McREL TECHNOLOGY INITIATIVE: THE DEVELOPMENT OF A TECHNOLOGY INTERVENTION PROGRAM

FINAL REPORT

Regional Educational Laboratory
Contract #ED-01-CO-0006
Deliverable #2005-09

Prepared by
Howard Pitler, Ed.D.
Director of Educational Technology

September 1=2005

This document has been funded at least in part with federal funds from the U.S. Department of Education under contract number ED-01-CO-0006. The content of this publication does not necessarily reflect the views or policies of the Department of Education nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government

TABLE OF CONTENTS

OVERVIEW OF THE McREL TECHNOLOGY INITIATIVE

The McREL Technology Initiative (MTI) was launched by Mid-continent Research for Education and Learning (McREL) in response to a concern in the Central Region[1] and across the nation: that schools lack the appropriate technological guidance, resources, and professional development programs to support them in becoming high-performing learning systems. To address this issue, McREL decided to create and test a comprehensive, research-based model of professional development that helps teachers integrate technology into their classroom instruction, and ultimately, helps students achieve challenging content standards. The research behind MTI has now developed into a model of professional development known as the McREL Technology Solutions (MTS) program. To develop this program, McREL conducted a comprehensive review of the relevant literature on education technology, professional development, and the use of technology to support learning, and then designed a research-based intervention. The intervention was pilot-tested and subsequently modified in view of the findings. McREL then conducted a field test of the modified intervention using a matched comparison design. The field test has generated data regarding the effectiveness of the research-based MTS model.

DEFINING A DIRECTION: A LITERATURE REVIEW

To aid in the design of the intervention, McREL conducted a comprehensive review of the literature (see Appendix A) on education technology and professional development. The purposes of conducting this review were: (1) to build a sound theoretical basis for the need and importance of McREL's technology program; (2) to guide the design of the intervention; (3) to identify critical factors that would likely impact the success of the intervention; and (4) to inform the design of the field test of the intervention, including identification of potential outcomes and measures as well as typical effect sizes and the length of time necessary to realize such benefits. The results of the literature review are summarized below.

> *Technology professional development should be part of a broader initiative in schools (Pisapia et al., 2000; Mann, Shakeshaft, Becker, & Kottkamp, 1999). Skills training, although important, is only one piece of the technology puzzle. Technology integration also should focus on the curriculum a school has adopted and should provide support for teachers and students in meeting curricular goals (Mize & Gibbons, 2000; Ringstaff & Kelly, 2002; Byrom, 1998; Honey, Culp & Carrigg, 1999). For example, while it is important for teachers to know how to use a spreadsheet, it is more important for them to learn how to use the analysis tools in the spreadsheet program to help students use the data to generate and test hypotheses.*
>
> *Simply putting computers in schools does not mean effective technology integration has occurred. Teachers must see the connection between new hardware and software and their educational applications in the classroom. Furthermore, professional development efforts will be undermined if the computers or infrastructure are not adequately supported. When there are problems with hardware or software, they should be corrected*

[1] For the purposes of this report, the Central Region includes the states of Colorado, Kansas, Nebraska, North Dakota, Missouri, South Dakota, and Wyoming.

quickly and, if possible, without interruption to the teaching and learning process (Ringstaff & Kelley, 2002; Fabry & Higgs, 1997).

Technology professional development does not occur in a vacuum. Cuban (1999) reported that working conditions and the day-to-day demands that teachers face, including high-stakes testing, increased demands for accountability, and the need to maintain order in the classroom, make it difficult for teachers to focus on implementing new technologies. Cuban also asserted that other barriers to technology integration include the introduction of new software and software upgrades, the limited capability of older computers in schools to support newer software, the unreliability of technology, and the lack of technical support to keep computers and networks running. Other factors influencing teachers' success in using technology in the classroom included their attitudes and modes of learning, their resistance or openness to change, and their levels of knowledge and experience with technology. To integrate technology effectively into classroom learning, teachers must not only learn the technology, but also move from teacher-centered to student-centered instruction, which can be a difficult transition for some teachers.

Granger et al. (2002) found that "supportive relationships among teachers, a commitment to pedagogically sound implementation of new technologies, and principals who encourage teachers to engage in their own learning" (p. 2) were factors that led to innovative teaching in the classroom. It is important, therefore, to design technology professional development in ways that provide opportunities for teachers to work and reflect together (pp. 1–2).

Although teachers perhaps represent the "front line" for the use of technology to improve student learning, a substantive body of research strongly points to the fact that training that does not include a school leadership component will be ineffective. According to Coley, Cradler, and Engel (1997), "research on the adoption of innovations in schools consistently points to the key role of administrators in successful implementation" (p. 5). Byrom (1998) identifies the leadership and vision that these administrators bring to the table, as they relate to technology integration, as the single most important factor affecting the successful integration of technology. Likewise, teachers' attitudes are strongly impacted by school administrators' support. Administrators need training "in how to provide adequate planning time and observe, coach, and reward teachers in the integration of computers into their instructional strategies. [This support leads to] increases in positive teacher attitudes and beliefs" (Pisapia et al., 2000, pp 18-19).

Using this literature review as a basis, McREL staff designed an intervention and supporting materials, and then conducted a pilot test of the intervention. The following section briefly reviews this work, as well as the key pilot-test findings that informed the field test.

PRELIMINARY INTERVENTION DESIGN AND PILOT TEST

Preliminary Intervention Design & Materials Development

McREL designed its technology integration intervention to focus on the roles of classroom teachers and school leadership teams in the technology integration process. A logic model (see Appendix B) was developed to show the relationship between the initiative activities and the various goals of the technology intervention. The intervention consists of a number of components, including an assessment of site needs, planning sessions with school leaders, professional development workshops, and teacher mentoring by McREL staff members. Surveys, training modules, and protocols were developed for use during the pilot test of the intervention. These tools were used to collect, distill, and, later, to deliver information to the sites and to ensure that McREL consultants used the same processes at each site.

In order to assess the level of technology use and availability in potential pilot-test sites, three tools were developed: the Teacher Technology Survey (see Appendix C), the Administrator Technology Profile (Appendix D), and the Technology and Learning Audit. Each tool went through a development and validation process during the pilot test.

The Teacher Technology Survey was based on constructs from *Technology in American Schools: Seven Dimensions for Gauging Progress* (Lemke & Coughlin, 1998) and from the Apple Classrooms of Tomorrow Project (ACOT) to determine (1) the extent to which teachers are comfortable using technology; (2) the extent to which technology supports classroom practices; (3) the degree to which technology influences the classroom learning environment; (4) teachers' attitudes toward technology; (5) teachers' comfort level in students' use of technology; and (6) the extent to which students can perform technology-related tasks. The survey also asks teachers to categorize themselves according to their level and type of technology use.

The Administrator Technology Profile was developed to determine administrators' level of technology use and their willingness to support technology integration in the classrooms. This profile asked administrators to respond to 5-point Likert scale and open-ended questions.

McREL's comprehensive Technology and Learning Audit was developed to assess the status of each school's technology infrastructure. The audit incorporated surveys, document reviews, and on-site observations to present a comprehensive description of a school's infrastructure, technology support, hardware and software, professional development programs, and readiness to integrate technology into instruction.

To guide teachers and school leaders in using technology appropriately, McREL developed 14 training modules as half-day training sessions. The modules (see Appendix E) were tested and finalized during the pilot test of the intervention. These training modules were designed to provide participants with technology skills training, lesson and unit design, and technology integration skills and resources. Each module is supported by a facilitator's and participant's guide that provides information on planning the training, along with all required participant handouts, a script for the training, and a participant evaluation form.

Implementation protocols were developed to guide the consistent delivery of the intervention across sites. Specific protocols include details on how to conduct a kick-off meeting, the steps and process for conducting a debriefing meeting for teacher mentees following the presentation of teacher-created projects, and guidelines for conducting a school/district showcase of teacher-created projects for other teachers, administrators, school board members, and community members.

