs and not worth the effort to fix. What a shame!!!

Our district doesn't provide the support that is needed to keep these computers up and running on a daily basis. Wiring problems, printer problems, log-in problems are to name a few of my frustrations with tech support.

Student Management

For some teachers, finding effective strategies for managing computer integration with a 4 to 1 ratio was challenging. Elementary teachers looked for ways to monitor and assist students working on the computers while continuing to deliver instruction to the rest of the class. Finding enough computer time for multiple classes of students within 50-60 minute blocks of time was the struggle for secondary teachers. Second, third and fourth year teachers found ways to make the ratio work, but a significant number said the process would be much more efficient and effective with a 2 to 1 ratio.

There are many activities that get cut short or left out because we can't take the time that is required for each student to spend time on the computers with the 4 to 1 ratio. We struggle with doing everything as groups and less as individuals in order to fit it into our schedule. We would definitely use them more if we could all use the computers simultaneously instead of having to provide other assignments for those who are waiting.

Time

Lack of time to explore programs and to plan and refine lessons was a constant challenge to TLP teachers. Every year for the five years of the project, a majority of teachers commented on the time constraints involved in implementing an integrated program, including the increased length of time to do projects with technology, not being able to get through required curriculum, lack of time to create and adapt lessons with

technology, and time to learn the various software programs. The first year was certainly the most difficult, although even second and third year teachers observed that they lacked the time to do all the planning they thought was necessary. To a certain extent this is the nature of teaching. However a time-intensive program like the TLP intensifies this demand, especially during a teacher's initial efforts.

> *There have been a number of challenges in integrating technology into my units of study, the primary one being time. The activities I have planned have taken more time than I have allotted in my planning and I have had difficulty finding the time to explore the programs myself to get a better understanding of how to incorporate them into various units or lessons.*

> *Time itself to prepare "good" assignments and projects. It seems like after the fact I realize what I should have done, but I must get ready for the next day. That is frustrating. Book and paper work was easier to do, but not as exciting and in many cases as effective. The tech projects and assignments are great when done well, they are exciting and effective, but they take time to set up. Time, Time, Time.*

> *TIME -- having enough time to do the kind of planning that would lead to the most successful use of the technology and curriculum planning.*

State Reform Initiatives

Another challenge for teachers was related to the reform efforts taking place in Washington State. Many districts and schools are adopting curricula that are more directive and explicit, require large blocks of time, and that allow minimal opportunity for teacher flexibility. Teachers in these situations reported that they were necessarily limited in what they could do with the technology.

> *Time is always the biggest challenge. Our required 90 min. of reading and 90 of math are not conducive to integration of any kind. I do occasionally integrate technology with my reading students, but because they are not with me throughout the day to continue projects, work on them in their "free time", etc. it is hard to do. Integrating technology requires that all students have access and not just during the "reading time."*

> *Our school has committed ourselves to two hours of a reading program each day in a block schedule. After you factor in PE, Library, and Music, it doesn't leave much time to do elaborate or complete lengthy computer projects. I have, however, found ways to integrate smaller lessons into my math, social studies and science. I try to focus on the objective of the lesson and simpler ways to integrate computers rather than having a project determine what the outcome is.*

> *I often feel overwhelmed by the demands placed on us by the new state standards. If I don't have time to plan and prepare, I find that I fall back into a traditional teaching mode.*

Survey responses supported journal reflections regarding the difficulties teachers faced in integrating computers into the classroom (Figures 7 and 8). The most pressing challenge, according to teacher responses, was a lack of time for planning. A total of 64.7% of respondents indicated that this was *often* a problem. Less troubling was access to computers, although almost one-third (31.8%) felt they did not have enough computers in the classroom. Lack of technical support was *occasionally* a problem, according to 51.9% of the teachers, and 41.6% agreed that *occasionally* there were not enough funds available to maintain equipment.

Figure 7.

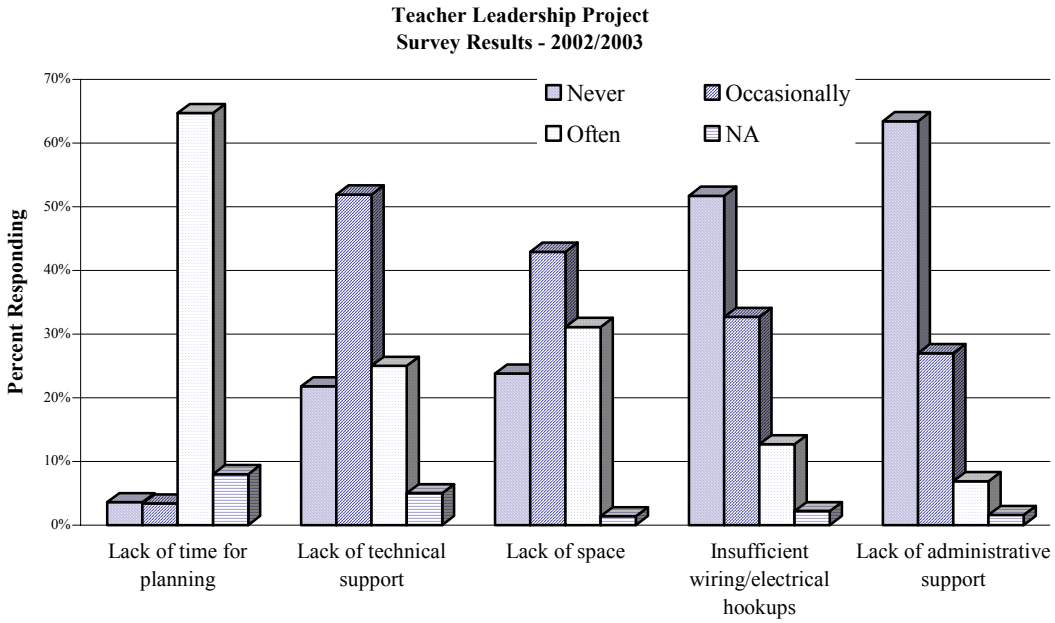
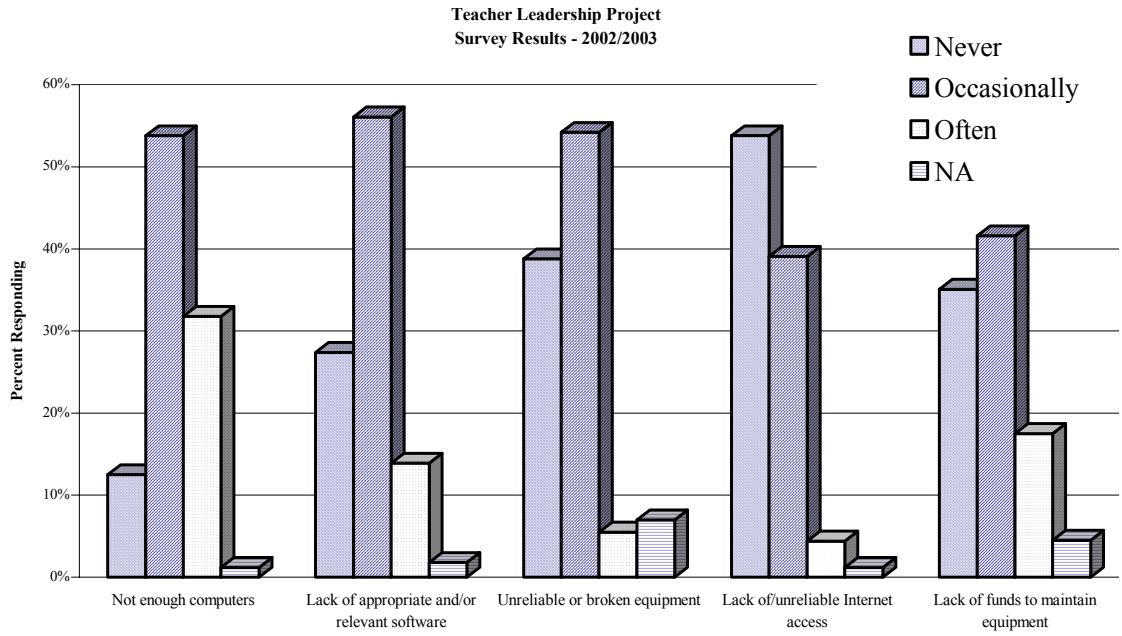


Figure 8.



Maintenance and Sustainability

One of the concerns raised by teachers regarding their technology integration efforts was the long-term sustainability of their efforts given the difficulty of maintaining and updating the technology. Funding issues prevented some teachers from buying replacement ink cartridges for printers, bulbs for projectors, and paper for printing. A lack of funds also prohibited teachers in some schools and districts from repairing broken equipment and updating obsolete hardware. Teachers view this as an unfortunate turn of events, given their extensive training in using technology in the classroom. The following comments reflect teachers' concerns about the long-term viability of the project, given the challenges of maintaining hardware.

> *In a year or two, the lack of funds to maintain equipment may well become a serious issue.*
>
> *Replacing and adding computers to the classroom - where will additional funding come from if I don't continue writing grants?*
>
> *Printer cartridges are an issue. We are always out of ink!*
>
> *I have to figure out ways to purchase updated computers since my original TLP computers are from 1997. Last week I made enough by selling used books to buy a refurbished Dell. I've done that for about 4 years now.*
>
> *Lack of funds and/or district support to maintain equipment is a major issue. My laptop is "failing." I could use a district one but they will only load a limited*

amount of software onto it whereas with my TLP one I was free to add programs such as my AOL software. If I purchase one on my own, they won't allow me to load district software onto it nor will they maintain it. What a dilemma!

We have been asked at _____ Middle School to supply our own paper and print cartridges for teachers with printers in their classroom out of our dept. budgets. I have used my science budget for consumables for my science labs. One set (1 color & 1 B&W) of printer cartridges is almost $65.00! Paper is around 20.00 per ream. That will last me most of the year, but I need 2 B&W printer cartridges and 1 color to make it through. My budget is $100.00. I cannot even purchase the needed consumables for the TLP grant with my science budget money because there is not enough money in it! I'm sure you've heard this all before.

Summary

What then, has been the impact of the Teacher Leadership Project on teaching, learning, and classrooms across Washington State? Findings from an analysis of teacher and student surveys, case studies, classroom observations, reflective journals, and sample lessons support the potential and positive effects of integrating technology into the curriculum. In these classrooms a student-centered environment is replacing what was, in many cases, teacher-centered instruction, and the role of the teacher is shifting from one of *director of learning* to that of *facilitator of learning.* Interdisciplinary projects requiring students to perform and coordinate multiple tasks have become a primary means of teaching and learning. Because of both the 4 to 1 ratio and the benefits of collaboration, these projects are typically undertaken by small groups such that lessons requiring students to work in isolation have decreased rather substantially. Students are more actively engaged in their work, which teachers believe will result in authentic, long-term learning with meaningful connections to the world beyond school.

Perhaps one of the most powerful findings was the extent to which technology influenced student motivation and enthusiasm. Both students and teachers were energized by the addition of computers to the classroom and by the world of learning opportunities they afford. Students stayed in from recess and teachers postponed retirement. Teachers believed this motivation was positively related to improved student learning. Written and oral communication, problem solving and critical thinking, research skills, and inclination to read were among the areas where teachers reported seeing evidence of student growth.

These findings suggest that when coupled with sound teacher training and technological support, the use of technology at a 4 to 1 student to computer ratio can lead to the integration of curriculum, more cooperative learning environments, and a focus on higher order thinking skills. Technology appears to have the potential to help teachers create classrooms where students experience *education* rather than schooling, *understand* rather than memorize, are *active* rather than passive, and where learning is connected to the *real-world*. However, it is important to note that these changes were not equally evident in all classrooms but were manifested to various degrees. In addition, technology

alone did not and cannot create these changes. Without the requisite pedagogical skills and without adequate technical support, no amount of technology will transform the classroom. As Pierson observed:

> A teacher who effectively integrates technology would be able to draw on extensive content knowledge and pedagogical knowledge, in combination with technological knowledge . . . unless a teacher views technology use as an integral part of the learning process, it will remain a peripheral ancillary to his or her teaching. True integration can only be understood as the intersection of multiple types of teacher knowledge and, therefore, is likely as rare as [teaching] expertise. (2001, p. 427)

Similarly, Earle stated:

> The focus of integration is on pedagogy – effective practices for teaching and learning. Teachers need to be able to make choices about technology integration without becoming technocentric by placing undue emphasis on the technology for its own sake without connections to learning and the curriculum. (2002, p. 10)

Evaluation Question 2:
What impact has the Teacher Leadership Project had on schools and districts in Washington State?

The Teacher Leadership Project was developed to train and support teachers in the use of educational technology for teaching and learning. Beyond that, it was intended that the program should build a cadre of teacher-leaders across the state to further extend the influence of a sound technology integration program. One of the primary purposes of the Teacher Leadership Project evaluation was to determine the extent to which the program did, in fact, have an impact beyond the walls of individual TLP classrooms. It was expected that TLP participants, as teacher-leaders, would model their skills, share their expertise, and facilitate training in their schools and districts to bring about an increase in the number of teachers trained in technology integration throughout Washington State.

The Impact of the Teacher Leadership Project on Washington Schools and Districts

Information gathered from TLP teachers, school and district administrators, and technical personnel suggested that the TLP impacted the educational landscape in several different ways. First, cadres of teacher-leaders were developed across the state, and their efforts were often instrumental in facilitating school reform platforms, in designing technology agendas, and in training others in the judicious use of educational technology. Secondly, there were those schools and districts across the state that adopted certain elements of the TLP professional development model for use in designing their own agendas, particularly those elements related to curriculum development and technology

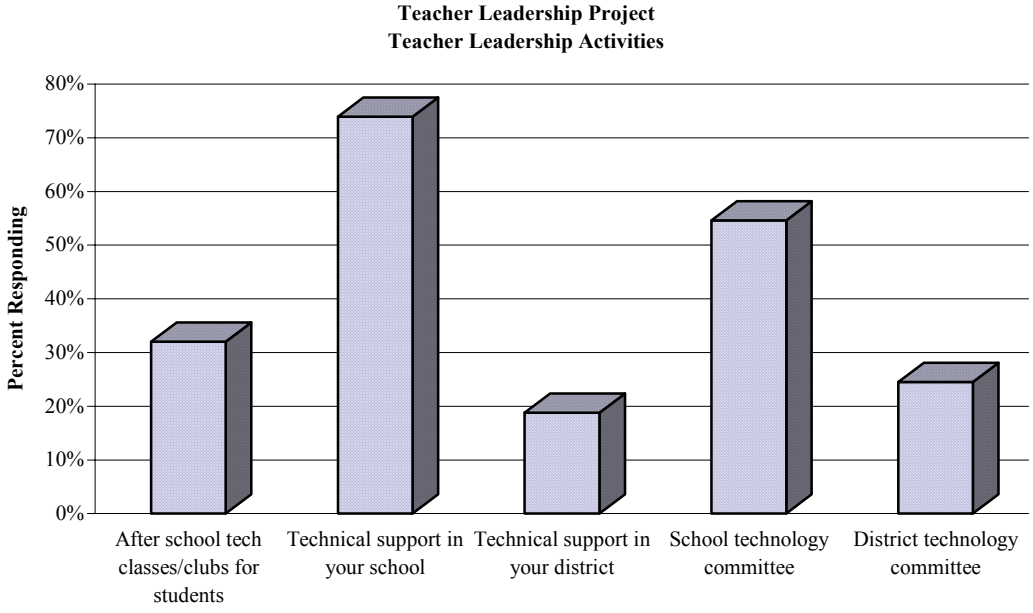
integration. Finally, schools and districts with large numbers of TLP teachers significantly improved their access to technology.

TLP Teachers' Leadership Activities

Teacher Leadership Project participants shared their knowledge and expertise in various settings and with a wide range of audiences between 1998 and 2003.

Approximately 50% of the TLP teachers reported that they had taken on building-level leadership responsibilities in one of several capacities. A majority of teachers (73.9%) offered technical support to their colleagues, solving technical glitches and assisting with software and applications. Of those who responded to the survey, 24.5% served on building technology committees, and 32% offered some type of after-school computer class or club for students. Other teachers exchanged classes with grade level peers in order to expose more students to the basics of technology, and some facilitated both individual and school grant applications (Figure 9).

Figure 9.



I was responsible for starting a bulletin board for my staff and getting the school web page up and going; applying for the Gates grant for our school; researching other grant opportunities.

I am identified as a resource person for those having problems with computers in our building. Teachers know they can find me and I'll help them individually.

My participation in the TLP has impacted my school. Two other teachers at my school, plus two from the year before, are also TLP participants. Therefore, other

teachers are definitely aware of what is going on, plus are eager to share in the knowledge and use. Due to our impact, our school has applied for a School Gates Grant. Additionally, our principal is looking into the possibility of obtaining Elmos for all teachers. Another area of impact has been on our Learning Support Program for intermediate students. During my planning times, some of the students in this program come to my room to use the computers for various activities.

Approximately 25% of the TLP participants took their expertise beyond the school to the district and the community. About one-fourth of the TLP teachers (24.5%) served on district technology and planning committees, while others (25.9%) provided in-service classes for the district. Teachers also served as technology representatives on curriculum adoption committees, worked on technology levies, and facilitated Technology Nights and Technology Fairs in the community.

District Technology Showcase is put on once a year to demonstrate technology use in the classroom to an audience of staff, parents, and community members. I have participated for four years, taking a group of students and demonstrating how we integrate technology into the curriculum in our classroom.

. . .open house with students demonstrating how to use the computer for different projects. Helping the community see how young students can integrate technology for a technology bond.

The biggest impact has been on my school. Before TLP I had no computers in the classroom, my students had no way of learning technology skills and learning science through the use of technology. Now my school has used budget money for the last two years to install computers in every classroom because of the successes in my classroom. Of course every success at our school impacts the district and the community since we are trying to educate the students who have not fit into the traditional school classroom. Every student who graduates from our school is one more person who has skills and knowledge to be a contributing member to the community.

Finally, an analysis of survey responses showed that approximately 25% of the TLP teachers had done little, if anything, in the way of sharing their expertise beyond the classroom. Reasons for this varied, but included a lack of time, lack of support, and lack of skill. A number of participants from Cohort 5, for example, stated that they were just too new to the program to begin training others. “I will get there, give me time!” responded one teacher while another asked, “Who has the time??? I’m still trying to figure out my own classroom!” There were also those teachers who attempted to share but whose efforts were not accepted.

I’ve offered many, many times to do these kinds of things, but they just ignore me, so I have given up trying to help. I put all my efforts into my class and my kids.

Technology in my school is the tech coordinator's area of expertise or the 21st century grant leaders who work with the tech coordinator. My attempts to work in this area have received no approval.

No, I am the only teacher with computers in the classroom. Therefore I could find no compelling reason to assume leadership responsibilities because I had no followers.

Reflective journal responses and teacher interviews supported findings from the survey data. Teacher Leadership participants acknowledged that they were viewed as technology leaders in their buildings and were frequently sought out to give instruction and technical assistance. Many felt that they had a strong influence on building decisions regarding the acquisition of technology and curricular issues related to technology.

It's the "trickle out my classroom door" impact; teachers see or hear me talk about different projects or methods of instruction involving my technology and want to incorporate it into their rooms as well. In fact, having so many computers in my room has made our administration look at building-wide use of technology. We have moved from the "take your class to the computer lab where all the computers are located" model to classroom "mini-labs.

Not only do my students have the opportunity to use technology in their learning, but several of my colleagues have also used the computers in my classroom. Other teachers are seeing some of the things I am doing with the technology and are asking how they can do the same. At times I feel like a resource person.

Teachers engaged in a wide variety of leadership activities in their buildings, depending on their experience, their available time, the reception of building staff, and the needs of their school. A majority of teachers provided technical support to their colleagues, and some found opportunities to teach classes, sponsor after-school clubs, and serve on technology committees. Very few teachers were unable to find ways to share their expertise and skills.

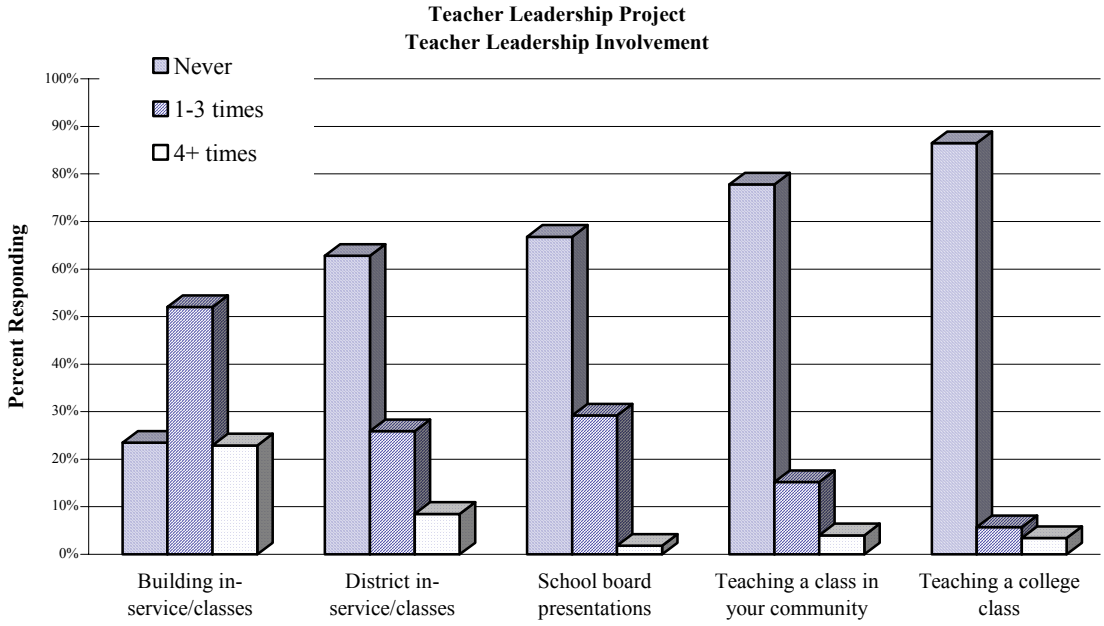
The Impact of Teachers' Leadership Activities

The various activities undertaken by TLP teachers impacted the educational endeavor in Washington State in several important ways. First, many teachers assumed leadership roles in their schools, districts, and communities who otherwise may not have done so. Secondly, the TLP training that teachers brought to their classrooms was often used as a model for related professional development activities in their schools and districts. Third, TLP teachers improved technology access in their schools and districts through the equipment they received from their grants.

Teacher Leadership

One of the most powerful findings of this evaluation was the degree to which the Teacher Leadership Project developed the leadership capacity of classroom teachers across the state. Although many teachers, principals, superintendents, students and parents initially viewed the Teacher Leadership Project exclusively as a technology grant, their perceptions changed as they came to understand the philosophy of the TLP. Recognizing that technology is a powerful tool, the Teacher Leadership Project stressed nonetheless that computers, printers, scanners, cameras, and software were worth little without skilled teachers and appropriate curriculum. Hence a primary goal of the program was to provide training in the appropriate and judicious use of educational technology. A second goal of the Teacher Leadership Project, however, was to develop in teachers a willingness to lead by example and to share their expertise. Data gathered over the past five years suggested that this goal was realized to an impressive degree (Figure 10). Again and again, teachers reported that they were viewed as expert and credible voices when it came to technology and how it could be used to improve teaching and learning. For example, TLP teachers were routinely recruited for technology planning teams to help design a school's technology agenda and to select hardware and software.

Figure 10.



TLP teachers were also influential in training their peers in sound technology-integration practices. An example of one teacher's impact is shared below.

Profile ~ Teacher Leadership in the Elementary School

According to the principal, "We had one of the very first TLP teachers, and I think of him as being very much like 'McGuiver' . . .he can do anything . . .he really is exceptional and he has the respect of the staff. " At a school that was in

the 'dark ages' technology-wise, this teacher completed the TLP training and convinced both the principal and other teachers that the TLP model of professional development was sound, and that their principles of technology integration were both reasonable and feasible. He convinced four other teachers to apply for the program; they did, and all four received grants. Others have applied since and the building now has a total of eight TLP-trained teachers. Together they have trained the rest of the staff in the principles of the Teacher Leadership Project so that the staff has common language and a common focus in their vision of how to use technology to improve teaching and learning. Ultimately the school was awarded a Gates school grant, due in large part to the efforts of the TLP teachers. "This project has brought people out of their shells," according to the principal. Teachers who used to hide in their classrooms have been re-energized, and 85% have taken additional technology training (Intel Teach to the Future, for example). "The power of the TLP is in training teacher-leaders," according to the principal. Teachers come away from the TLP training with confidence, and they go beyond what they ever thought they could. Their work has changed the culture of this school, and of the district as well. "Our school was never seen as a leader before, but now we are the leader, by far. We now receive strong support from the Board and from the central office. Our efforts have also influenced district policy . . .when the district math committee started the curriculum adoption process, they looked beyond textbooks to include technology resources in the package."

Some associated with the Teacher Leadership Project believed that certain teachers had a predisposition toward leadership prior to their involvement with the Teacher Leadership Project. Just as often, however, it appeared that the program provided the encouragement and the opportunities for teachers to develop that potential. TLP instructors modeled leadership behaviors in a technology environment as they directed the training sessions for new TLP participants. In addition, they provided structured, supported, and safe opportunities for teachers to develop their own leadership capabilities. Once back in their buildings, teachers were encouraged to share their efforts with colleagues, and because of their technical knowledge and skills, they were viewed as competent and respected leaders. Many teachers reflected on their leadership responsibilities in their journals.

This year I have become more involved as a professional. I used to sit back at faculty meetings and rarely participate. This year I have been able to speak up more often. I am also an active participant on the Reading Committee at the Middle School and the Common Intellectual Committee at the High School. Being more actively involved in education has made me a better professional.

I have been able to help staff with some technology questions, as well as taking some leadership roles in some curricular areas, which included decisions on distance learning programs our district would offer for students. I also used some online resources to help my AP students and helped my colleagues get involved in using these resources as well.

> *In my school and district I am looked upon as a Technology leader. I have done several training sessions for our school and am proud of our teachers as they are beginning to take on this leadership role as they have developed their skills.*
>
> *I've been asked to teach tech classes to preservice teachers through a local university.*
>
> *Our school has benefited from having much more access to technology and ideas. I'm sure that is multiplied by the many teachers across the district that have been involved.*

The impact of TLP-trained teacher-leaders was also noted in a recent study of leadership and resource allocation practices in schools. The study explored ways in which "schools use money, time, and talent to support instructional design and improve student learning" (Beck, Elfers, Plecki, & Portin, 2002, p. 3). Results of the study pointed to the Teacher Leadership Project as being a significant factor in how teacher-talents were used to provide direction in decision-making and governance. "The full sample of eight schools incorporated some forms of shared or distributed leadership in their internal governance and decision making. We concluded that the Gates Foundation's Teacher Leadership Program clearly added more capacity to the schools' distributed leadership structure" (p. 16). In one school, for example,

> the seven TLP teachers . . .each participated broadly in curriculum teams throughout the school. There was an ethic of the school, that 'everyone participates' but the expertise of the TLP teachers appeared to be a particularly important resource. Equally so at *School A,* where a TLP teacher was crucial in spearheading improvements in math instruction. (Beck, Elfers, Plecki, & Portin, 2002, p. 17)

Furthermore, results indicated that each of the schools they studied

> . . . possessed qualities that set the stage for teacher leadership. However, prior to the advent of the TLP, only a few teachers apparently had emerged as serious leaders in the instructional arena. Participation in the TLP program, in the view of the teachers we met, played a central role in energizing and encouraging participants, not only to embrace new behaviors in their classrooms, but also to embrace new roles – leadership roles – within their schools. (Beck, Elfers, Plecki, & Portin, 2002, p. 27)

While a majority of TLP teachers suggested that their leadership efforts had an impact on their school or district, there were those who had no discernable influence beyond the classroom.

> *Since I am the only TLP person in my building and only 1 of 3 elementary TLPers in my district, I think there has only been a minimal amount of impact. If there*

had been another teacher or two in my building, we could have collaborated and worked together to make some changes towards more technology-based teaching in the school.

To be honest- I think my participation in the TLP grant was seen as a hassle. My administrator was not very interested in what I was doing in the classroom. I felt like I was always saying - "the district needs to do "X", in order to meet the guidelines of the grant, etc..

Very little [impact]. Only TLP teacher at my school. I didn't hear about opportunities to network with TLP teachers at nearby schools, and didn't have the time to create such opportunities.

Support

Levels of support provided to TLP teachers varied widely between schools and districts around the state, for various reasons. Some had either not developed or committed to a progressive technology agenda and therefore were less than enthusiastic about spending money for individual TLP teachers' efforts. Other districts lacked the funds to provide anything beyond basic education dollars, and thus TLP teachers were left to use their own initiative and resources to make the program work. The contrast between districts with different levels of support and different demographics was striking in some cases and is illustrated below based on observations and interviews with TLP teachers.