The responsibilities for McREL trainers and site staff for each meeting, debriefing session, and showcase event were detailed in these protocols. Protocols included objectives for each activity, a list of needed materials, evaluation tools, and timelines.

Pilot Testing the Intervention

A pilot test of the intervention was conducted between the fall of 1999 and the spring of 2002 in ten schools representing six school districts from five states (see Appendix F). The pilot test examined the relative success of different types of professional development in technology integration, including whole staff training, cadre training, and one-on-one mentoring. A detailed report of the pilot test of the intervention was completed and submitted to IES (Pitler & Barley, 2004).

In July 2002, McREL trainers met to review and discuss the implications of the pilot-test experiences across participating sites. This review of the pilot test resulted in a number of key insights and suggestions for modifications to the intervention:

- **Planning and goal setting.** It is critical for school leaders to develop clear and tangible goals and to develop a detailed activity plan to reach those goals. These plans must be routinely reviewed with appropriate site personnel to ensure that all parties are working collaboratively to address site technology goals.
- **Written agreement.** A written agreement (see Appendix G) between McREL and the site is essential to the successful implementation of the intervention. This agreement should serve as the primary reference point for determining how all activities and projects will be conducted at each site, and specify how problems that arise will be resolved. The agreement should include a timeline, descriptions of roles and responsibilities, and primary and backup contact information for McREL staff members and for school leadership teams.
- **Teacher projects.** Teacher-created technology-infused units are a key requirement of the intervention. These projects create opportunities for teachers to translate the general technology knowledge they gain from training sessions and from intensive mentoring by McREL staff into standards-based learning activities. The more connected projects are to teachers’ technology competency levels and class needs, the more motivated teachers are to continue to seek ways to integrate technology into their instruction, and the more meaningful the projects are to them. A project-based approach is helpful even to beginners.
- **Showcase results.** Showcasing projects in an open forum helps develop interest among teachers not initially involved in the intervention; promotes peer learning

when the showcases are interactive; facilitates personal contact among mentors, other teachers in the school or district, and administrators; and gives teachers opportunities to learn about other approaches that might address their specific instructional needs. Showcases also can be valuable reflection experiences for project presenters.

- **Involve the public.** Showcases also offer a public forum for displaying teacher integration projects, increasing accountability and demonstrating personal investment from those teachers. Showcases that are open to the community can serve a positive public relations role for school board members, parents, community members, and other stakeholders.
- **Site readiness.** The success of the intervention rests in part on each site's understanding and self-analysis of existing programs, staffing, available tools, and technology integration goals.
- **Feedback to administrators.** School principals and district leaders need to be active supporters of the program and should continually be apprised of new classroom practices and the new skills teachers have acquired.
- **Teacher development and support.** The selection and recruitment of teachers as mentors, as well as ongoing support for teachers involved in the project, are critical factors in building a long-term, sustainable, internal mentoring program.
- **Sustainability.** Incentives for mentors, as well as mentees, encourage the behaviors necessary for sustaining the mentoring program. The entire school or district must see the program as a catalyst for moving from a traditional professional development model of one-time workshops with little follow-up to one that provides immediate classroom impact and gives teachers the skills and competencies needed to effectively mentor colleagues. Professional development that includes job-embedded release time demonstrates administrative support for the program.
- **Personal intervention/high touch.** McREL's high-visibility presence at sites implementing the intervention is a critical factor for motivating teachers to develop and refine their technology integration skills. As outside experts, McREL staff members mentor teachers and reinforce the commitments that teachers and administrators have made in the written agreements.
- **Technology and Learning audit.** The comprehensive technology and learning audit process used in the beginning of the pilot test proved to be a very time intensive and expensive process in an effort to streamline the process. McREL developed the Technology Integration Readiness Survey (see Appendix H). Much of the information about a site's relative strengths, weaknesses, and issues influencing technology integration gathered through the audit is also collected during the administration of the Technology Integration Readiness Survey. Although the comprehensive audit process can be valuable for some sites, it should be considered optional.

- **State involvement.** State officials' interest and involvement supports and reinforces the commitment made by the district and school sites implementing the intervention. It also provides opportunities to leverage state resources to support local site programs.

INTERVENTION REDESIGN

Drawing on the research and lessons learned during the two-year pilot test and literature review, MTS was redesigned to include key elements and activities critical to integrating technology into the classroom at the school or district level. These key elements and activities included:

- Assessment of a school's infrastructure
- Ongoing peer mentoring
- Peer observations
- Reflective practice
- Curriculum and technology workshops and training sessions
- Leadership support

The first year of MTS is designed to assess the current technology status of the site, develop an implementation plan, and identify and train an initial group of 15 percent of the total teachers at a site as technology mentors. McREL uses the Technology Integration Readiness Survey to assess each site's technology infrastructure and teachers' comfort levels and experience working with technology. A group of potential mentors is selected at each site based on Technology Integration Readiness Survey data and feedback from the site's administrative team. McREL staff mentors selected teachers to provide them with the skills and competencies to use technology in their classrooms to support their curricula. Each teacher mentee, with McREL guidance, designs and implements technology-infused lessons and units. McREL staff then facilitates individual debriefing meetings with each mentee to reflect on the process of unit development and implementation.

Teacher mentees use the MTS Lesson Planning Guide (see Appendix I) as they develop their technology-infused lessons and units. The Planning Guide focuses the teachers on district content standards and International Society for Technology in Education (ISTE) technology standards. McREL staff created a matrix of standards addressed by each teacher within each school to aid in the long-term planning process. Table 1 provides an example of a matrix of ISTE NET-S Standards addressed in one MTS field test site. The column on the left refers to the six categories of standards as outlined by ISTE for technology skills for students:

1. Basic operations and concepts
    a. Students demonstrate a sound understanding of the nature and operation of technology systems.
    b. Students are proficient in the use of technology.

2. Social, ethical, and human issues
    a. Students understand the ethical, cultural, and societal issues related to technology.

   b. Students practice responsible use of technology systems, information, and software.
   c. Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.

3. Technology productivity tools
   a. Students use technology tools to enhance learning, increase productivity, and promote creativity.
   b. Students use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.

4. Technology communications tools
   a. Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.
   b. Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.

5. Technology research tools
   a. Students use technology to locate, evaluate, and collect information from a variety of sources.
   b. Students use technology tools to process data and report results.
   c. Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.

6. Technology problem-solving and decision-making tools
   a. Students use technology resources for solving problems and making informed decisions.
   b. Students employ technology in the development of strategies for solving problems in the real world.

Within the matrix, the grade level of standards addressed (Elementary, Middle, or High) was denoted by with an E, M, or H. Individual teachers are shown across the second row. McREL staff used this information to help with tracking the standards addressed.

Each mentee observes a partner mentee twice each semester using the MTS Reflective Dialog Protocol (see Appendix J). After each partner mentee has observed the other, the two mentees use the Reflective Dialog Protocol Guiding Questions (see Appendix K) as a framework to debrief each other on their visits. The teacher pairs sit together and each presents their reflections on the other's lesson. The protocol guides them in their questioning. After each teacher has the opportunity to share, the two teachers discuss the overall observation process and how they might use what they learned in the future.

Table 1. Sample of ISTE NET-S standards addressed at one site

Category	MONETT MIDDLE SCHOOL							
	Teacher							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1			M	M			M	M
2			M	M				
3	M	M	M		M	M	M	
4	M					M	M	
5		M	M	M	M	M		M
6			M	M	M			

Similar data were collected for each content standard. The goal was to help teachers focus on content and standards, rather then on technology for technology's sake.

At the end of each semester, mentees share their technology infused work with colleagues. This meeting takes the form of a group debrief in which all mentees share their projects with each other and comment on each other's work. The sharing at the end of the second semester takes the form of a public showcase. All teachers in the district, along with all district administrators, attend this event. School members, students, the media, and the general public are invited. This meeting is both a time to share the successes of the mentees and create added excitement within the district for the coming year.