District A was a large, suburban district north of Seattle, and one that has long placed a high priority on technology. To this end, all teachers in the district were provided with at least several classroom computers. For TLP teachers this improved their student to computer ratio significantly, as was the case in Mrs. Smith's classroom. She had 10 student desktop computers, one laptop computer, a projection device, a digital camera, and a scanner. The district also ensured that teachers were provided with sufficient technical support. Given the resources provided by the district, training provided by the Teacher Leadership Project, and the pedagogical expertise of this particular teacher, it was not particularly surprising that Mrs. Smith's classroom was one in which technology was used effectively and creatively to facilitate student learning. The potential of the TLP was realized in this classroom due to a combination of teacher, school, and district factors.

District B was a smaller suburban district east of Seattle that struggles with high student mobility and poverty. Technology is viewed as an "extra" that would come at the expense of basic education and skills, and thus little attention has been paid to acquiring or training teachers to use technology. Observations in three classrooms painted a clear picture of the struggles faced by TLP teachers. District technical personnel were in the one classroom first thing in the morning, repairing glitches and preparing the computers for district-mandated levels testing. The help was welcome, but teachers nevertheless had to spend countless hours before, during, and after school maintaining their hardware.

Typical problems were made worse because the school was old and did not have adequate wiring to support computer-rich classrooms. One teacher had all but given up any pretense of integrating technology. “It’s just too hard to do here. We’re always running into technical problems, there’s not enough support to help us, and the district isn’t forward-thinking anyway.” Another teacher continued to use the technology as often as possible, albeit in traditional ways. He relied on his own children to help with glitches, and made efforts to help others in the building with technical issues whenever possible. The better part of his teaching day was spent “dealing with technology,” although it was questionable whether it had made much difference in student learning. A third teacher lacked even the most basic teaching competence and thus the technology, when used, was used ineffectively.

This contrast provided several key lessons. First, TLP training is more powerful when distributed in schools and districts with active, progressive technology agendas and support than in districts with only scattered interest and commitment. Secondly, teachers’ skills are fundamentally important to the success of any technology integration program. There is no denying that students learn technical skills from their exposure to technology, whether or not the teacher is competent. Still, technical proficiency comes at a high price when the equipment is provided without skilled teaching. Selecting strong schools and strong teachers is a critical factor in ensuring the effectiveness of any technology training program.

Professional Development

For some schools and districts, the Teacher Leadership Project model of professional development was powerful enough that it was adopted as a model for their own continuing education efforts. For example, a number of schools and districts chose to use elements of Understanding by Design to direct curriculum planning work after being introduced to it by their TLP teachers. As one principal stated:

> *I can gauge the impact of the Teacher Leadership Project by the response of the district to the principles of Understanding by Design. There is now an emphasis on this model from the district administration, and it stems directly from the Teacher Leadership Project. The TLP teachers modeled this at their schools, and then at various district classes, and now it is an emphasis for all schools.*

Another principal observed:

> *Our professional development in the area of technology has increased. The district has implemented "Tier 1" and "Tier 2" levels of competency that teachers must obtain to earn computers for their classroom. While I do not believe this tiered system is a direct result of the TLP, I believe that the Tier 2 training is based very closely on the training the TLP provides.*

Teachers shared similar examples of how their work with Understanding by Design influenced school and district practice.

. . . I have also been a technology instructor for my district, helping many district employees become familiar with PowerPoint, Microsoft Word, etc. And, as a Teacher Leadership Cadre member, I will be working with my staff, teaching them how to plan units based on the "Understanding by Design" model.

My participation in TLP has directly impacted my school through the use of Understanding by Design; many of my staff have purchased the handbook and have begun to use it in their own classrooms. My school district has adopted the handbook for use district wide.

The work we did with Understanding By Design complemented the work my school was doing with project-based learning. As I said before, I believe my work with TLP helped prepare me to be effective in my new role.

My building principal borrowed my Understanding by Design book and remarked "You are sitting on a gold mine." He would like to train all staff members using the UBD as the platform from which to work.

I am in the process of starting a book study at the high school with the book Understanding by Design. I believe that the book is a valuable method of writing units of study.

There were also those schools and districts that adopted the Teacher Leadership Project model of professional development as a blueprint for their own technology integration training efforts. One teacher described those efforts, noting that because of the TLP:

There were also those schools and districts that adopted the Teacher Leadership Project model of professional development as a blueprint for their own technology integration training efforts.

I was asked to help create a district program we call the _____ Technology Project. It is the same model the TLP uses. Teachers apply, get a 4 to 1 ratio, laptop, same amount of training, etc . . .To date we have trained over 120 teachers. We take administrators with us as well.

Another teacher reflected on the professional development training that had taken place at her school, which included offering a series of technology classes to both the staff and to community members. She reported that "the last one was a full house." In another school, a team of TLP teachers responded to the individual needs of their staff with an in-service day focused on technology.

Our staff has four Gates TLP recipients and we were part of an in-service for our school last week. The day was dedicated to technology and I taught a PowerPoint class and others taught a Word class. The staff chose which class to attend and alternated it with our tech specialist teaching about our new email network. This was a good method because people were able to choose what they needed and

also work in a small group so they could ask specific questions about what they were interested in. This was helpful because as in all buildings, we have a wide range of experience with technology. We also offered to anyone who would like to create a PowerPoint presentation for Curriculum Night next year, the use of our laptop and presentation device. A few were excited about this and began creating their presentation at my class.

I have continued to provide computer training to our staff, through clock-hour classes sponsored by ESD 112. So far, I have completed 5 classes at 6 hours each, and one class after school in our computer lab. Teachers taking this class have laptop computers and projection devices in their classrooms. They also have at least 5 student computers in their classrooms. Through these classes, our building has become much more focused in our approach to the use of technology and students will be able to see technology integrated at all grade levels.

Technology Access

Finally, results of the evaluation indicated that the Teacher Leadership Project had a huge impact on schools and districts by increasing their technology access. Numerous teachers and principals discussed the benefits of the TLP in terms of the hardware and software it provided to participating teachers. In some schools, the additional technology provided through TLP grants offered at least some relief to crowded library and computer labs. Some of those involved with the project acknowledged, in fact, that the primary reason they applied for the grant was for the technology. According to one principal with an impressive number of TLP teachers:

We developed a focused plan a long time ago to get and use more technology. This [the TLP] was one way of getting the equipment and the training. I was very purposeful about the process and the selection of top candidates [in my building]. I reviewed and assisted these teachers in writing their applications to strengthen them.

The fact that TLP grants included not just training, but also hardware and software was of great consequence to smaller and rural schools and districts. Time and again teachers from such schools commented that were it not for their TLP grants, they would have little in the way of up-to-date technology. One teacher observed, "I have brought significant gifts of hardware and software that my poor school might not otherwise enjoy." The down side, of course, was that these districts did not always have the necessary level of technology support nor the funds to maintain and sustain the equipment. Nevertheless, there is no doubt that the TLP grants were influential in improving technology access across the state.

The TLP has provided more technology and training than would have ever been possible in our rural district . . .

The TLP has provided more technology and training than would have ever been possible in our rural district . . .

We are a financially poor district and receiving this technology will enhance education for many years to come.

TLP has had a large impact on our school. We are a very small, rural school (non-high district 850 kids) with kids that are not likely to have access to this much technology if it weren't at their school.

My school is computer poor, except for the computers and other technology the TLP participants have been able to purchase. The students now have more access to using up to date technology in their learning.

Our student body, one of the poorest in the state, has had a greater opportunity to use technology than many other schools.

It has given our poor district resources which we could have never afforded. The training was invaluable.

The impact of the Teacher Leadership Project on schools and districts has been significant, and that impact extended beyond simply the acquisition of technology. The program was influential in developing cadres of teacher-leaders across the state with expertise in technology integration and curriculum development. A majority of TLP teachers have taken on leadership roles in their buildings and districts, providing direction for technology planning, assisting in professional development training, and facilitating school reform efforts. Some were more effective with informal leadership tasks, such as assisting colleagues with technical set-up and training, while others participated in a more structured format. As one teacher noted, "While working with my team teacher I realized the concept of "L" in TLP. Leadership doesn't have to be formal lectures at staff meetings . . .my team teaching partner now feels comfortable with technology." In either case, TLP teachers made notable progress in fulfilling the expectation that they contribute to the larger educational community.

Critical Mass

Results of the evaluation suggest that the Teacher Leadership Project had a significant impact on classrooms, schools, and districts in Washington State. The development of teacher-leaders, greater access to technology, and a model for effective professional development were all outcomes of the program. One of the most compelling findings regarding teachers' leadership activities and the impact of those activities, however, was the degree to which their efforts were maximized when they achieved a "critical mass" at the school. The power of numbers was clear according to both teachers and principals. Schools moved further and faster in implementing a technology agenda when two, three, or more TLP teachers were situated in one building. Beyond that, teachers at the same school had opportunities to reflect, share, and commiserate with each other in ways that single TLP participants did not have. In fact, over the years many TLP participants suggested the program should address a philosophy of "critical mass."

Research literature provides some degree of support for the practice of working towards a "critical mass." Having opportunities to reflect on new learning and being able to share ideas and strategies appear to be important factors in facilitating teachers' efforts to effectively use technology for teaching and learning. The importance of collaboration emerged in a study done by Windschitl and Sahl (2002) on laptop classrooms. They found that one of the most powerful ways in which teachers increased their proficiency in using technology for teaching and learning was through regular collaboration with their peers. In addition, educators from a Connecticut middle school reported that providing teachers with opportunities for "social support" was one of the primary reasons their technology-training program was so successful (Saylor & Kehrhahn, 2003). An evaluation of the Ameritech Training Academy revealed the advantages of team training. "ATA team members were, in fact, extremely positive about the focus on planning and leadership. And according to teachers and administrators alike, the requirement that each team have administrative representation was critical" (Brown, 2003a, p. 19). One teacher commented, "Experiencing the process of integrating tech tools with a building team was extremely powerful. Time to plan with your building team was built into the process and helped us focus on building goals as a team . . ." (p. 19). Finally, a report on the Intel® Teach to the Future program identified several ways in which a "critical mass" impacted a school's technology integration efforts. For example, there was a greater incidence of collegiality among teachers regarding technology integration in schools with a high number of technology-trained teachers. More importantly, however, was the discovery that at "critical mass" schools, these teachers served as a "change force" in their schools, moving technology integration efforts forward (Martin et al., 2002).

The Teacher Leadership Project did provide time for trainees to collaborate and reflect at the summer seminar and during follow-up sessions throughout the year. However, especially in the first few years of the project, the selection process often resulted in the awarding of one grant per building or even one grant per district. At least a few teachers suggested that their efforts would have been more productive had they at least one TLP partner to work with. Interviews with teachers and principals from "TLP-rich" schools and districts supported this suggestion. For example, an elementary school with eight TLP teachers found that "the power of numbers has been critical." Teachers shared a common language regarding technology integration and curriculum planning, and collaboration and sharing around technology-enhanced projects was embedded in the school culture. The critical mass of TLP teachers at this school played a large part in their decision to apply for a school Gates grant, which they subsequently received.

Another elementary principal described his cadre of seven TLP-trained teachers as "the nucleus of our efforts." The teachers influenced the rest of the staff in their use of technology to support teaching and learning, in the implementation of Understanding by Design principles, in a move toward more constructivist teaching and learning practices, and in the decision to apply for a Gates school grant. The principal observed that the cadre of TLP teachers increased the capacity of the school to do both informal and formal professional development within the building, and he described the TLP teachers as being the leverage in going for the Gates grant. Responses from teachers offer support to the contention that critical mass is a factor in maximizing the TLP training.

I am the only TLP participant in my school. If there had been any way to assure more than one participant in a school, I think the TLP would have much more than twice the impact on the school and community.

Our school is a model TLP school. We have had 8 teachers who have received the grant. When we received the Gates School Grant a few years back, we chose to do TLP like training for all of our staff. It has made a GIANT influence in the school. The district is following in our footsteps and the community thinks its fabulous.

There are four of us at my school to receive the TLP grants. That represents big bucks for technology that we might not have even thought of if the money had to come out of our district or PTA technology funds. We have learned through the use of the wide variety of tools that we have acquired. The training has also helped us, because again, we couldn't afford to buy all of what we have gotten. All of the members of our staff have participated in technology classes and together we share what we learn. We're all on the same page at the same time, which is necessary to implement any new program successfully.

TLP has made a large influence on our school. I was the first of 6 TLP participants . . . We now have a "Critical Mass" of people immersed in UbD and project-based learning.

TLP has made a large influence on our school. I was the first of 6 TLP participants from _____. We now have a "Critical Mass" of people immersed in UbD and project-based learning. A group of us, through the SIP process, are trying to change the culture of our school into a professional learning community, where all adults constantly learn for student benefit. TLP was the first step in this adventure, opening my eyes, so to speak, to the possibilities out there for adult learning in a school environment. It is now critical to our future.

There are several TLP teachers on our staff. It has united us as teachers with a common focus. It has made us leaders in our school as far as technology goals are concerned.

Summary

The impact of the Teacher Leadership Project on schools and districts in Washington State has been significant, according to teachers and administrators. The efforts of teacher-leaders have been instrumental in facilitating various educational reform strategies, including changes in teaching practices, curriculum development, and technology integration. The TLP has also been used as a model for school and district professional development activities. Finally, the program has provided schools and districts across the state with much needed hardware and software, increasing access for both students and teachers.

There is evidence to suggest that critical mass is an important element in how much a school or district can accomplish with its equipment and training. Those who represented technology-rich buildings suggested that having considerable resources – computers, software, and trained teachers – increases the likelihood that those resources will be used to improve teaching and learning across the entire school.

The efforts of teacher-leaders have been instrumental in facilitating various educational reform strategies, including changes in teaching practices, curriculum development, and technology integration.

Evaluation Question 3:
What are the strengths and limitations of the Teacher Leadership Project as a model of professional development?

A group of 27 teachers developed a model for the Teacher Leadership Project in 1997 in an effort to provide training and support for teachers in the judicious use of educational technology. The fact that it was developed *by* classroom teachers *for* classroom teachers was fundamentally important to the design team. As the co-administrators of the program observed, "It's all about teachers teaching teachers. It was created by teachers, and it always comes back to teachers and their classroom experience." The third evaluation question addressed the degree to which this model, "by teachers, for teachers," has been a successful one.

Reflections from teachers' journals, survey responses, interviews, and observations at training sessions were among the sources from which data were gathered to address this question. Following a brief description of the TLP training model, findings are discussed in terms of the program's strengths and limitations.

The Teacher Leadership Training Model

The Teacher Leadership Project began in 1997 when 27 intermediate classroom teachers designed the program and subsequently implemented it in their classrooms. The program was intended to provide training and support for teachers interested in using technology as a tool to support teaching and learning. Although the program evolved in many ways over the five years it received funding from the Bill & Melinda Gates Foundation, the original intent went unchanged. Specifically, the program was designed to:

- Infuse technology into the curriculum based on state learning targets.
- Provide a training plan for educators that addresses the needs of adult learners.
- Incorporate a curriculum framework into the technology training model.
- Encourage and support teacher-leaders.
- Seek resources to support the model.

- Produce materials to share with others.
- Evaluate the effectiveness of the model.

Initially offered to intermediate teachers of grades 5, 6, and 7, participants were provided with the equipment and the training to help them launch a technology-enhanced curriculum. Equipment provided to each participant included a laptop computer, student computers to reach a 4 to 1 ratio, a printer, and Office software. As the program expanded to primary and secondary teachers, equipment specifications changed to meet their unique needs. For example, primary teachers were provided with a document camera and projector in lieu of a 4 to 1 student to computer ratio.

Selection

Over the five years the program received funding, a total of 3,387 teachers in five cohorts received TLP training. The selection process was carried out by the TLP administration and experienced "TLPers" who scored applications based on several specific criteria. For example, teachers were expected have some experience in using a computer for word processing as well as a strong interest in using technology for learning. Selection also took into account school and grade-level representation (Table 6). While some train-the-trainer models of professional development focus on the establishment of a "critical mass," the Teacher Leadership Project was developed and expanded based on a philosophy that encouraged dispersing the resources broadly. Thus the selection process focused on breadth rather than depth.

Table 6. Number of Teacher Leadership Project Participants

Teacher Leadership Project	# of Teachers Selected	Grades Represented
1997 – Start-up Cohort	27	5th - 7th
1998 – Cohort 1	160	5th - 7th
1999 – Cohort 2	227	5th - 7th
2000 – Cohort 3	1000	K - 10th
2001 – Cohort 4	1000	K - 12th
2002 – Cohort 5	1000	K - 12th
Total	**3,414**	**K - 12**

Training

Teachers who received the TLP grant were given 11 days of training over the course of their first year in the project. Beginning in the summer following their selection, teachers attended a five-day training session at one of several locations around the state, typically in comfortable hotels. Follow-up sessions were held three times during the year [October, January, and May] and followed a Friday-Saturday format. Training days were generally long and intense, beginning at 8:00 a.m. and ending between 8:00

and 9:00 p.m. (Appendix B). In accepting the grant, each teacher was given a list of training dates. Expectations regarding attendance and punctuality were strict, and the TLP administration was consistent in upholding them.

Although no formal follow-up training was provided beyond the participant's first year, there were several opportunities offered across the state for those teachers interested in gathering together voluntarily for additional sharing and reflection.

Obligations

Teachers selected into the TLP agreed to certain stipulations, including attendance at all training sessions, participation in all evaluation activities, maintaining and using an e-mail account, and sharing relevant lessons and strategies. Participating districts also agreed to meet certain grant requirements regarding the purchase of equipment, technical support, and substitute release days (See Appendix C).

Strengths of the Teachers Leadership Project Model

Support can be found in the research literature for several conditions that have proved critical to the success of a technology-training program. These conditions include a focus on curriculum and pedagogy (Becker, 2000c; Brown, 1997; Earle, 2002; Pierson, 2001; Salomon, 2002), time for collaboration (Brown, 1997; Earle, 2002; Eastwood, Harmony & Chamberlain, 1998; Salomon, 2002; Windschitl & Sahl, 2002) and follow-up training (Earle, 2002; Eastwood, Harmony, & Chamberlain, 1998; Franklin, 2001). Teachers themselves have indicated that training and access to equipment are critical to successful integration, as is adequate technical support. Functional equipment without training is only superficially useful, and training without sufficient and/or functional equipment makes the process of integration much more cumbersome, if not impossible (Brown & Rojan, 2002; Brown, Fouts, & Rojan, 2001; Stuen & Fouts, 2000). Furthermore,

> Teachers need opportunities to observe models of integrated technology use, to reflect on and discuss their evolving ideas with mentors and peers, and to collaborate with others on meaningful projects as they try out their new ideas about teaching and learning with technology. (Ertmer, 1999, p. 54)

A comparison of traditional and research-proven professional development practices (Table 7) further illustrates these conditions (Newmann & King, 2000).

Table 7. A Comparison of Traditional and Research-Proven Professional Development Practices

Traditional Professional Development Practices	Research Proven Professional Development Practices
Brief workshops, conferences, university or extension courses	Sustained opportunities to learn, experiment, and receive advice and feedback
Little or no follow-up activity	Opportunities for long-term feedback and follow-up activities
Individual participation	Team effort with professional peers within and outside the school

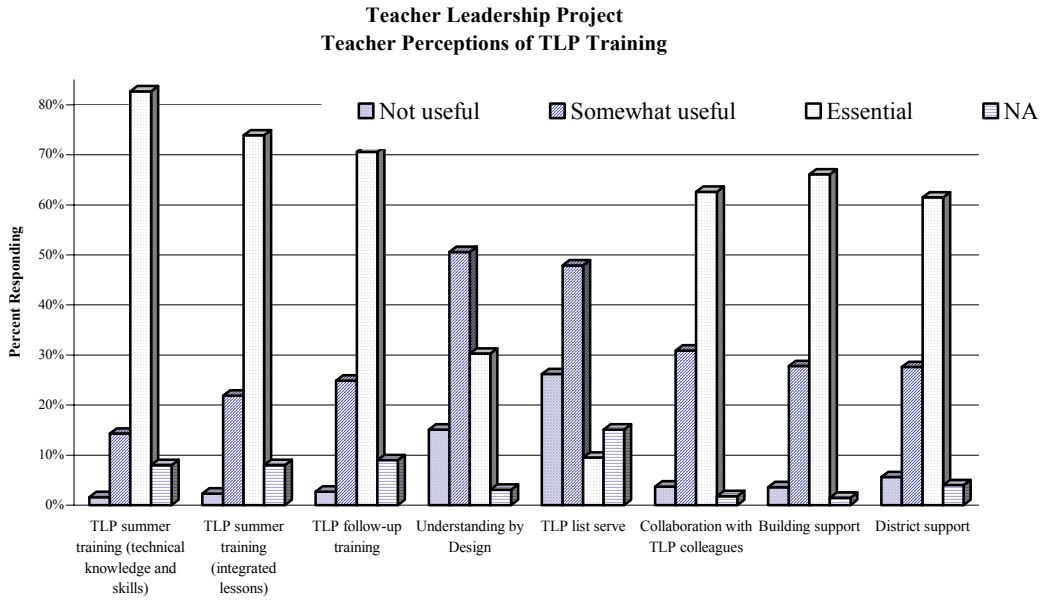
To what degree does the Teacher Leadership Project meet these critical conditions? Results of the evaluation found that teachers' reactions to their TLP training were consistently positive, as were those of principals at TLP schools. Specific strengths of the program included:

- The interactive nature of the training
- Classroom teachers as instructors
- A focus on curriculum
- Technology access (hardware and software)
- Leadership development
- Follow-up training
- Opportunities for collaboration and reflection

Training. The enthusiasm with which TLP teachers discussed their training was truly remarkable. Many stated that it was unlike any professional development opportunity they had previously experienced and suggested that both state and local school districts could benefit from following such a model. Of those teachers who responded to the survey, 82.7% indicated that the technical training provided during the summer session was essential to their success in the classroom, while 73.9% agreed that the focus on curriculum and integrated lessons was "essential" (See Figure 11).

The enthusiasm with which TLP teachers discussed their training was truly remarkable. Many stated that it was unlike any professional development opportunity they had previously experienced.

Figure 11.



Interview and journal responses were no less impressive, and in fact clear patterns emerged regarding the strengths of the training. First, the fact that the program was one of "teachers teaching teachers" was a strength. That instructors came from the classroom and returned to the classroom gave credibility to the program that would have been otherwise difficult to achieve. As one teacher reflected, "Good support, excellent training in a professional and caring way . . . taught by real teachers who have a vested interest in seeing this [process] work." Another observed,

> *Teachers teaching teachers. . . excellent model. . . By receiving instruction in a manner that is "real" and can be taken back into the classroom and applied, it really makes us realize how relevant the instruction is. The instructors understand exactly where we are in our schools (empathy) and are able to encourage us and show us new ways to do things.*

Many responses focused on the instructors' professionalism, knowledge, care, and support.

> *The TLP training is wonderful. It is teachers sharing with teachers. The presenters can practically answer the questions that participants have because they are actually using it and doing the same things in their classrooms. The presenters have the same "limitations" as the participants have and therefore the knowledge that is shared is so practical. It was TERRIFIC!!!*
>
> *Teachers teaching teachers" is a very powerful mode of delivering instruction. They are seen as experts and resources (because they are) and I have found that*

I think the biggest strength of TLP was that it was designed by classroom teachers and was taught by teachers who were still in the classroom.

they are willing to continue offering support, ideas, & guidance even after the one-year weekend sessions have ended.

The training is excellent - good teaching models are presented with technology as support for good teaching. It would have been valuable even without the computers!

I think the biggest strength of TLP was that it was designed by classroom teachers and was taught by teachers who were still in the classroom.

Participants were also enthusiastic about the interactive, hands-on nature of the training they received, which many compared to "the type of good instruction we should be providing for our students." Teachers valued a learning model that integrated technical skills into curriculum projects and allowed for practice. According to one, "It's a great professional development model. Instead of teaching tech skills that are isolated skills, by using an integration model you remember things better. (Just like the kids!)."

As reported in previous evaluations of the Teacher Leadership Project, teachers were extremely positive about being provided time during their training sessions to work on projects, to practice skills, to discuss the "big" issues in education, and to collaborate with colleagues. According to many respondents, teachers *never* have enough time to do everything that needs to be done, and so TLP participants considered it a gift, of sorts, to be provided time to talk and plan. Survey results provided further evidence of the value teachers placed on collaboration; of those who responded, 62.6% agreed that collaboration was essential to their successful integration efforts.

> *THE TIME provided after receiving the grant to work on curriculum, technology implementation, and collaboration with others.*
>
> *Collaborating with colleagues in all subject areas, help sessions, time to work/practice modeled lessons, and researched-based discussions offered the range of material and skill development needed for us as TLP participants to engage and motivate our students.*
>
> *The opportunity to communicate with other teachers is wonderful. The time provided for sharing was great.*

Teachers also expressed overwhelming support for the three follow-up training sessions. Findings from the survey showed that 70.6% of respondents found that the follow-up sessions were essential to their success in the classroom. This enthusiasm was evident in journal reflections and interview data. The summer training provided basic knowledge, skills, and motivation; follow-up sessions offered teachers the opportunity to review their learning and to problem-solve issues that emerged once they tested the waters in the classroom. One teacher spoke for many when he noted, "Of course the

initial training was phenomenal, but the three sessions throughout the year were the most beneficial because we could share and learn from each other."

The slow dissemination of information over the year was appreciated- one workshop would have been too much to absorb.

Continued training is so valuable. There is no way I would have been able to absorb all of the information during our summer session. Allowing us to use it, experiment with it, and then share the results has been so amazing. I love the networking opportunities with other teachers.

I loved the follow up classes the most (the initial training was great if a little intense at times). Getting to share ideas/projects with others as we met was wonderful. I wish that part could have continued through all three years of the grant.

Teachers also clearly supported the curriculum focus of the training. As noted previously in this report, teachers generally confirmed the value of the *Understanding by Design* curriculum framework. While a number of teachers acknowledged that the principles of Understanding by Design were not new, (many noted that they had always used these principles to guide their teaching efforts), they nevertheless appreciated the fact that the TLP training was intentional in using such a framework to facilitate their efforts to plan appropriate projects and lessons. A majority of teachers reported that the focus of their TLP training on integrated curriculum was essential to their efforts in the classroom (73.9%), while 30.3% believed that their training in Understanding by Design was essential.

"Of course the initial training was phenomenal, but the three sessions throughout the year were the most beneficial because we could share and learn from each other."

The strength of the TLP model lies in the acknowledgement that technology is a tool. At various time in the teaching process, it enhances the learning process. There are times that technology use is not appropriate and times that it is crucial. Understanding by Design is also a strength as teachers integrate threads of the curriculum.

The TLP model has a strong foundation in pedagogy and how to design solid lessons (essential questions, enduring understandings. . .UbD) This is the most powerful piece I feel, because that is what drives the content. The technology is just a tool to enhance that content and learning.

I have appreciated the model of good curriculum development with the technology component. You have to have both to develop good teaching leaders.

Finally, teachers reported a high degree of satisfaction with the general nature of the training sessions. Again and again teachers observed that they were treated like professionals during their time with the TLP. The found that TLP instructors showed great respect for teachers and their work, a respect that was demonstrated in numerous ways. From the accommodations to the instruction and materials to the provisions for follow-up sessions, teachers reported being treated as valuable members of the greater professional community. The following comments are representative of those heard from a large number of TLP participants.

> *For the first time in my public education career, professional development treated TLP participants and me as first class fliers! Not only did we receive outstanding instruction in technology, we were treated as professionals who were valued in our field. Too often other professional development "opportunities" cram 200 people into a large meeting room, provide them with juice and coffee, and offer their products for sale. TLP provided excellent accommodations and everything to make it possible for us to learn and grow!*
>
> *As I said earlier, the teachers that participated were treated with respect and given lodging and meals. Very seldom does professional development include any of the "perks" that professionals in the business community receive. I felt that my education and profession was acknowledged. Working with colleagues from other schools was so inspirational. I learned what was going on in other districts as well as the applications for technology. Working in groups and learning from others is very powerful. The follow-up weekends again helped with the continuation of learning the various applications. Having earlier grant participants teach us was helpful and worked well.*
>
> *One of the greatest strengths of TLP as a model of professional development is that teachers are treated as professionals with the assumption that teachers want to improve what they are doing.*
>
> *It was so effective to take teachers out of their environment and have them focus on just technology both for the week long training and the weekend training. It was like being a kid again. . . . getting to learn. . .it was so much fun!!! The people that directed and taught were so fun to learn from and were truly there to help. . . . It was absolutely fantastic!!!*

Access

Regarding access to technology, Becker noted:

> Regular use of computers with students is highly dependent on access to computers . . .Those who don't have this level of access in the classroom must therefore make use of shared spaces, like computers labs. However, access to several computers in a classroom proves to be a more suitable setting for a great

> deal of school-based computer use than does an even greater number in a computer lab, particularly for academic secondary teachers. (1999, p. 2)

"The most important strength is that the equipment is given, and then extensive training is given, so that equipment can be used effectively."