Up to three workshops with the entire school staff are delivered by McREL staff. McREL made recommendations on the titles of the workshops based on the needs identified through the Readiness Survey and conversations with each site's administrative team.

Administrators from all MTS sites meet quarterly via video conference to discuss ways to support change within their buildings. The content for these quarterly meetings includes key concepts from *Balanced Leadership: What 30 years of research tells us about the effect of leadership on student achievement* (Waters, Marzano, & McNulty, 2003) and a book study of *Good to Great (Collins, 2001).*

The second year of the program is intended to increase the capacity of the school by training the first year teacher mentees to mentor other teachers in the technology integration process. Throughout the program, there is an emphasis on helping administrators understand the importance of their support for the technology integration process, particularly when the process means that teachers and others may need to significantly change their practices.

The two year MTS program is conducted in three phases – planning, implementation, and transfer. The following section outlines each of the three phases.

Planning Phase

The planning phase of MTS includes four major activities as shown in Figure 1. The planning phase generally begins in March and concludes in July as the site moves into the implementation phase.

Determine Site Readiness

After a school has been identified as a potential site for MTS, McREL administers the Technology Integration Readiness Survey. The Technology Integration Readiness Survey provides information on a site's current level of infrastructure, software, and technology related professional development. This survey will show a site either ready or not ready to undertake the MTS intervention. If a site scores in the "not ready" category, McREL staff will provide the school leadership with an action plan to move them to the "ready" category.

Administer Teacher Technology Survey

The Teacher Technology Survey is administered once a site is determined to be ready for the MTS intervention. McREL staff uses the data from the Teacher Technology Survey to work with the site's administrative team to develop the implementation phase plan. The Teacher Technology Survey is also used to identify a pool of teachers to be considered for the mentee program in the first year of MTS.

Develop Implementation Plan

McREL uses the data collected from the Teacher Technology Survey to work with the site's administrative team to develop the implementation plan. This plan identifies the workshops that will be delivered during the coming school year, dates McREL staff will meet with mentees for planning and debriefing meetings, release times for teacher mentees to plan, the date of the end of the year technology showcase, and dates for all administrative team planning meetings.

Select Initial Mentees

McREL staff meets with the site's administrative team to gather their input on the prospective mentees identified through the Teacher Technology Survey. Potential mentees are interviewed by McREL staff to gather qualitative data concerning the teacher's interest and enthusiasm toward becoming an MTS mentee. A total of approximately 15 percent of the total teaching staff will become mentees in year one of the MTS.

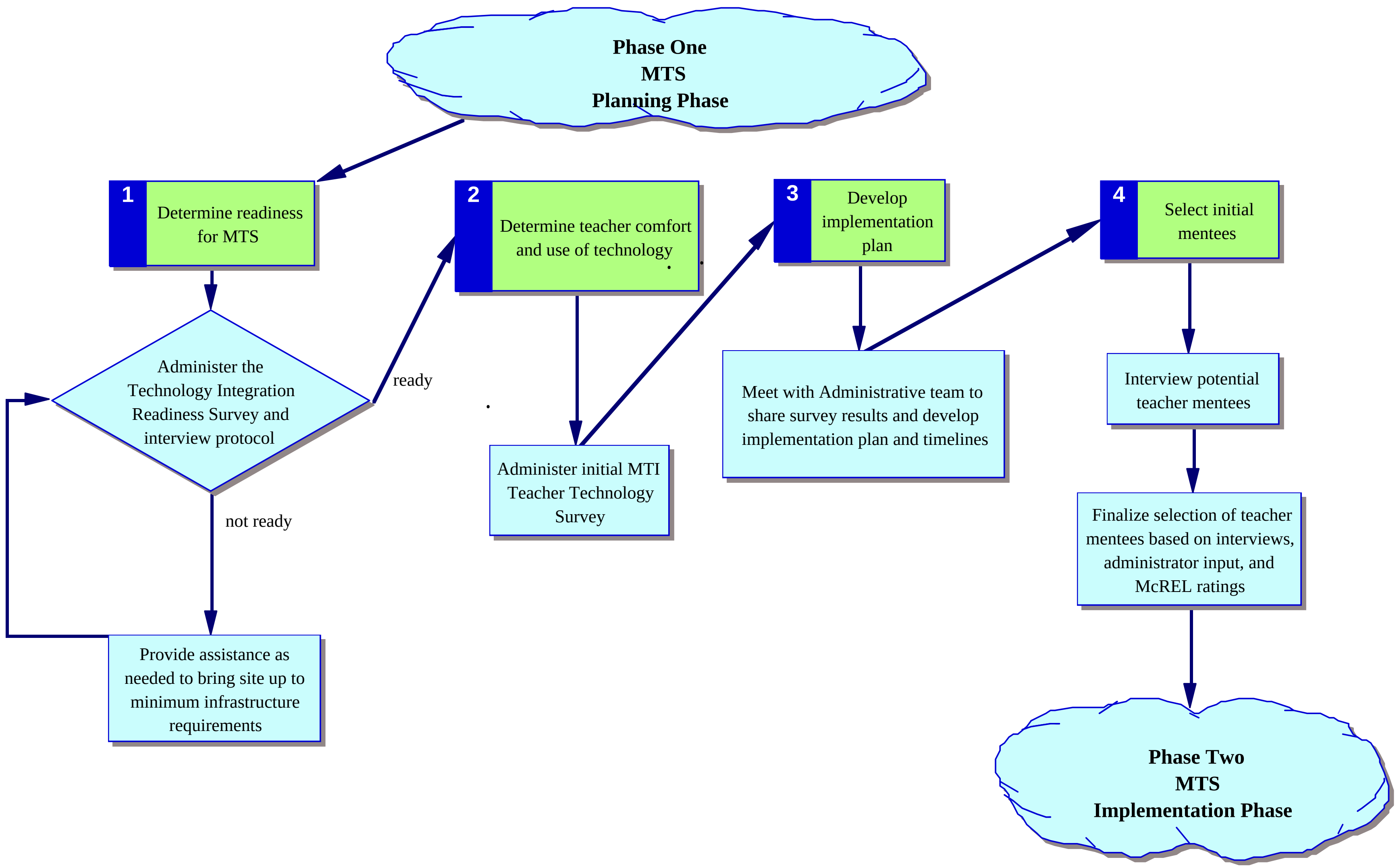


Figure 1. McREL Technology Solutions: Planning Phase

Implementation Phase

The implementation phase of MTS is guided by the plan developed in the planning phase and is comprised of four main activities as shown in Figure 2. The four activities – one-on-one mentoring, whole-staff workshops, online administrative meetings, and a second administration of the Teacher Technology Survey – take place over the course of the first year of MTS.

One-on-one Mentoring

One-on-one mentoring, was identified during the pilot test as a critical component of the implementation phase. Activities for the first year of MTS are designed, in part, to build a team of teachers who are mentored in the first year, and then go on to mentor other teachers in the second year. Each mentor teacher is required to develop, teach, and debrief at least one technology integration project each semester. Projects are driven by the district curriculum standards and benchmarks, and also correspond to NETS*S Standards for Students. To support project development, teachers will receive a minimum of three hours of mentoring from McREL staff each semester. During each semester, mentees will observe a partner mentee at least twice and debrief with that partner. At the end of the first semester, teachers will meet as a group to debrief their projects, and at the end of the year, they will showcase the year's projects to the entire staff and school community. This meeting is both a time to share the successes of the mentees and create added excitement within the district for the coming year.

Whole Staff Workshops

Whole staff workshops are delivered by McREL staff twice during the school year. The workshops presented are determined by the administrative team during the planning phase and are based on Teacher Technology Survey data and administrative team input. The purpose of the whole staff workshops is to address needs common to the majority of the teaching staff. All MTS workshops present research-based material and are primarily hands-on. McREL staff meets with the administrative team after each workshop to share the evaluations with the team.