An unrelated review of educational technology and learning pointed out, "Without sufficient access to technology, of course, even well-trained, highly motivated teachers will not be able to integrate technology effectively into instruction" (Kelley & Ringstaff, 2002, p. 17). Thus, it came as no surprise that teachers were extremely positive about the hardware and software they were provided through their TLP grants. The hardware and software, along with the training, made the grant a complete package, according to a majority of teachers. As one respondent noted, "The most important strength is that the equipment is given, and then extensive training is given, so that equipment can be used effectively." For many, the grant provided resources they would otherwise have been unable to obtain and which they believed were critical to the teaching and learning enterprise. Teachers' comments reflect their attitudes about the necessity of adequate classroom resources.

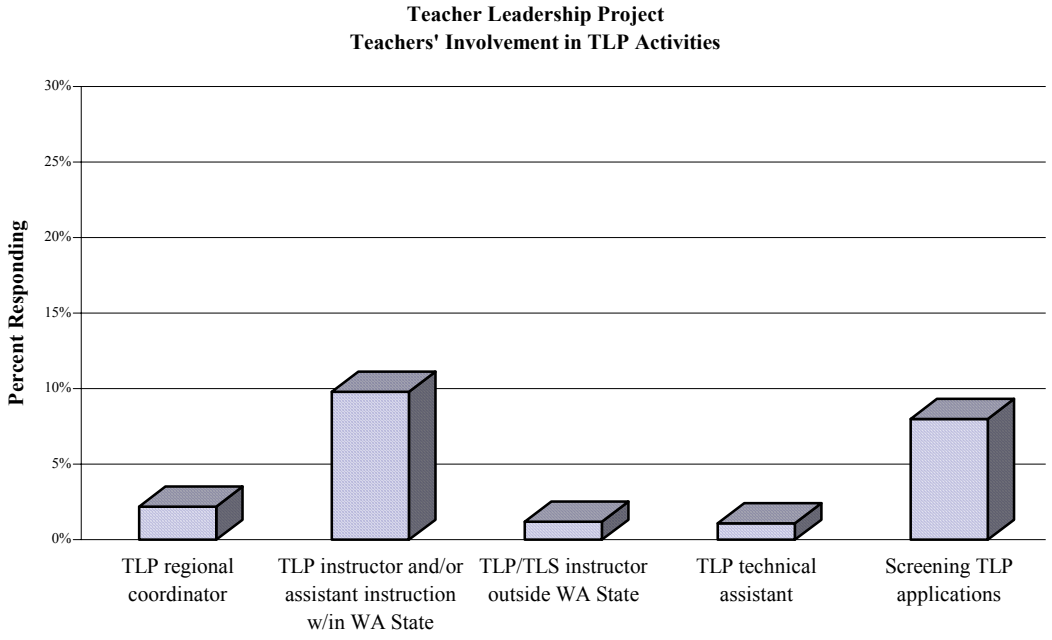
> *After the obvious blessing of all the equipment, extensive and continued training is at the hub of the successfulness of the TLP program.*
>
> *I believe the biggest strengths of the are the training AND the materials (computers, cameras, etc..) Many times we receive training but do not have the materials to go with it or we receive materials, but have no idea where to begin using those materials. The packaged combination is terrific.*
>
> *The biggest strength of TLP is the fact that my class now has more computers which can impact more students learning. Without this hardware and software my lessons would not be as effective.*

Professional Development

As previously discussed in this report, a primary goal of the Teacher Leadership Project was to develop the leadership capacity of classroom teachers across the state, thereby building a cadre of expert technology teacher-leaders. To this end, program developers were intentional in designing a model in which skilled, knowledgeable instructors modeled the characteristics of effective leaders. Furthermore, the program was designed to provide a variety of opportunities during which TLP participants could develop and expand their leadership capabilities. For example, summer training sessions included structured activities requiring new TLP teachers to share with their peers. Follow-up sessions increased the level at which teachers were expected to "lead" by sharing strategies and work samples from their classrooms. And although there were no formal requirements that teachers offer classes for their building colleagues, the conditions and support for such instruction were made clear during training sessions.

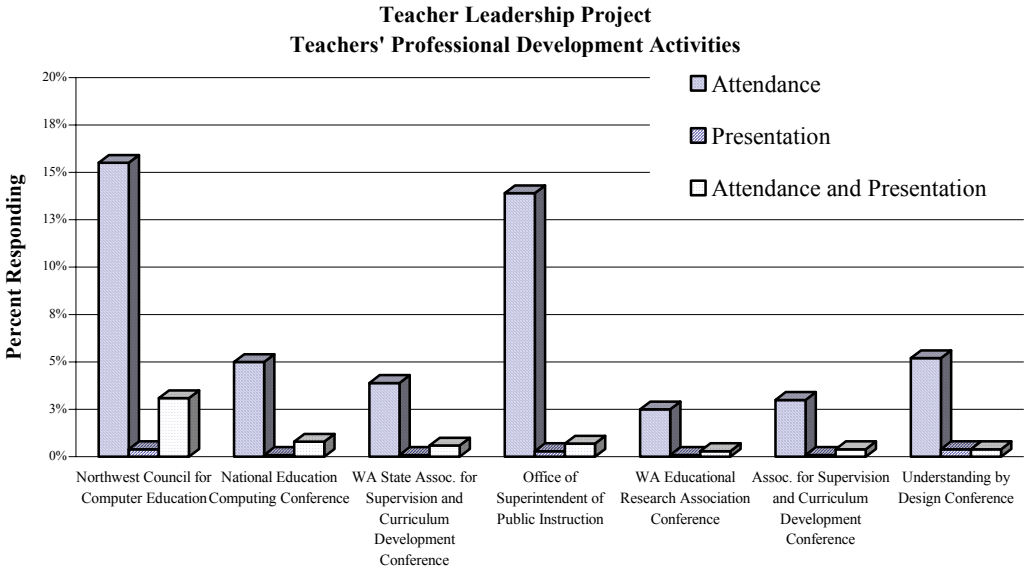
Once they had completed their training, TLP teachers had various opportunities to get involved in the project in a leadership capacity. For example, as the project grew so did the need for additional instructors, a need filled by experienced TLP participants. Many took advantage of the chance to work as summer instructors, assistant instructors, help-desk facilitators, or follow-up instructors, and still others provided leadership as regional coordinators for the training sessions (See Figure 12). TLP participants were also involved in screening applications for future cohorts and in developing curriculum materials for the project. These activities served the purpose of developing leadership capacity and also kept participants connected to the program.

Figure 12.



Many TLP participants took their knowledge and skills beyond the confines of the project itself, however, presenting at local, state, and national conferences (see Figure 13). Teachers reported attending and/or presenting at NCCE (Northwest Council for Computer Education), NECC (National Education Computing Conference), WSASCD (Washington State Association for Supervision and Curriculum Development), OSPI (Office of the Superintendent of Public Instruction), WERA (Washington Educational Research Association), ASCD (Association for Supervision and Curriculum Development), and UBD (Understanding by Design) conferences. Other conferences and activities noted by respondents included, among many others, National Middle School Conference, Learning Space, Intel Teach to the Future, National Science Teachers Convention, Teach the Teachers, National Council for the Social Studies, National Association for the Education of Young Children, and Washington State Disabilities Conference.

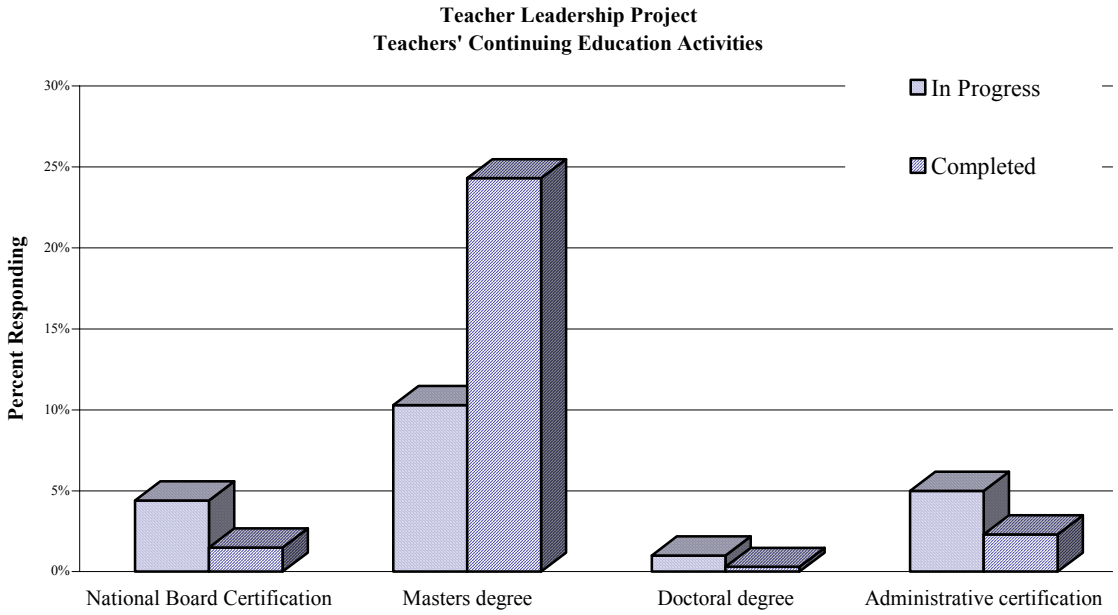
Figure 13.



The focus of the Teacher Leadership Project on leadership influenced the direction many TLP teachers took in their professional careers as well. National Board Certification, masters and doctoral degrees, and administrative credentials were among the continuing education activities that TLP teachers pursued after receiving their TLP grants (see Figure 14), and many more teachers described professional doors that had opened to them because of the TLP. According to one teacher,

> *I took the leadership part of TLP to heart. I have become an instructional leader in my school. I helped lead a class for all teachers in my school during the summer before last to share ideas on integrating technology into the curriculum. I am also working as the assistant principal of curriculum and instruction as a result of the leadership that the grant allowed me to assume. I am also half way through a masters in educational leadership at GU as a direct result of what I learned about during my TLP grant. I was named teacher of the year from my school.*

Figure 14.



Some teachers moved out of the classroom into central office positions, consulting positions, and even university positions. But whether or not their professional position changed, a majority of TLP teachers suggested that an important strength of the Teacher Leadership Project was that it offered teachers opportunities to become active teacher-leaders. As one teacher observed:

> *I have become a technology trainer in my district. But the most important influence had to do with my thinking. TLP helped me visualize myself as a leader and changed the way I think about my career. I can be successful with technology and the sky is the limit.*

A representative sample of journal and survey responses captures teachers' perceptions of the impact of the Teacher Leadership Project.

> *Who would have ever thought two years ago that I would be giving a presentation by myself at NCCE? Really! And who would have ever thought I would be teaching a class at the district level? Not me. But just look!"*

> *TLP has influenced my professional career tremendously. I now conduct many technology inservice and trainings with my staff. I have also been an assistant instructor for the summer TLP session and the fall follow-up session. Until my TLP experience, I had never taught adult learners. I have discovered that I not only love teaching children, but also love helping adults learn more about teaching and learning with technology.*

Yes! TLP was a watershed moment in my career. It helped me see what professional development could be and I now work full-time in professional development.

I had the opportunity to become a Lesley University Program Coordinator for a regional Technology in Education Masters Program, and also enrolled in the program myself. I have earned a Master's degree in Educational Technology, and TLP had much influence on my decision to pursue this degree.

I am no longer in the K-12 classroom but support university faculty and staff in their learning and integration of technology and my university students benefit from my experience and knowledge gained through TLP.

I have become a technology trainer in my district. But the most important influence had to do with my thinking. TLP helped me visualize myself as a leader and changed the way I think about my career.

The TLP has given me an opportunity to write articles for the NEA website owl.org. I have currently had 2 articles published.

Through the learning opportunities and encouragement to lead integration efforts (a TLP expectation), I've become more outspoken and possess knowledge that I did not have before. Because of this change in my role within the district, my superintendent has encouraged me to obtain my administrative credentials so that I may become a leader who empowers an entire staff to make positive curricular changes. Today I sent my application to SPU in order to begin their administrative credential program.

I was lucky enough to teach with a woman who received her TLP grant one year before I received mine. The two of us led teacher workshops, gave presentations to the district technology committee and had a voice in selecting new teacher desktop stations. I am currently sharing more workshops with staff and will be joined in that effort by the TLP grant recipient from my building who followed me one year behind. The ripples of TLP go on and on.

TLP has made me more aware of the good things great teachers do and how they prepare for the lessons they teach. It has made me more cognizant of the EALRS and strategies or methods I can employ to reach the specific targets. I now believe the technology is just a tool and not the specific target.

Yes- It was the catalyst for my pursuit of a Masters and PhD.

That the Teacher Leadership Project encouraged teachers across the state in their leadership efforts is obvious. Whether in the classroom, the school, the district, the local community, or the greater educational arena, TLP participants took seriously the charge that they help influence the direction of education in Washington State.

Limitations of the Teacher Leadership Project Model of Professional Development

While the strengths of the Teacher Leadership Project were many and compelling, limitations were noted as well. Over the years, TLP participants identified several constraints of the program, including the lack of continued training and support, hardware and software issues, and selection strategies.

Lack of Continued Training and Support

Research findings regarding the elements of effective technology integration training are quite clear in suggesting that in-depth, sustained professional development opportunities are much more likely to have a lasting impact on teaching and learning than shorter, less rigorous programs. As Speck noted, "Professional development takes time and must be conducted over several years for significant change in educational practice to take place. Substantial change in school practice typically takes four to seven years, and in some cases longer" (Speck quoted in Rodriquez, 2000, p. 5). As evaluators of the Intel® Teach to the Future program concluded, "In order for teachers to make a sustained investment in both classroom technology integration and inquiry-based or project-based learning, they will need continued support, increased technical resources, and further professional development" (Martin et al., 2002, p. 34). The Teacher Leadership Project embraced the need for sustained training to a greater degree than many other similar programs. Still, the need for additional training was evident. "The greatest challenge of training lies in recognizing that the need for it never ends. Just as computers and Internet connections require continual upgrades to function at their best, human resources must also be updated to stay current and functional" (Franklin, 2001, p. 5). TLP teachers definitely supported this view. Some participants desired more skills-training, while others focused on the benefits that came from gathering together to share and collaborate. Many of those teachers who expressed a need for more training recognized the financial implications of such a proposition, and yet they were hopeful that funding could be found. While some teachers attempted to form their own local TLP-like groups, these were seldom as productive as the more formal training sessions. In any case, teachers were consistent in their recommendations that training be extended to a second and even a third year.

> *Well, the 6 follow-up days are critical to lasting success and change. Extending those opportunities over several years would be a significant help.*
>
> *I wish we could meet more often and continue to do so over the three years, not just the first.*
>
> *I would love to have a continued relationship with the others in my group or other TLP teachers on my level. I feel so out of it this year, and I know that I could learn so much more from this kind of continued contact.*

I wish we could have met as a group again this year. I missed the learning and the ideas that were generated from the weekend meetings. I am fortunate to have several TLP people in my building, but each year there seemed to be more to benefit from being an active part of the group.

Follow-up sessions once or twice a year for the second and third years of the grant would make it more effective in my opinion.

I would have liked to meet (maybe less frequently) with my group into a second year. Once you've done a few lessons the first time, it would be nice to share how much better it worked the second time around. Also, the networking would have had a stronger base. Some of us are so busy, it's hard to continue the contacts without the impetus of a scheduled meeting.

Follow-up sessions once or twice a year for the second and third years of the grant would make it more effective in my opinion.

There were teachers who felt that in signing a three-year commitment to the program they were ensured of three years of continued training and support. In some cases these teachers felt that they had been abandoned, although this was more true in the early years of the project before the parameters had been made fully clear.

The grant is billed as a three-year grant, which is reasonable given the fact that it takes about three years to fully implement a technology rich environment. However support is withdrawn at the conclusion of the first year. It would make sense for two things to be in place: a) a support system for teachers to be mentored and coached, perhaps using former (existing) TLP teachers, and b) extend the training sessions for teachers beyond the first year. As a TLP trainer, one of the unanticipated benefits was the opportunity to be around teachers who were using technology in their classrooms. This opportunity became a support to me in my own classroom practices.

TLP has done very little in the way of support for year 2ers. This is ridiculous. We signed on for a 3-year grant and yet there is no support . . .

I feel far removed from the process now. Regional meetings, or just a CD with new things available would be reenergizing for those of us who were in the program 2 years ago.

There MUST be more follow-up, including in regards to whether or not teachers received the hardware they needed in order for their classroom to work. I feel like once my TLP workshops were done I was cast out of the loop and on my own, with no more guidance or advice or help. I never did receive a projector, which has greatly influenced the amount of tech work in here in a negative way, yet nobody from TLP was ever able to help me or even return my requests for help.

More training. Even with the 4.5 days in the summer and the 3 follow up sessions more time is needed. Statistically, true integration takes 3-5 years - we are still just scratching the surface.

Previous evaluation studies of the TLP found that the first year of training was intense, practical, and often overwhelming; teachers were given more information than they could process. It was only as they continued their efforts into the second year that they had a context for much of what was included in the first year of training. Given that so much time and money was put into first-year training efforts, teachers reasoned that ongoing training would maximize the effectiveness of those efforts and benefit not only teachers but also the program and the educational agenda in the state. The following responses reflect such a need.

Have one workshop weekend the second and third year of the grant . . . The first year I was still getting my feet on the ground, so to speak, and then the workshops were over. I would have benefited from continuing the workshops the second and third year when I was more aware of what I could actually do with my students.

More follow-up trainings in year two and three. The growth would be tremendous given the experience that the participants would have going into a year two and three follow-up.

Continued training in the second year teachers are in the program would be helpful. So much time and energy are spent the first year connecting and becoming familiar with the equipment, it was not until this second year that I felt really ready to explore integrating the technology into the curriculum.

The follow-up sessions should have continued for another year. The first year was getting spent on getting it set up and management issues. I think by the second year the participants have enough knowledge and confidence to learn some of the "advanced" information on each of the programs as well as share information with each other on what worked well, etc.

Selection Strategies

Participants in buildings with several grant recipients believed that collegiality was directly related to their success in impacting their school's technology culture and agenda.

The benefits of developing a critical mass of technology-trained teachers have been previously discussed in this report. However, this emerged as a primary theme when teachers were asked about ways to strengthen the Teacher Leadership Project, and thus the issue deserves some attention in terms of the project's limitations. Teachers repeatedly suggested that selection strategies take into account the number of TLP participants per building. Participants in buildings with several grant recipients believed that collegiality was directly related to their success in impacting their school's technology culture and agenda.

Teachers who were the sole TLP representatives in a school, on the other hand, often found themselves struggling to make an impact beyond the classroom. In some cases they believed that even their classroom efforts would have been strengthened had they a colleague with whom they could share, reflect, and problem-solve. Interviews with teachers and principals underscored this perception; many attributed much of their progress in making school-wide changes to the presence of a cadre of TLP teachers.

> *I enjoyed the whole experience, I am not sure if I would change the model. However, It was disappointing to discover the following year that teachers in my building were not encouraged to apply for the grant because there was already one participant in the building. It would have been beneficial to have another staff member in the program.*
>
> *Encourage two from one school who team together to participate. I think having a team in your building would build the program faster.*
>
> *I think that it would be very powerful to award the grant to a small cadre of teachers (say 2-3) from the same school. This would create a strong web of support within a teaching cluster, and the synergy created by the shared learning experience would sustain the enthusiasm and the momentum for change.*
>
> *Having a team member from the same building to collaborate with on a more frequent basis would have really helped. I was the only person selected from my building; if a pair could be selected from each setting (if two apply) the institution, management, ability to talk about frustrations and successes would be more frequent than just at the follow-up sessions.*
>
> *I would like to attend classes with a cohort from my building. Our building has done much of the material presented at TLP. It would be fun to build from where we are in a setting such as this.*

Technical Issues

In addition to limitations related to training and the selection process, issues emerged over the course of the Teacher Leadership Project regarding hardware and software. Specifically, teachers from schools and districts that used Macintosh computers struggled at times to participate in training or to take their training back to the building. Additional complications arose when they were given PC laptop computers and yet expected to function in a Macintosh environment. In addition, one of the more powerful software programs used in training – School Kit – was not available for Macintosh computers, a fact that teachers found frustrating. Many teachers over the years of the project suggested that TLP participants be allowed to choose their preferred platform, reasoning that it would make their efforts less complicated and more effective.

> *My building uses Macs. I was given a PC lap top. I would have used an iBook a lot more than the PC I was given.*

My biggest concern during my training was the lack of information regarding the Apple platform. The majority of the training focused on the Windows platform.

Provide Mac training and options as well as PC. I have Macs and was unable to take full advantage of the Help Desks, etc. The PC laptop that I received sits unused because there's no need to use it to create work for my classroom when everything else is Mac.

I would change some of the seminars to Mac based. I know that Bill Gates uses PCs, but our whole school, and my whole experience has been with Macs. I could have learned a lot more if I wasn't so uncomfortable with my PC laptop. I feel that I missed a lot of what went on because I was getting familiar with my laptop instead of starting at a higher learning curve. There are people out there who are familiar enough with Macs to teach the classes.

Summary

Thus, the major limitations that emerged from an analysis of TLP data included the need for long-term training, the missed potential in creating critical mass, and various hardware, software and platform issues. While these were the only significant limitations uncovered, teachers offered numerous other suggestions regarding ways in which the program might be strengthened. These suggestions emerged from reflective journal responses and from responses to the following survey question: What changes, if any, would make [the TLP] a stronger model of professional development? Some of those responses are shared as an example of the wide variety of attitudes and perceptions teachers held.

Go slower for dummies in crowd. More specific tech help, maybe more than just one techie. Let people move more at their own speed.

Perhaps the sessions could be a little more segregated with skill groups. I found that the workshops didn't contain a lot of new knowledge for some and everything was new for others. It would be nice to have beginning and advanced sessions offered.

The training moves too fast for some and too slow for others. I think that an improvement would be for the participants to sign up for the training that they need on particular programs and then receive in-depth training in those areas. Some of the time in the training has been a great waste of time with the trainers showing us their great creative works but not showing us how to create the works. That has been frustrating.

TLP spends too much time teaching tech basics outside of integrated curriculum. The technology and software skills should follow curriculum development.

It was EXTREMELY uncomfortable and embarrassing for me to get through the first two-day session during the school year. I have Macs in my classroom and I had the PC and I just couldn't keep up and I was ready to quit and give all the hardware and software back and shrink back into the comfort of being computer illiterate and not push forward. The fact that I have biological kids that are computer savvy saved my spirit. They would break things down for me to move forward at a much slower pace after an embarrassing weekend. I really would not have applied if I would have known that the humiliation level would be so enormous. The whiz kids that did the presentation were hot to demo their talents, which they have every right to do but the three of us that didn't possess the skills to keep up with "whiz kids" were basically dropped. When you have an application that states that everyone is welcomed to apply regardless of their level of expertise then you should also be able to provide support for the less capable. I actually wanted to go to my room and cry.

Understanding By Design textbook was disappointing to say the least. Research and find a better book that teacher can use as they hit the deck running. Intel's TTF text was better thought out.

As much as I love the UbD model (and I do), the timing does not allow for adequate learning. If the point is to improve student learning, than the teachers learning the model (as students) must also have enough time to learn the model well. I would rate the work that we do as something closer to exposure than to implementation. Either TLPers need to do more work between meetings (bringing in finished UbD components) or there needs to be more time at the meetings.

The level of understanding of the instructors in terms of UbD is okay, but not great. It does not appear that they are working from much real experience with the model; they have an intellectual understanding (mostly), but not a felt, experiential understanding (it seems to me).

I do not mean to sound cranky here; I like the instructors and believe they work hard. But if you are going to use UbD as an essential component (and I hope you do), then the instructors need more training and, perhaps more importantly, more experience using the model to create curriculum.

Seems ironic that teachers don't have internet access while training.

I would like a component for observation of/from our coordinators or presenters.

We need more time to implement the ideas. I don't know how TLP can do that. It has to come from the district. When you get caught up in the day-to-day, you just have to get stuff done.

It would have also been nice if our district would have let the TLP people meet even once a quarter to support each other and share what kinds of lessons we have come up with, and to problem solve.

Additional Findings

The evaluation of the Teacher Leadership Project focused on three primary research questions, which provided important information on teachers' efforts in the classroom, the school, the district, and the broader educational community. However, additional findings emerged and offer insight into the process of technology integration.

Over the five years that the Teacher Leadership Project was evaluated, certain patterns emerged from the thousands of reflective journals that were submitted regarding the process teachers went through in infusing technology into the curriculum. While not true for every teacher, TLP teachers related similar experiences in their integration efforts as well as in their attitudes and perceptions. Sandholtz et al. (2000) proposed a five-stage model of technology integration that closely describes, in many ways, the process experienced by a majority of TLP teachers. The stages of *entry, adoption, adaptation, appropriation,* and *invention* evolved from their study of the Apple Classroom of Tomorrow (ACOT) project. In their model, "text-based curriculum delivered in a lecture-recitation-seat work mode is first strengthened through the use of technology, and then gradually replaced by far more dynamic learning experiences for students" (p. 258).

Entry

The authors describe *entry* as the "unavoidable initiation" during which time teachers with little or no experience with computer technology found themselves "unpacking boxes, running extension cords, untangling cables, inserting cards, formatting disks, checking out home computers, and generally trying to establish order in radically transformed physical environments . . .occasionally ACOT teachers had second thoughts about the wisdom of their mission" (p. 258).

TLP teachers, too, found the first months of their integration efforts to be busy with set-up tasks, including arranging the room, figuring out student management issues, and solving technical glitches. As noted in the 2001 evaluation report of the Teacher Leadership Project, "teachers were frustrated by beginning of the year problems related to ordering, delivery, and set-up of the computers and upset at how complicated and inefficient the process turned seemed to be . . . Some teachers waited several months for computers, software, networking capabilities, and projection devices, due in large part to district policy, district inefficiency, and /or shortage of technical personnel (Brown, Fouts, & Rojan 2001, p. 85).

My computers are in my classroom, but they are still sitting in boxes. When they were delivered I was told not to unbox them. I did set up one computer, but my principal told me not to tamper with the others that the district technology personnel would be responsible for setting up the computer and loading the

> *software due to liability issues. Hummm…So, no integration except in the atmosphere of the room for the last two weeks…I have felt very frustrated with the slow process in our district with ordering the computers, delivering the computers and then setting the computers up and getting them ready to use. The wiring for an internet connection was completed at the end of the summer, but the phone connection has not been completed yet* (Brown, Fouts, & Rojan, 2001, p. 86).

Adoption

The second stage of the model is described as a time when teachers "showed more concern about how technology could be integrated into daily instructional plans . . . interspersed among traditional whole-group lectures, recitations, and seat work, teachers incorporated computer-based activities aimed primarily at teaching children how to use technology . . .teachers found students rushing ahead through feature after feature on their own and mastering the use of the software in a few hours and over a number of days. Another common instructional agenda was learning how to save, store, and organize work" (Sandholtz, et al., 2000, p. 259). Teachers in the ACOT program also spent a good amount of time teaching keyboarding and basic word processing competencies.

Again, TLP teachers related similar experiences in their journals, particularly in the early years of the program. After getting their equipment set up, teachers focused their efforts on integration, most often word processing and information access (Encarta, Internet). Some teachers were able to shift to a project-based curriculum relatively easily, while others were frustrated in their attempts to manage a technology-rich classroom. For many, their efforts were focused on blending technology "into the most familiar form of classroom practice, direct instruction" (p. 260). Similar findings were reported in a study of the Intel® Teach to the Future program. "Technology integration by itself is not synonymous with teaching that enhances student learning. Teachers first have to become comfortable with technology by using it to teach in ways that are already familiar to them. Only then can teachers begin to think critically about new learning opportunities that technology might provide their students" (Martin et al., 2002, p. 10).

Adaptation

In this stage, productivity was a major theme (p. 262). Students produced more and at a faster rate. Students "wrote more and better" and willingly reworked their papers (p. 262). Additionally, students were more motivated to do their work, were more curious, and were more assertive in their approach to learning (p. 262). The authors quoted one teacher as stating, "On Monday, when I announced that it was time for recess, the students wanted to continue to work in the classroom . . . they are really involved . . ." (p. 262).

AS TLP teachers became more skilled in delivering an integrated curriculum, they too reported that students were more motivated to do their work, coming to school early, staying in at recess, and lingering after school. They also reported that students "loved" to do research when they had access to computers and that they were much more inclined to write – and even to make necessary revisions. As one teacher reported in her journal, "I

also saw much better revision/editing in the writing process. I think they realized it wasn't as hard to go back and make changes to improve their writing (which they are often resistant to when written out by hand)" (Brown, Fouts, & Rojan, 2001, p. 38). TLP teachers repeatedly noted the motivational impact of technology. For example, "Motivation continues to be the number one benefit to using technology in the classroom. Students view the use of technology as more fun, which makes it easier to teach" (Brown & Rojan, 2002, p. 57).