Online Administrative Meetings

Online collaboration with administrators occurs quarterly during the two years of the MTS. All administrators in the program come together via videoconference to discuss the administrator's role in supporting technology integration. McREL staff shares key points from McREL's meta-analysis on school leadership (Waters, Marzano, & McNulty, 2003).

Re-administer Teacher Technology Survey

Teacher surveys are administered at the beginning of the MTS and again at the end of the first year. These data are analyzed and eventually used to gauge progress and make necessary adjustments to the implementation plan after year one.

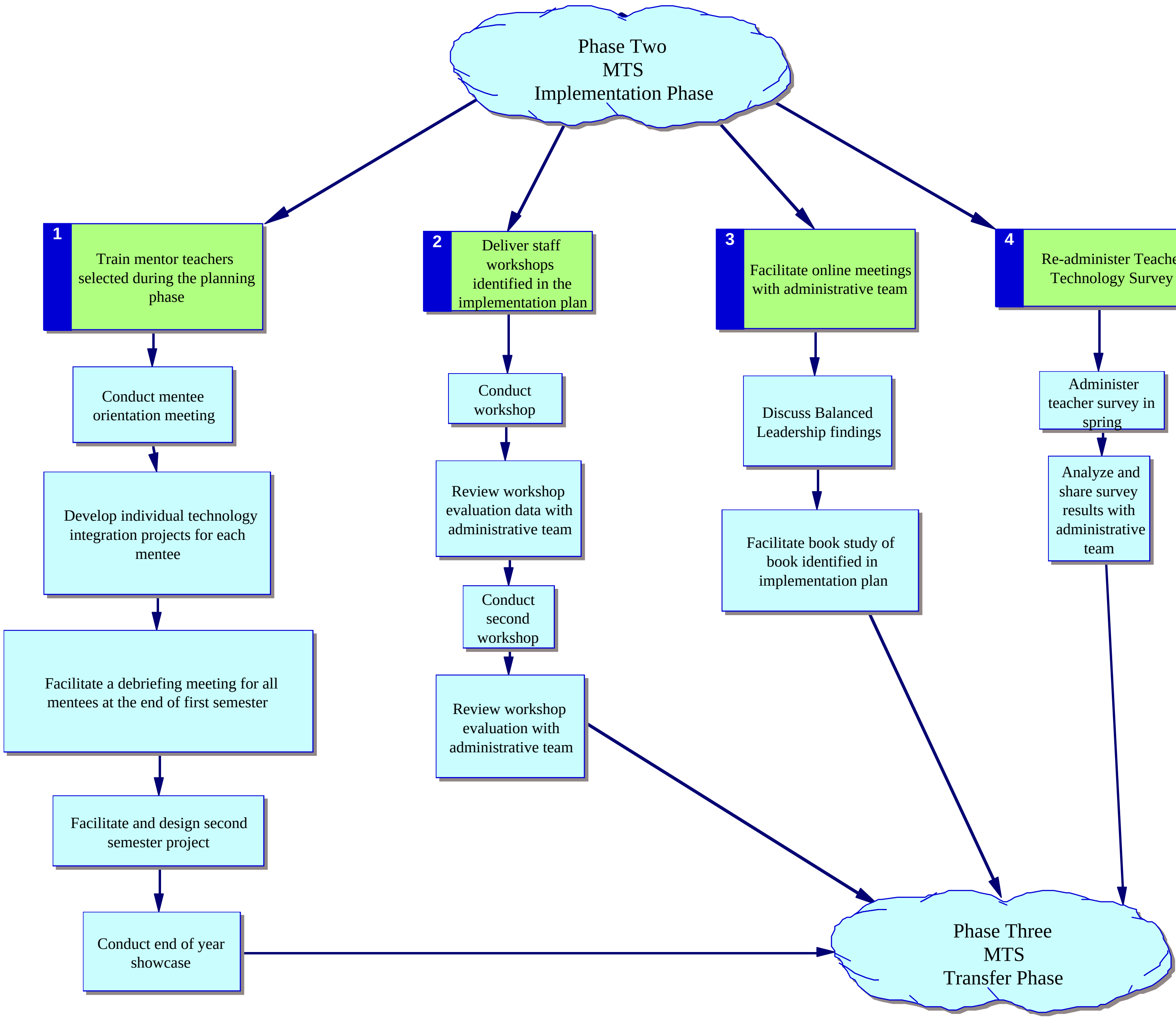


Figure 2. McREL Technology Solutions: Implementation Phase

Transfer Phase

The transfer phase of MTS is comprised of six main activities as shown in Figure 3. The six activities – development of a year-two implementation plan, selecting year-two mentees, one-on-one mentoring, whole-staff workshops, online administrative meetings, and a third administration of the Teacher Technology Survey – take place over the course of the second year of MTS and are designed to give the site the capacity to continue the MTS intervention in the future without McREL assistance.

Development Of A Year-Two Implementation Plan

McREL uses the data collected from the Teacher Technology Survey administered at the end of year one to work with the site's administrative team to develop the year two plan. The administrative team compares the baseline data with year one data and looks for areas of gain and areas needing additional attention. The plan identifies the workshops that will be delivered during year two, dates McREL staff will meet with mentees for planning and debriefing meetings, release times for teacher mentees to plan, the date of the end of the year technology showcase, and dates for all administrative team planning meetings.

Select Year Two Mentees

McREL staff meets with the site's administrative team and year one mentees to gather their input on the prospective mentees for year two. Potential mentees are interviewed by McREL staff and year one mentees to gather qualitative data concerning the teacher's interest and enthusiasm toward becoming an MTS mentee. A total of approximately 15 percent of the total teaching staff will become mentees in year one of the MTS.

One-on-one Mentoring

First year mentees take on the role of mentors in year two. With guidance from McREL staff, these mentors work with the new group of mentees guiding their mentee through all of the MTS steps they experienced in year one, leading to two technology integration projects, a semester debrief, and an end of the year showcase event.

Whole Staff Workshops

Whole staff workshops are delivered by either McREL staff or selected mentors twice during the school year. Each workshop has both participant's manuals and a facilitator's manual so that a mentor can feel comfortable in delivering the workshop. The workshops presented are determined by the administrative team during activity one and are based on Teacher Technology Survey data and administrative team input. The purpose of the whole staff workshops is to address needs common to the majority of the teaching staff. All MTS workshops present research-based material and are primarily hands-on.

Online Administrative Meetings

Online collaboration between MTS administrators also continues in year two. Administrators go deeper into the leadership research and collaborate with each other to build strategies to support technology integration in their respective sites.

Administer Final Teacher Technology Survey

Teacher surveys are administered for the final time at the end of the second year. These data are analyzed and eventually used to gauge progress and make necessary adjustments to the action plan as the school plans to take total control of MTS in year three.