Appropriation

Sandholtz et al. characterize appropriation as a change in attitude rather than a change in practice, where old habits are replaced with new ones (p. 263). "Teachers' new habits reveal a change in beliefs about the usefulness of technology. This milestone is a necessary and critical step before on can move onto more imaginative uses of technology for teaching and learning" (p. 263).

This was also an important turning point in the journey for TLP teachers. For many, this was a time when they reported in their journals that they "couldn't imagine teaching without technology." Computers, projectors, printers, and cameras had become "tools of the trade," so to speak, and were an integral part of the curriculum.

More importantly, it was a time when many teachers experienced an epiphany of sorts in how they viewed technology and its place in the classroom. Simply put, they found balance in how technology could and should be used. Gone for many were their notions that the technology had to be used every day for every lesson. They recognized that many of their initial efforts were "forced" in that they "looked for as many ways as possible to fit technology into the curriculum." Experience allowed them to step back and focus on the curriculum rather than on the technology. As one teacher observed, "My focus is now on the curriculum. I don't look at it like 'I have Publisher, how can I use it?' Now I am more likely to say, 'I am teaching the Revolutionary War' and then I'll see if technology has a place and if it will enrich the unit."

Invention

The fifth stage identified by Sandholtz et al. is one where teachers began to move beyond traditional uses of technology and to experiment with "new instructional patterns and ways of relating to students" (p. 264). Teachers at this stage utilized more project-based instruction, team teaching, and individually paced instruction. Teachers took on the role of facilitator, lessons were more student-centered, and students were more collaborative. It was at the point that "ACOT teachers became more disposed to view learning as an active, creative, and socially interactive process than when they entered the program. Knowledge came to be viewed more as something that children must construct for themselves and less as something that can be transferred intact" (p. 267).

Many, but not all TLP teachers reached such a point in their integration efforts. These were the teachers that adopted new beliefs about teaching and learning and about curriculum planning. They reported that their planning efforts were more intentional and

focused on outcomes and that their students were more actively engaged in the learning process. They saw themselves as facilitators of learning and gave much greater authority to students in directing and managing their own education. In short, these teachers were becoming more constructivist in practice, developing the components of powerful teaching and learning - active inquiry, in-depth learning, and performance assessment - put forth by the Gates Foundation.

Still, a fair number of teachers were not able to reach this point. For some, this was a practical matter; a lack of technical support or lack of funds for repairs and supplies prevented then from moving ahead. Others did not have the pedagogical skills to design effective lessons nor to facilitate in-depth learning. In these cases, teachers continued to use technology primarily as an expensive tool to improve the efficiency, if not the effectiveness of their teaching and learning efforts.

Summary

Teacher Leadership Project teachers' comments clearly underscore findings from the research on effective models of professional development. The programs that tend to have a lasting impact on teachers, classrooms, and schools are those that are sustained over a long period of time, that provide opportunities for teachers to engage in relevant, hands-on activities, and that incorporate time for practice and collaboration (Darling-Hammond, 1999; Windschitl & Sahl, 2002). Teachers' responses spoke volumes about the effectiveness of the Teacher Leadership Project as a model of professional development. Sound instruction given by practicing classroom teachers, leadership development, access to technology, and a focus on curriculum were all viewed as strengths of the program by TLP participants. On the other hand, they agreed that the model would have been even stronger had it provided continued training and collaboration opportunities and established selection parameters that maximized the power of numbers.

CONCLUSIONS AND RECOMMENDATIONS

The Teacher Leadership Project, funded by the Bill & Melinda Gates Foundation and administered by Educational Service District 189, provided teachers in Washington State with training, equipment, and support in technology integration between 1998 and 2003. The project also supported teachers in their efforts to share their skills and knowledge with colleagues in and beyond their immediate schools and districts. Over the course of the project, a total of 3,414 teachers completed training through the Teacher Leadership Project. The evaluation of the Teacher Leadership Project was designed to determine the extent to which the project met its stated goals of training teachers and developing leadership capacity in the state. Data were gathered through several different sources, including teacher reflective journals, classroom observations, teacher interviews, teacher, student, and parent surveys, lesson analyses, and observations at training sessions.

Findings revealed that the Teacher Leadership Project was a remarkably effective training program that embraced many of the conditions identified in research literature as being critical to successful technology integration. These conditions included in-depth, hands-on training, a focus on curriculum, access to technology, ongoing training, collaboration and reflection.

Teachers expressed overwhelming satisfaction with the training they received, and they stressed the value of having a program based on "teachers teaching teachers." The fact that TLP instructors were from the classroom and understood the nature of teaching and learning at a practical level resonated well among participants. Furthermore there was strong approval for the substance and structure of the training. Participants appreciated the fact that technical skills were taught in the context of academic content, and the time they were given to collaborate, share, and practice were considered among the most valuable aspects of their training. And finally, teachers were treated as professionals whose work and ideas had worth, a strength of the program that was recognized time and again by participants.

The impact of the Teacher Leadership Project on teachers and the classroom was impressive. Changes in students' attitudes, behaviors, learning, and work products were among those that teachers attributed to their technology integration efforts. Specifically, they noted improvements in student writing, problem solving skills, and in their abilities to conduct research. Students were more motivated about learning, more likely to complete academic tasks, more self-directed, and more collaborative in rich-technology environments, all changes that teachers related to increased student learning. Real world connections made possible by computers and the Internet were viewed as one of the most powerful applications of an integrated curriculum. These changes were not universal, however. Much of the success of the Teacher Leadership Project was related to teacher expertise. Strong teachers with sound pedagogical skills were more likely to use

technology in ways that transformed student learning than were their less-skilled colleagues.

It was also found that in TLP classrooms a student-centered environment often replaced a teacher-directed curriculum, and interdisciplinary projects replaced traditional, text-based assignments. Projects that required students to perform and coordinate multiple tasks were becoming important means of teaching and learning, and students worked more often in small groups than they did in isolation. The 4 to 1 ratio, when coupled with sound teacher training and support appeared to facilitate curriculum integration, cooperative learning environments, and higher order thinking. Technology had the potential to help teachers create classrooms where students experience *education* rather than schooling, where they *understand* rather than memorize, where they are *active* rather than passive, and where the learning is connected to the *real world* rather than isolate and artificial.

Although there were many benefits to technology integration, the fact remains that weak teaching was not markedly improved when teachers had access to technology; instruction may have been more efficient, or the quality of student products may have been better, but it was not necessarily true that more learning took place. As noted in an evaluation of the Intel® Teach to the Future project, "Technology integration by itself is not synonymous with teaching that enhances student learning" (Martin et al., 2002, p. 10).

The Teacher Leadership Project had a significant impact on schools and districts across the state. The efforts of teacher-leaders have been instrumental in facilitating various educational reform strategies, including changes in teaching practices, curriculum development, and technology integration. The TLP has also been used as a model for school and district professional development activities. And finally, the program has provided schools and districts across the state with much needed hardware and software, increasing access for both students and teachers. This was important to all TLP participants, but particularly to smaller and rural schools and districts.

There was some indication that certain teachers had a predisposition toward leadership, and yet just as often it appeared that the program provided encouragement and opportunities for teachers to develop that potential. TLP instructors provided structured, supported, and safe opportunities for teachers to develop their own leadership capabilities. Once back in their buildings, teachers were encouraged to share their efforts with colleagues, and because of their technical knowledge and skills, they were viewed as competent and respected leaders. Many TLP participants took their knowledge and skills beyond the confines of the project itself, however, presenting at local, state, and national conferences.

There is evidence to suggest that critical mass was an important element in how much a school or district was able to accomplish with its equipment and training. Those who represented technology-rich buildings suggested that having considerable resources – computers, software, and trained teachers – increased the likelihood that those

resources would be used to develop a sound technology agenda and to influence a school's efforts to address state reform initiatives.

Findings from the TLP evaluation parallel those of other research studies investigating educational technology. Teacher training and access to equipment are critical, as are technical support and time for reflection and collaboration. The process of learning to integrate technology into the curriculum can be frustrating and overwhelming, and it does not happen quickly. Teachers' enthusiasm is often diminished when they face technical glitches, student management challenges, and a lack of time for planning. And without a commitment on the part of schools and districts to maintain hardware, teachers face the prospect of losing equipment to disrepair and obsolescence. Still, the potential of technology to support teaching and learning, under certain conditions, is becoming more and more clear, and the Teacher Leadership Project has moved educators in Washington much closer to realizing that potential.

The Teacher Leadership Project has played a part in addressing some elements of the reform agenda passed by the Washington State legislature in 1993. Furthermore, TLP participants have been active in furthering the restructuring objectives of the Gates Foundation through their efforts in Washington classrooms, schools, and districts. While many viewed the Teacher Leadership Project as primarily a technology initiative, the effects of the program have been far more encompassing than simply training teachers to use computers in the classroom. The Teacher Leadership Project has developed a cadre of teacher-leaders throughout the state who have been trained as thoughtful and intentional designers of curriculum who are also accomplished at using technology to support the curriculum. Technology is but one of the tools they have at their disposal to create sound learning opportunities for their students.

The Teacher Leadership Project encompasses many of the key components of successful professional development programs. One of the most important of these was that the program was developed and taught by practicing classroom teachers. Instructors brought practical experience and practical examples of technology integration to their training sessions, and it was clear that this added to strengthened the integrity of the program in the eyes of teacher-participants.

Recommendations

The Teacher Leadership Project was influential in moving forward the technology agendas of schools and districts across the state, particularly when several teachers were present in a building. TLP teachers modeled ways to integrate technology into the curriculum and helped direct decision-making efforts in hardware and software acquisitions as well. To that end, selection efforts should focus on building a critical mass of technology-trained teacher-leaders in schools with the interest and potential to support a dynamic technology agenda.

Research on successful professional models suggests that in-depth, sustained training opportunities are more powerful and the effects more long-lasting than are short,

"one-shot" models. The Teacher Leadership Project involved teachers in 11 days of intense, practical, and targeted training over the course of one year. The rigorous initial training, followed by shorter sessions throughout the year, proved to be an excellent model worthy of replication. The work of integrating technology into the curriculum is alternately exciting, discouraging, and frustrating. Teachers need opportunities such as those provided in follow-up sessions to come together and share successes, frustrations, technical challenges, and questions. Teachers' efforts would be further strengthened by additional training and collaboration opportunities during the second, third, and even fourth years of their work. Any attempts to fund or facilitate such meetings would maximize the money spent on first year training.

Findings from the evaluation study suggest that much of the success of the Teacher Leadership Project was due to the nature of the training sessions and the attitudes of TLP instructors and administration. The fact that teachers were treated as competent and concerned professionals was not lost on participants. They appreciated the training accommodations and the respect with which their questions and comments were received, and many noted that it was the best professional development they had ever attended. Planners of professional development programs should be aware of this in designing various in-service and training conferences. Teachers are willing to work hard and to work seriously when provided with reasonable conditions and high expectations.

Although many beginning TLP teachers had access to technology directors or technology support personnel, others were left to make decisions about equipment selection on their own. This proved difficult for some, who were not familiar with hardware and peripheral specifications and yet needed to make important (and often expensive) decisions on their own over a relatively short timeline. In some cases teachers rushed to fill purchase orders and spend grant dollars, selecting equipment that turned out to be less useful than anticipated. Teachers would be well-served by having the opportunity to take advantage of "selection seminars," using the advice and experience of senior participants and technical personnel in making purchasing decisions.

Results of the evaluation indicated that teacher collaboration was at the heart of the program's success. Teachers were overwhelmingly positive about the opportunities for sharing and collaboration provided during their training sessions. The importance of collaboration in such change efforts is well recognized in the research literature. There is also some evidence to suggest the benefits of team training and team collaboration. While the TLP selection process did not require team participation, this may be a strategy worthy of consideration in any future planning efforts.

As with any new entity, the Teacher Leadership Project evolved over the years and was notably strengthened by several specific changes. First, the TLP listserv provided participants with a venue for sharing questions, successes, and frustrations on an ongoing basis. Many participants utilized this element of the program and found it helpful in sorting out various issues. Secondly, the TLP also developed a website to which participants could turn to find answers to any number of questions regarding the program such as meeting times and locations, program requirements, and contact information. As

more and more people utilize the web for anytime information access, it is a credit to the TLP that this resource was developed and maintained as a service to teacher-participants. Finally, midway through the project, an intentional emphasis was placed on curriculum with the adoption of the Understanding by Design framework. Research supports the use of technology as a means to and end, and not as an end in and of itself, and therefore making curriculum design a focus of the training was in fact a prudent decision.

One continuing source of frustration for teachers involved in the project was the lack of time needed to develop and refine technology-integrated lessons. On countless occasions, teachers observed that they had plenty of ideas for projects and lessons, but no time to develop them. One of the primary benefits of the follow-up meetings was the fact that it provided a venue and the time to share curriculum projects. This way, as many pointed out, they could share their resources and not spend so much time "reinventing the wheel." One way to address teachers' need for pre-planned curriculum lessons would be for the Teacher Leadership Project to develop a resource library of lessons, cross-categorized by grade level, subject, and timeline, just as an example. Teachers could give and take, refine and share, and ultimately save time in designing technology lessons.

While many schools have moved to some type of block schedule, there are still numerous schools that operate on a traditional 50-minute time schedule. This was the source of some frustration to TLP teachers who found it difficult to manage project-based learning and a 4 to 1 student to computer ratio within a 50-minute timeframe. These teachers need to be provided with examples of successful models of technology integration under such circumstances.

As the presence of technology in schools increases, there are those who remain interested in knowing how technology is best used in primary classrooms. The Teacher Leadership Project focused much of their attention on this issue, and has important information to offer regarding hardware, software, training, and appropriate use of technology in K-2 classrooms. In whatever ways possible, including sharing at professional conferences, in professional journals, and in the popular press, the Teacher Leadership Project should make efforts to share the wealth of accumulated knowledge regarding technology integration in primary classrooms.

A major and real concern of TLP teachers is the sustainability of their efforts. The dual challenges of aging equipment and budget crises in schools do indeed raise the question of how these efforts will be maintained in the future. Given that so much money was spent training and equipping teachers to integrate technology, it would benefit teachers, students, schools, and districts if ways could be found to maintain and update equipment. While the Teacher Leadership Project was not in the business of funding replacements, repairs, supplies, and the like, it is still possible that the project could provide connections to grants and other funding sources that teachers might access to secure continued support.