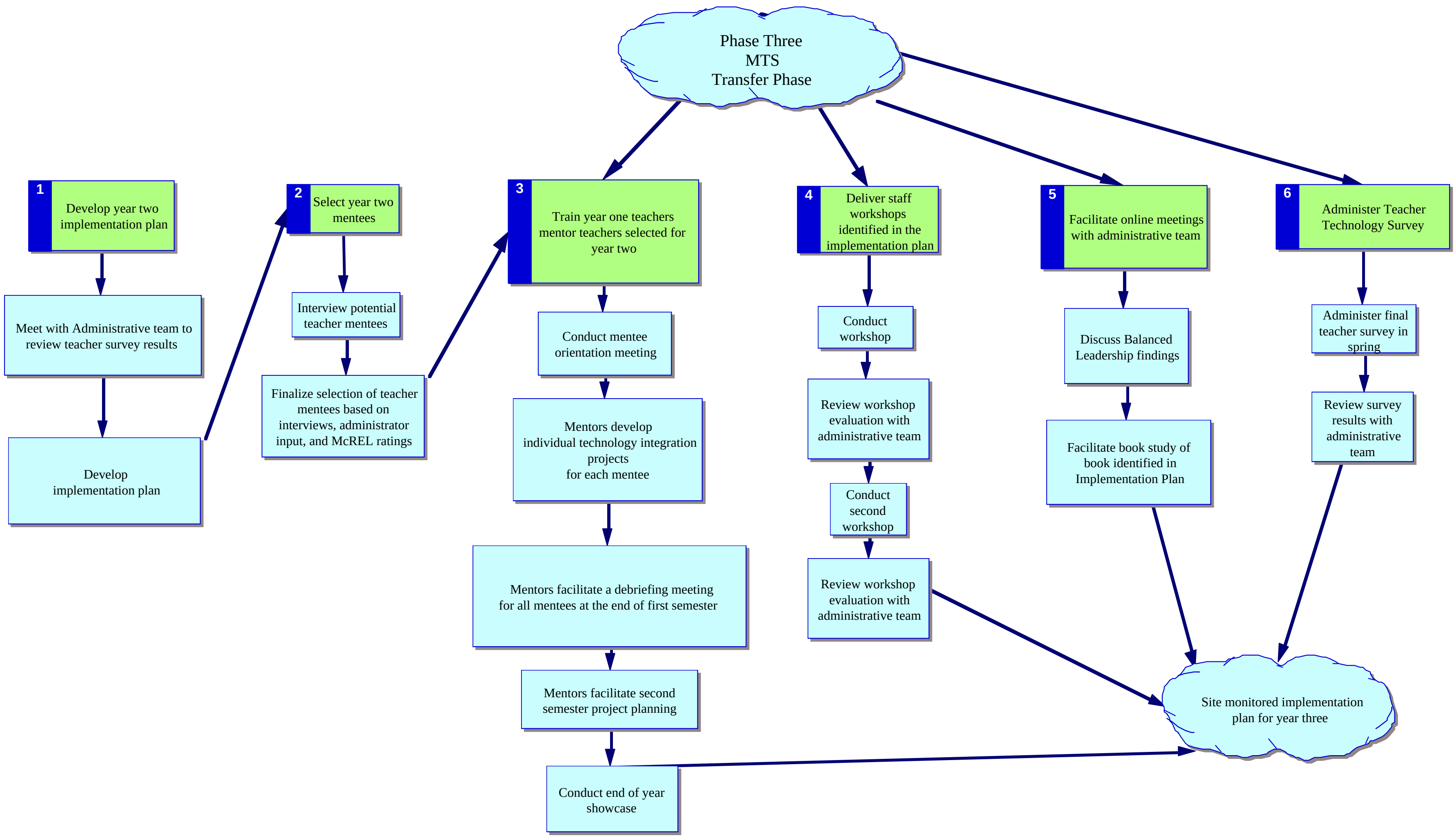


Figure 3. McREL Technology Solutions: Transfer Phase

FIELD TEST OF THE INTERVENTION

Site Selection

McREL staff began MTS field test site selection by contacting six of the Central Region's state departments of education and providing them with a description of the field test and a list of minimum site requirements. The target population for the intervention is the small or medium rural school or district with a lower capability in technology integration, due at least in part to a lack of professional development in technology integration. Although recruitment was expedited by conversations at the state level, the program is a school or district level intervention. Each state nominated a set of sites, resulting in a list of approximately 100 candidate sites. Each site was contacted and given a description of the field test and an intervention timeline. Thirty-two sites signed a letter of intent to participate in the field test. These 32 sites were interviewed using the MTS Technology Integration Readiness Survey and the information gathered was evaluated on several factors including demographics, results of the MTS Readiness Survey, perceived teacher technology comfort level, types of incentives sites were willing to provide, and perceived willingness to commit to the intervention. McREL staff narrowed the candidate list to nine potential sites, based on this evaluation.

Comparison sites were identified from the original candidate list to match the intervention sites. The sites were matched on several school/district characteristics included in the National Center for Education Statistics (NCES) Common Core of Data. Matching characteristics included (1) locale (rural, suburban); (2) grade level; (3) size of school/district; (4) percentage of students eligible for free or reduced-price lunch; (5) percentage of minority students; and (6) student achievement scores. McREL generated a list of potential sites, and subsequently collected more detailed information from the potential comparison sites through interviews about technology hardware, software, infrastructure, and involvement in technology-related projects/programs. Fourteen sites expressed an interest in serving as comparison sites and were found to be good matches based on responses to interview questions; 11 of these sites were selected as field-test sites, including seven elementary schools, two middle schools, and two high schools.

Field Test Questions

As a program that focuses foremost on teachers, the primary field test questions are as follows:

1. What impact has the initiative had on teachers' knowledge, attitudes, and beliefs regarding the role and use of technology in their instruction?
2. How did the project affect participants' use of technology?
3. What impact has the initiative had on teachers' capacity to integrate technology into their instruction?
4. How have classrooms been affected by MTS? What was the impact of the project on teaching and learning?
5. What impact has MTS had on students?

Because contextual factors in the school and district also affect how teachers implement technology, two additional questions were developed and a survey created for school administrators to gather additional data. These questions are:

1. Are administrators knowledgeable, skilled, and supportive of educational technology?
2. Do administrators report a greater impact of technology in their schools since the beginning of the MTS program?

The names and locations of the intervention and comparison schools included in this report, matched by school level, are shown in Table 2. There are five intervention elementary schools and six comparison elementary schools (a seventh elementary school did not participate in the final survey); four intervention middle schools and three comparison middle schools (although one of these is middle-high); and two intervention high schools and two comparison high schools. In the field–test group there are two districts represented and in the comparison group there are three districts. The average school size for the treatment sites is 283 students with 21 teachers; the average school size for the comparison sites is 304 students with 20 teachers.

Table 2. Field-Test Schools and Comparison Schools Matched by School Level

Field-test Schools	Comparison Schools
Elementary Schools	
1) South Elementary, Lander, WY 2) Park Elementary, USD 405, Lyons, KS 3) Central Elementary, USD 405, Lyons, KS 4) Flandreau Elementary, Flandreau School Dist, Flandreau, SD 5) Beresford Elementary, Beresford, SD	1) Osmond Elementary, Afton, WY 2) Overland Elementary, Rock Springs, WY 3) Dakota Valley Elementary, Dakota Valley School Dist., North Sioux City, SD 4) Elk Point-Jefferson Elementary, Jefferson School Dist., Elk Point, SD 5) Parkston Elementary, Parkston School Dist., Parkston, SD Buchanan Elementary, Pierre, SD
Middle Schools	
1) Wheatridge Middle School, Gardner, KS 2) Monett Middle School, Monett, MO 3) Lyons Middle School, USD 405, Lyons, KS 4) Flandreau Middle School, Flandreau School Dist., Flandreau, SD	1) Dakota Valley Middle School, Dakota Valley School Dist., North Sioux City, SD 2) Elk Point Jefferson Middle School, Jefferson School Dist., Elk Point, SD 3) Parkston Secondary, Parkston School Dist., Parkston SD
High Schools	
1) Flandreau High School, Flandreau School Dist., Flandreau, SD 2) Lyons High School, USD 405, Lyons, KS	1) Dakota Valley High School, Dakota Valley School Dist., North Sioux City, SD 2) Elk Point Jefferson High School, Jefferson School Dist., Elk Point, SD

Data Collection

Data collection consisted of a teacher survey and an administrator profile for both comparison and intervention sites and interviews and site visits for intervention only. Earlier progress reports included formative findings from these visits. These are not included in this report. Teachers and administrators used either a four- or a five-point rating scale to answer survey items with responses indicating agreement, frequency, or levels of ability. Survey items were based on the literature review and a review of extant instruments. In addition to surveys, data were collected through interviews and a site visit. Site visits were made to program sites in Spring of 2004 and a final post-program site visit is planned for Fall of 2005.

The Teacher Technology Survey included 123 items that addressed questions about teacher perceptions of their comfort with technology, attitudes and beliefs about technology, and technology use in their classrooms. Teacher attitude items also included perceptions about school and district support for technology. Teachers were asked about student capabilities with technology and influences of technology on their teaching and student learning. The Teacher Technology Survey was first administered online to teachers in intervention schools in Spring 2003 and to comparison-school teachers in Fall 2003. It was administered annually to intervention-school teachers thereafter and as a post measure to comparison-school teachers in Spring 2005 (See Table 3).

Table 3. Data Collection Schedule

Timeline	Group	Teacher Survey	Administrator Survey
Spring 2003	Intervention	X	
	Comparison		
Fall 2003	Intervention		
	Comparison	X	
Spring 2004	Intervention	X	X
	Comparison		X
Spring 2005	Intervention	X	X
	Comparison	X	X

The Administrator Technology Profile includes items on (1) administrators' skill level in using software, (2) administrators' attitudes toward using technology, (3) extent to which schools use software, (4) planning for technology, (5) use of professional development activities by school staff, and (6) perceived impact of technology on schools. The Administrator Technology Profile, an online survey to assess the relationship between administrator roles and successful technology integration was used to collect data from intervention and comparison school administrators in Spring 2004 and Spring 2005.

In the report *McREL Technology Initiative: The Development of a Technology Intervention Program* (Pitler& Barley, 2004), submitted to IES in September of 2004, these teacher mentees were compared to all other teachers in the intervention schools in order to measure progress at the end of one year. In the second year of the program, the original teacher mentees became mentors of other teachers. Not all

teachers were mentored. Thus, there is a group of MTS participant teachers within the total population of the intervention schools. For this final report, comparisons are made between these teachers (who were mentored either first or second year), all teachers in intervention schools (in order to assess school level impact), and all teachers in comparison sites.

Table 4 shows the number of teacher respondents by year and by school for the intervention schools. Some teachers work across school levels within a district; therefore, the sum of the number of responses for schools in a district may exceed the overall number of responses for the whole district. Accuracy of the response rates is influenced by the necessity of using an estimate of the number of teachers who received the survey (second column from the left). That number is based on the staff listed at that school in 2004. The overall response rate for 2003 was 91 percent, for 2004 it was 75 percent, and for 2005 it was 74 percent. Individual school/district response rates for 2005 varied from 57 percent to 100 percent. Of the known 65 program participants in 2005, 50 (77%) responded to the 2005 survey.

Table 4. Number* of Participants (n) and Response Rate: Intervention Schools

Intervention Schools	Est. Teacher count	2003 n(Response Rate)	2004 n(Response Rate)	2005 n(Response Rate)	Number responding all 3 years	Number of Mentors 2004	Number of Mentors 2005
South Elementary	24	24 (100)	22 (92)	20 (83)	13	4	7
Beresford Elementary	28	25 (89)	20 (71)	17 (61)	10	5	9
Monett Middle	30	27 (90)	17 (57)	19 (63)	10	4	8
Wheatridge Middle	38	38 (100)	33 (87)	25 (66)	19	6	11
Flandreau Elementary	29	23	21	29	16	2	3
Flandreau Middle	17	19	27	20	9	1	4
Flandreau High	16	20	24	20	10	2	3
Flandreau District*	62	62 (100)	58 (94)	60 (97)	31	5	10
Lyons Central Elementary	15	14	12	14	7	2	3
Lyons Park Elementary	19	9	17	19	7	2	5
Lyons Middle	20	16	5	14	3	3	6

Intervention Schools	Est. Teacher count	2003 n(Response Rate)	2004 n(Response Rate)	2005 n(Response Rate)	Number responding all 3 years	Number of Mentors 2004	Number of Mentors 2005
Lyons High	29	26	19	15	4	4	6
Lyons District*	83	65 (78)	49 (59)	55 (66)	22	11	20
Total	**265**	**241 (91)**	**199 (75)**	**196 (74)**	**105**	**37**	**65**

*Teachers work at more than one school within the district. Therefore, the sum of the number of responses by school may exceed the overall number of responses for the whole district. Shaded rows indicate district totals.

Table 5 indicates response rates for the comparison schools. Comparison-school teachers were surveyed twice, in the fall of 2003 and the spring of 2005. Again, the district total number of teachers may be less than the sum of the schools due to teachers working in more than one school in the district. The teacher count is again an estimate from public sources. The overall response rate for comparison teachers was 79 percent in 2003 and 77 percent in 2005. Individual school/district response rates varied from 57 percent to 100 percent.

Table 5. Number* of Participants (n) and Response Rate: Comparison Schools

Comparison Schools	Estimated Teacher Count	2003 n Respondents (Response rate)	2005 n Respondents (Response rate)	Number responding both times
Osmond Elementary	17	15 (88)	15 (88)	10
Overland Elementary	28	16 (57)	16 (57)	11
Buchanan Elementary	16	16 (100)	18 (100)	7
Dakota Valley Elementary	NA	22	28	14
Dakota Valley Jr High	NA	18	24	9
Dakota Valley High School	NA	14	20	8
Dakota Valley District*	74	49 (66)	59 (80)	26
Elk Point-Jefferson Elementary	NA	26	24	16
Elk Point-Jefferson Jr High	NA	19	14	11
Elk Point=Jefferson High	NA	19	15	11
Elk Point-Jefferson District*	52	49 (94)	41 (79)	30

Comparison Schools	Estimated Teacher Count	2003 n Respondents (Response rate)	2005 n Respondents (Response rate)	Number responding both times
Parkston Elementary	NA	25	20	16
Parkston Secondary	NA	22	22	15
Parkston District*	52	43 (83)	36 (69)	27
Total	**239**	**188 (79)**	**185 (77)**	**111**

*Teachers work at more than one school within the district. Therefore, the sum of the number of responses by school may exceed the overall number of responses for the whole district. Shaded rows indicate district totals.

Finally, teachers were asked to place themselves in one of five technology user categories. User type categories ranged from an “entry level” user (level =1), who is just starting to use technology, to a “transformation” user (level 5), who creates new ways to use technology tools for real-world applications. No significant difference was found between the intervention teacher mean (mean = 2.19) and the comparison teacher mean (mean = 2.22) on technology user type.

Responses of school administrators from intervention and comparison schools were also compared. Across the survey there were only five items (out of 72) for which significant differences were found between the intervention and comparison administrators. In three of the five, the comparison administrators reported a stronger attention to aspects of technology than the intervention administrators. There was no difference in how the administrators rated themselves as technology users; both groups were at the middle level.

Data Analysis

This section includes the analyses that were run on the data sets to determine initial comparability and also a summary of results from earlier years. Following that, the section addresses results for each of the research questions.

Analyses of Comparability of Intervention and Comparison Schools

Data from the intervention and comparison teachers were analyzed to determine if teachers from comparison and intervention schools were comparable related to technology use and comfort with technology when the program began. Findings from this analysis were reported in *McREL Technology Initiative: The Development of a Technology Intervention Program* (Pitler & Barley, 2004). The results indicated no significant differences between the two groups of teachers when compared by school levels. In other words, intervention and comparison teachers were no different with regard to their technology use and comfort level within the three school levels. Both intervention teachers and comparison teachers were in the mid-range (M=2.50 to 3.50, on a five-point scale) in comfort level, attitude level, and student use of technology when they began their involvement in the intervention. Although there were no differences when teachers were compared by school level, significant differences were found between

comparison teachers and intervention teachers in two areas (the extent to which technology supports classroom practices and the degree to which technology has changed the classroom learning environment) when all three school levels were combined. Comparison teachers had higher means in each of these areas. Finally, an item on the Teacher Technology Survey asked teachers to place themselves in one of five technology user categories. User type categories ranged from an "entry level" user (level =1), who is just starting to use technology, to a "transformation" user (level 5), who creates new ways to use technology tools for real-world applications. No significant difference was found between the intervention teacher mean (M=2.19) and the comparison teacher mean (M= 2.22) on technology user type.