One of the most useful strategies in working through the arduous process of change is that of reflection. Teachers who are able to seriously and intentionally reflect on their practice are often able to move forward in the change process more smoothly than those who push ahead without taking time to contemplate their efforts. The Teacher Leadership Project built in two opportunities for teachers to actively and continuously reflect on their practice. These included: (1) monthly journals in which they recorded activities, thoughts, and perceptions; and (2) reflective journals required for the evaluation. While many teachers viewed these requirements as simply "one more thing to do," others took seriously the charge that they reflect on their efforts. Those that did often reported that their reflections provided "ah-ha" moments which in turn informed and improved their practice. It is highly recommended that any future training efforts include some element of intentional reflection as a way of encouraging and supporting the change process.

The emphasis placed on leadership was clearly a strength of the Teacher Leadership Project, as was the way it was modeled by instructors. Teachers took on any number of leadership positions in and beyond their classrooms and were often instrumental in moving ahead a school's reform efforts. While other programs *require* teachers to lead by recruiting and training their colleagues, the TLP was able to accomplish similar results by encouraging and supporting leadership activities rather than requiring them. This appeared to be a sound model for growing committed and skilled teacher-leaders.

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Appendix A Technology Use Survey for Teachers 1998-2003

Teaching, Learning, and Leading with Technology

Section 1: General and Demographic Information

1. Your first name (not required):

Your last name (not required):

2. Current Assignment (required):

☐ Grade K ☐ Grade 1 ☐ Grade 2 ☐ Grades 3-5 ☐ Grades 6-8 ☐ Grades 9-12

☐ Administration ☐ Specialist ☐ Not currently teaching

Other:

3. Primary subject area (required for middle and high school assignments only):

☐ Language Arts ☐ Math ☐ Science

☐ Technology ☐ Fine Arts ☐ P.E.

☐ Social Studies ☐ Foreign Language Other:

4. Gender (not required): ☐ Male ☐ Female

5. Year you received your TLP grant (required):

☐ 1997 ☐ 1998 ☐ 1999 ☐ 2000 ☐ 2001 ☐ 2002

6. Current TLP Status (required):

☐ Still using TLP hardware/software

☐ No longer using TLP hardware/software (i.e. moved, no longer in the classroom, new position, etc)

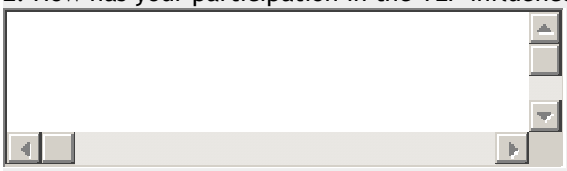
Oher:

Section 2: Impact of the TLP on Teaching and Learning

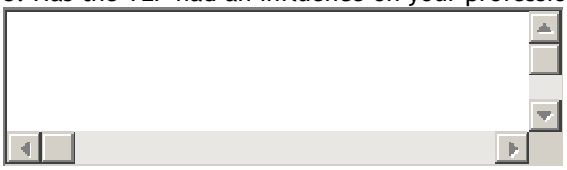
Please respond to the following questions based on your TLP training and your experience in integrating technology into the curriculum:

1. How do your students benefit from being in a technology-rich classroom?

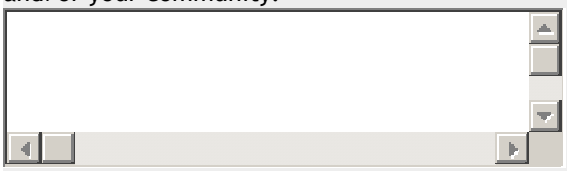
2. How has your participation in the TLP influenced your work in the classroom?



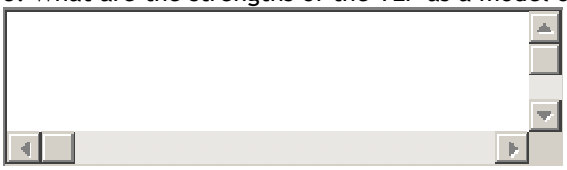
3. Has the TLP had an influence on your professional career? Please explain.



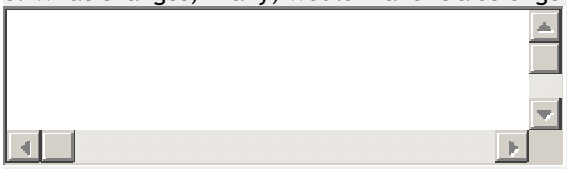
4. What impact, if any, has your participation in the TLP had on your school, your district, and/or your community?



5. What are the strengths of the TLP as a model of professional development?



6. What changes, if any, would make it a stronger model of professional development?



Section 3: Technology Integration and Student Learning

Please mark the response that indicates the degree to which technology integration has influenced the following elements of teaching and learning in your classroom:

	strongly disagree	disagree	NA/no difference	agree	strongly agree
7. Students are better able to understand conceptually challenging material.	☐	☐	☐	☐	☐
8. Students show a greater interest in learning.	☐	☐	☐	☐	☐
9. The quality of student work is generally better.	☐	☐	☐	☐	☐
10. Students are more motivated to	☐	☐	☐	☐	☐

complete their assignments.

11. Parents are more involved in their child's education.	☐	☐	☐	☐	☐
12. Students' focus is on learning, not on the technology	☐	☐	☐	☐	☐
13. It would be difficult to accomplish my learning goals without the technology.	☐	☐	☐	☐	☐
14. Integrating technology into my curriculum improves student learning.	☐	☐	☐	☐	☐
15. Students are more likely to collaborate with each other on their lessons and projects.	☐	☐	☐	☐	☐
16. It is easier to accommodate different learning styles and abilities when technology is available.	☐	☐	☐	☐	☐

Section 4: Student Use of Technology at School

Please indicate to what extent your students use technology for each of the following activities.

	never	occasionally	often	n.a.
17. Practicing skills	☐	☐	☐	☐
18. Collecting and/or analyzing data	☐	☐	☐	☐
19. Word processing	☐	☐	☐	☐
20. Creating graphs	☐	☐	☐	☐
21. Presentations and/or demonstrations	☐	☐	☐	☐
22. Research	☐	☐	☐	☐
23. Communication using e-mail or the Internet	☐	☐	☐	☐
24. Drawing/artwork	☐	☐	☐	☐
25. Web design	☐	☐	☐	☐
26. Multi-media activities	☐	☐	☐	☐

27. Other:	

Section 5: Technology Challenges

Please mark the response that most closely identifies the extent to which each of the following factors limits your integration efforts.

	never	occasionally	often	n.a.
28. Not enough student computers	☐	☐	☐	☐
29. Lack of appropriate and/or relevant software	☐	☐	☐	☐
30. Lack of appropriate and/or relevant peripheral hardware (i.e. probes, printers)	☐	☐	☐	☐
31. Lack of time for planning	☐	☐	☐	☐
32. Lack of technical support	☐	☐	☐	☐
33. Lack of space	☐	☐	☐	☐
34. Insufficient wiring/electrical hook-ups	☐	☐	☐	☐
35. Lack of administrative support	☐	☐	☐	☐
36. Lack of student interest	☐	☐	☐	☐
37. Unreliable or broken equipment	☐	☐	☐	☐
38. Lack of / unreliable Internet access	☐	☐	☐	☐
39. Lack of funds to maintain equipment	☐	☐	☐	☐
40. Need for additional teacher training	☐	☐	☐	☐

41. Other:	

Section 6: TLP Training and Support

Please indicate the degree to which each of the following factors has contributed to your success in integrating technology into the curriculum:

	not useful	somewhat useful	essential	n.a.
42. TLP summer training (technical knowledge and skills)	☐	☐	☐	☐
43. TLP summer training (integrated lessons)	☐	☐	☐	☐
44. TLP follow-up training (Friday/Saturday meetings)	☐	☐	☐	☐
45. Understanding by Design	☐	☐	☐	☐
46. TLP list serve	☐	☐	☐	☐
47. Collaboration with TLP colleagues	☐	☐	☐	☐
48. Building support (principal, colleagues, technical support)	☐	☐	☐	☐
49. District support (administrative personnel, technical support)	☐	☐	☐	☐
50. Other:				

Section 7: Leadership and Professional Development

Please identify the areas in which you have assumed a technology-related leadership role since receiving your TLP grant:

	never	1 - 3 times	4+ times
51. Building inservice / classes	☐	☐	☐
52. District inservice / classes	☐	☐	☐
53. School board presentations	☐	☐	☐
54. Teaching a class in your community	☐	☐	☐
55. Teaching a college class	☐	☐	☐
56. Other:			

Please check any of the technology-related activities you have been involved in since receiving your TLP grant:	
57. After school tech classes / clubs for students	☐
58. Technical support in your school	☐
59. Technical support in your district	☐
60. School technology committee	☐
61. District technology committee	☐
62. TLP regional coordinator	☐
63. TLP instructor and/or assistant instructor within Washington State	☐
64. TLP /TLS instructor outside Washington State	☐
65. TLP technical assistant	☐
66. Screening TLP applications	☐
67. Other	

Please identify any of the following professional development activities in which you have taken part since receiving your TLP grant:			
	Attendance	**Presentation**	**Attendance & Presentation**
68. Northwest Council for Computer Education (NCCE)	☐	☐	☐
69. National Education Computing Conference (NECC)	☐	☐	☐
70. Washington State Association for Supervision and Curriculum Development Conference (WSASCD)	☐	☐	☐
71. Office of the Superintendent of Public Instruction Conference (OSPI)	☐	☐	☐
72. Washington Educational Research Association Conference (WERA)	☐	☐	☐
73. Association for Supervision and Curriculum Development Conference (ASCD)	☐	☐	☐
74. Understanding By Design Conference (UBD)	☐	☐	☐

75. Other

Please identify any of the following continuing education programs you have pursued since receiving your TLP grant:		
	In Progress	**Completed**
76. National Board Certification	☐	☐
77. Masters degree	☐	☐
78. Doctoral degree	☐	☐
79. Administrative certification	☐	☐
80. Other		
81. Please list any professional recognition or awards you have received since accepting your TLP grant:		
82. Please list any work you have had published since receiving your TLP grant.		

Submit Reset

Bottom of Form

Appendix B TLP Agenda

Sunday

4:00-6:00pm - Arrival/ Participant registration

6:00pm - Dinner and Welcome

7:00pm - Out of the Box & Scavenger Hunt

8:30pm - Journal writing & Homework
What do you believe about teaching and learning with technology?

-Introduce the final assignment that will be given to them Wed. night

9:00pm - End of evening

Monday

7:30am - Breakfast

8:15am - Sharing and response-homework assignment
- Group response main themes

8:30am - Philosophical Introduction to Teacher Leadership Project

8:50am -Copyright Information

9:00am - Exploratory Curriculum Project

12:00pm - Lunch/ Introductions

1:00pm - Exploratory Curriculum Project – continued

2:15pm - Benchmark activity - relating project to essential learnings

2:30pm - Journaling- reflection on the discovery learning process/ then table discussion for further processing

3:00pm - Free Time

5:00pm - Sharing of projects

6:00pm - Dinner

7:00pm - Help Desks

8:45pm - Homework: Reading and Response
- Read and respond to articles

9:00pm - Exit Slip

Tuesday

7:30am - Breakfast

8:15am - Sharing and response - homework

8:30am - What the research tells us about teaching and learning with technology -

9:30am - Scaffolding Project

12:00pm - Lunch

1:00pm - Scaffolding Project - continued
2:30pm - Benchmark activity - relating project to essential learnings

2:45pm - Journaling- reflection on the understanding of scaffolding.

3:00pm - Free Time

5:00pm - Discussion - Using Technology in the Classroom

6:00pm - Dinner

7:15pm - Help Desks

8:45pm - Exit Slip

Wednesday

7:30am - Breakfast

8:15am - Troubleshooting Tips

8:30am - Curriculum and Technology Project: Math and Science using Excel

12:00pm - Lunch

1:00pm - Curriculum and Technology Project -continued

2:00pm - Sharing of project

2:30pm - Benchmark activity - relating project to essential learnings

2:45pm -Journaling

3:00pm - Free Time

5:00pm - Classroom Management/Set-up Discussion

6:00pm - Dinner

7: 15pm - Advanced PowerPoint
- Discuss Final Assignment that is due in the morning.

9:00pm - Exit Slip

Thursday

7:30am - Breakfast

8:15am - Sharing - homework assignment

10:00am - SchoolKit

12:00pm - Lunch

1:00pm - Surveys
SPU/Clock Hour evaluation

1:30pm -Evaluation Presentation
By Carol Stuen

2:00pm - Understanding by Design introduction- Hand-out books

2:30pm - Evaluation of Session

2:45pm - Closing

[Grant Benefits](#)
[Participant Obligations](#)
[District Obligations](#)
[Evaluation](#)
[Forms](#)
[FAQ](#)
[Help Desk](#)
[TLP Home](#)

Teacher Leadership Project

2002-03

NW ESD 189 in Partnership with
The Bill and Melinda Gates Foundation

School District Obligations

- Provide the following in the classroom:

  Grades K to 2:

  - Minimum of 3 computers
  - LCD Projector
  - Document camera
  - Printer

  Grades 3 to 12:

  - A ratio of one multimedia computer for every four students.
  - A presentation device and a printer

- Provide substitute teachers for three release days.
- Have a technology plan. (State-approved for public school districts)
- Commit to keeping the equipment in the teacher's classroom for at least three years.
- Provide technical support for the hardware in the classroom.
- Provide summer session and regional meeting reimbursement for mileage for the participant.

Date Last Modified: June 5, 2002
Questions and Comments to

-TLP Team -

Grant Benefits
Participant Obligations
District Obligations
Evaluation
Forms
FAQ
Help Desk
TLP Home

Teacher Leadership Project

2002-03

NW ESD 189 in Partnership with
The Bill and Melinda Gates Foundation

What does the Project provide?

- $9,000 to purchase equipment to assist in meeting the classroom technology requirements
- A laptop for each participating teacher's use
- Microsoft software package which includes:
  - Windows computer:
    - Office XP Professional
    - Microsoft Encarta Reference Library 2002
  - Apple computer:
    - Microsoft Office
    - Encarta '98 Deluxe
- Access to the SchoolKit web site for all teachers in the participant's school
- Lodging expenses for all training sessions
- 11 days of professional development

Date Last Modified: May 28 , 2002
Questions and Comments to
-TLP Team -

Fouts & Associates, L.L.C.
16000 Bothell Everett Highway
Suite 170
Mill Creek, Washington 98012