Responses of school administrators from intervention and comparison schools were also compared. Across the survey there were only five items (out of 72) for which significant differences were found between the intervention and comparison administrators. In three of the five the comparison administrators reported a stronger attention to aspects of technology than the intervention administrators. There was no difference in how the administrators rated themselves as technology users both groups were at the middle level.

Analyses at End of First Year of Implementation

To determine whether there were differences after one year between mentees and other teachers, comparisons were made in several areas. Figure 5 indicates that significant differences were found in four areas. Teachers who had participated in the first year exceeded non-participants in teacher comfort level in using technology; technology support for classroom practices; technology influence on the classroom environment, and comfort level in student related technology. These data were analyzed using the data from the previous spring as covariates in order to adjust for initial differences between first year

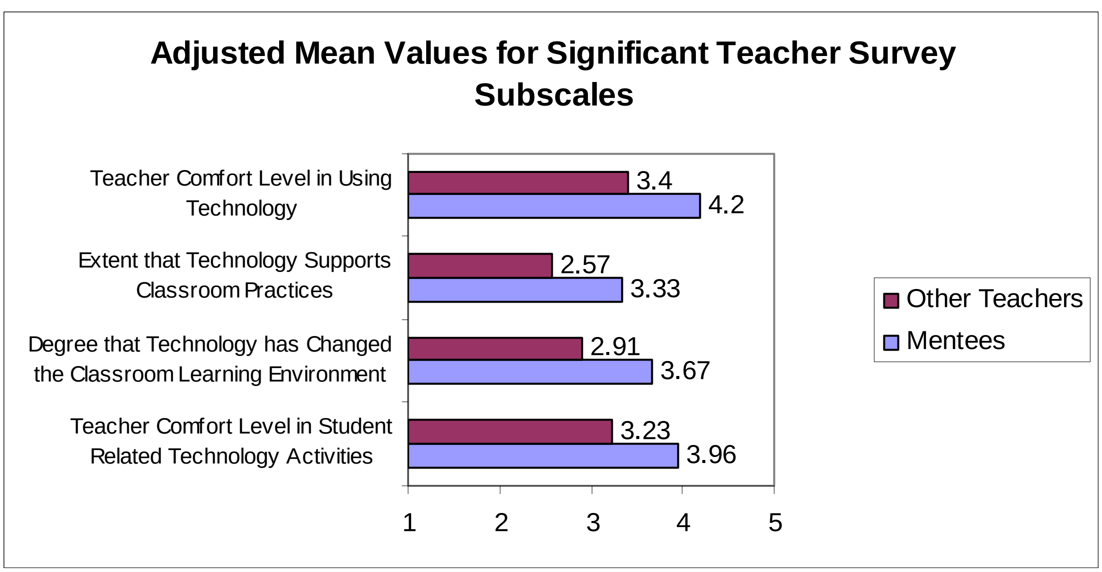


Figure 5. End-of-first year differences in the characteristics of mentees and other teachers.

participants and other teachers. Thus, the results did indicate that the first year of training had made a difference for participants in these four areas.

Findings Following the Final Year of Intervention

The presentation of the findings in this section is organized around the five primary evaluation questions for McREL's Technology Integration Program. Following these primary questions, findings on the two contextual questions are reported.

What impact has the initiative had on teachers' knowledge, attitudes, and beliefs regarding the role and use of technology in their instruction? Table 6 includes the numbers and means for three groups of teachers: all teachers in the intervention schools, MTS participant teachers who were either mentees or mentors in the MTS program only, and all comparison teachers. The results of three analyses are then presented: a paired t-test for all teachers in the intervention sites to show growth across the years of the program, a one-factor ANOVA (ANalysis Of VAriance between groups) to compare the teachers in the intervention schools to comparison school teachers in 2005, and a one factor ANOVA comparing MTS mentor/mentee teachers to comparison teachers. A t-test allows researches to see whether the means of two groups differ statistically. When the t value or F value is significant ($\alpha = .05$) the value has an asterisk. The scale for these items was 1 to 5 with 1=strongly disagree and 5=strongly agree.

Table 6. Impact on Teacher Knowledge, Attitudes, and Beliefs: 2005 Results

Item	2005 (n) and Means			Statistics		
	Intervention		Comparison	Growth 2003–2005	2005 Differences Intervention vs Comparison	
	All teachers	MTS mentors	All teachers	All MTS teachers	All teachers	MTS mentors
I understand how I can use technology to help me attain school and district standards.	(196) 3.72	(50) 4.08	(184) 3.72	t=3.83*	F=.00	F=6.85*
I have sufficient training in how to integrate technology into my classroom instruction.	(196) 3.27	(50) 3.98	(185) 3.25	t=1.93	F=.04	F=22.14*
Sometimes I wish that technology would go away**	(196) 2.23	(50) 1.92	(185) 2.23	t=.62	F=.00	F=3.63
Integration of technology into classrooms is a high priority for me.	(196) 3.64	(50) 4.32	(185) 3.55	t=1.18	F=.94	F=32.9*
I am willing to learn or continue to learn about integrating technology into my classroom.	(194) 4.26	(49) 4.59	(184) 4.24	t=.51	F=.04	F=13.17*

Item	2005 (n) and Means			Statistics		
	Intervention		Comparison	Growth 2003–2005	2005 Differences Intervention vs Comparison	
	All teachers	MTS mentors	All teachers	All MTS teachers	All teachers	MTS mentors
Technology makes my teaching more effective.	(195) 3.67	(49) 4.12	(184) 3.68	t=2.19*	F=.04	F=11.05*
Technology helps me to accommodate different learning styles	(193) 3.84	(49) 4.31	(185) 3.90	t=4.07*	F=.61	F=12.98*
I feel that computers are important for student use.	(196) 4.27	(50) 4.38	(185) 4.22	t=1.25	F=.50	F=2.40

* p ≤.05
** Disagreeing with this item demonstrates a stronger belief in technology.

There were no significant differences between survey responses from the total faculty of the MTS schools and those of the comparison schools at the end of the program (see the middle column under "Statistics"). Teachers in MTS schools reported significant growth since the beginning of the program in three areas (see the first column under "Statistics"): understanding how to use technology to attain standards, believing that technology improves teaching, and that technology helps with accommodating different learning styles. When comparing those teachers directly involved in the program (mentors and mentees) to the comparison schools (see the last column under "Statistics"), their knowledge, attitudes, and beliefs, are significantly stronger in all but two areas.

How did the project affect participants' use of technology? Table 7 shows teachers' skill levels in seven areas in 2005. Again, all teachers in MTS sites were compared to the comparison site teachers and then only the teachers directly involved in the MTS mentor program are compared (see the second column under "Statistics"). The shaded statistics, also in parentheses, indicate that the comparison teachers reported a significantly higher level of skill in these areas. The scale is treated as a continuum but included four categories: 1= I don't know how to do this, 2=I can do this but sometimes need help, 3=I can do this independently, and 4=I can teach others to do this.

Table 7. Teacher Use of Technology

Item *What is your skill level in*	2005 (n) and Means			Statistics	
	Intervention		Comparison	2005 Differences Intervention vs. Comparison	
	All teachers	MTS mentors	All teachers	All teachers	MTS vs Comparison
1. using a word processor to create documents?	(195) 3.43	(50) 3.74	(185) 3.63	t=(8.69)*	F=1.42

Item *What is your skill level in*	2005 (n) and Means			Statistics	
	Intervention		Comparison	2005 Differences Intervention vs. Comparison	
	All teachers	MTS mentors	All teachers	All teachers	MTS vs Comparison
2. using a spreadsheet to enter and calculate numbers?	(191) 2.43	(49) 2.84	(184) 2.65	t=(4.46)*	F=1.55
3. using a spreadsheet to create graphs?	(195) 2.26	(50) 2.80	(182) 2.50	t=(5.35)*	F=3.88*
4. using a database to enter information?	(190) 2.19	(47) 2.51	(183) 2.39	t=(4.05)*	F=.59
5. using a database to search for and sort information and create reports?	(194) 1.96	(50) 2.24	(185) 2.25	t=(9.37)*	F=.00
6. using a digital camera and/or scanner to get pictures onto a computer?	(195) 2.68	(50) 3.20	(184) 2.89	t=3.79	F=4.12*
7. using multimedia software to create a product?	(193) 1.75	(50) 2.08	(184) 1.70	t=.27	F=6.35*

* p ≤.05

The items in Table 7 are arranged in descending order of the need a teacher would have for the skill. Teacher means ranged from 3.43 to 1.75 for teachers in MTS sites. For the first five skills, the comparison teachers reported being more skilled than teachers in MTS schools. For only one of these skills: The MTS participant group was significantly higher than the comparison teachers, using a spreadsheet to create graphs. MTS mentors scored significantly higher in the last two skills, using a digital camera or scanner and using multimedia software to create a product.

Table 8 invites teachers to classify themselves as technology users. The scale is again categorical (being analyzed as continuous) including 1=entry, 2=adoption, 3=adaptation, 4=appropriation, and 5=transformation.

Table 8. Type of Technology User

Item	2005 (n) and Means			Statistics	
	Intervention		Comparison	2005 Differences Intervention vs. Comparison	
	All teachers	MTS mentors	All teachers	All teachers	MTS participants
I would classify myself as the following type of technology user:	(196) 2.40	(50) 3.10	(183) 2.49	F=.86	F=18.62*

* p ≤.05

Level three is described as a teacher who is shifting toward more student-based project learning and encourages the use of a variety of technology tools. Only the MTS participants have a mean exceeding the midpoint (3.10) and that mean is significantly higher than the comparison mean of 2.49.

What impact has the initiative had on teachers' capacity to integrate technology into their instruction? Table 9 shows the set of items about the extent to which technology supports various classroom activities. The scale is 1=no support to 5=complete support. The table presents comparisons among the same three groups described earlier as well as pre/post information for the teachers in MTS schools. A paired sample t-test was used for that analysis and ANOVAs for the other two.

For three of the five items, teachers in the MTS schools reported increased support from technology from 2003 to 2005, in integrating standards, spending time coaching students, and using class time for students to work in groups. Nonetheless, the 2005 means fall between minor and moderate support from technology, which is not a very high level. The MTS Mentors means all exceed 3.0 (moderate support) and are all significantly higher than the comparison group means.

Table 9. The Extent to Which Technology Supports Classroom Activity

Item *Extent to which technology supports*	**2005 (n) and Means**			**Statistics**		
	Intervention		**Comparison**	**Growth 2003-2005**	**2005 Differences Intervention vs. Comparison**	
	All teachers	MTS mentors	All teachers	All MTS teachers	All teachers	MTS mentors
integrating standards into my curriculum	(192) 2.83	(48) 3.35	(184) 2.88	t=3.25*	F=.19	F=11.48*
integrating variety of subjects/content into each of my lessons	(189) 2.72	(47) 3.13	(180) 2.74	t=.67	F=.02	F=6.97*
spending time coaching/advising students	(188) 2.45	(46) 3.13	180) 2.43	t=4.45*	F=.01	F=15.03*
using class time for students to work on projects	(189) 2.80	(47) 3.53	(179) 2.71	t=1.67	F=.58	F=21.64*
using class time for students to work in groups	(189) 2.52	(47) 3.06	(182) 2.56	t=3.17*	F=.11	F=9.96*

* p ≤.05

Table 10 also includes five items for which teachers reported on a 1 to 5 from high to low on their use of technology to support instruction.

Table 10. Technology Support for Instruction

Item	2005 (n) and Means			Statistics	
	Intervention		Comparison	2005 Differences Intervention vs. Comparison	
	All teachers	MTS mentors	All teachers	All teachers	MTS vs. Comparison
I use technology in my classroom to enhance student understanding.	(195) 3.88	(50) 4.40	(185) 3.84	t=.15	F=21.14*
I use technology in my classroom to improve student skills.	(194) 3.79	(49) 4.27	(185) 3.91	t=2.2	F=8.42*
Extent technology supports keeping students informed of their progress in class	(191) 3.29	(47) 3.72	(181) 3.39	t=.49	F=2.46
Extent technology supports evaluating electronic versions of student work	(187) 2.63	(46) 3.54	(176) 2.46	t=1.31	F=22.90*
Extent technology supports involving students in development of learning activities involving technology	(186) 2.46	(46) 2.83	(179) 2.46	t=.00	F=4.96*

* $p \leq .05$

There were minimal differences between all teachers in MTS schools and teachers in comparison schools in 2005. The MTS mentor teachers' means are significantly higher than the comparison teachers' on four of the five items: using technology to enhance student understanding, to improve student skills, to evaluate electronic versions of student work, and to involve students in development of learning activities.

How have classrooms been affected by MTS? What was the impact of the project on teaching and learning? Three tables, 11, 12, and 13, summarize data about the influence of the program on teaching and learning. Table 11 includes items about changes as a result of adding technology in teacher and student roles. The scale for these items ranges from 1=Not at all to 5=A lot. These items also indicate the impact of the program on students in how learning takes place.

Table 11. Changes in the Learning Environment

Item *As a result of adding technology to my teaching*	**2005 (n) and Means**			**Statistics**		
	Intervention		**Comparison**	**Growth 2003-2005**	**2005 Differences Intervention vs. Comparison**	
	All teachers	MTS mentors	All teachers	All MTS teachers	All teachers	MTS mentors
my teaching style has changed in that I am more of a facilitator.	(151) 3.15	(49) 3.61	(148) 3.18	t=1.39	F=.04	F=6.61*
students direct their own learning.	(150) 2.82	(49) 3.33	(148) 2.78	t=2.36*	F=.09	F=10.91*
students work together in collaborative groups.	(147) 3.13	(48) 3.46	(148) 3.18	t=.32	F=.14	F=2.63
students use a variety of resources for their projects.	(149) 3.26	(49) 3.61	(148) 3.28	t=1.77	F=.03	F=3.14
student work is shared with a variety of audiences.	(149) 2.83	(49) 3.22	(147) 2.77	t=2.36*	F=.20	F=7.38*

* $p \leq .05$

The MTS participant teachers reported (mean = 3.61) that adding technology to their teaching had made them more of a facilitator of learning. This was significantly higher than the comparison teachers (mean = 3.18). For two items (students direct their own learning and student work is shared with a variety of audiences) all teachers in MTS schools reported a significant increase from 2003 to 2005. MTS participant means are significantly higher than those of the comparison teachers.

Table 12 reports on teaching and learning from the perspective of how far along teachers are in enhancing teaching and learning through the use of various technologies. The scale is 1 to 4, where 1=I do not use this in my classroom, 2=I am beginning to understand its relevance and to experiment, 3= I make a conscious effort to include it in teaching, and 4=I naturally include it in teaching and learning and use it in powerful ways.

Table 12. Teacher Use of Technology

Item *How far along are you in*	**2005 (n) and Means**			**Statistics**	
	Intervention		**Comparison**	**2005 Differences Intervention vs. Comparison**	
	All teachers	MTS mentors	All teachers	All teachers	MTS vs. Comparison
enhancing teaching and learning using a word processor to create documents?	(193) 2.84	(50) 3.24	(185) 2.95	t=.96	F=3.30

Item *How far along are you in*	**2005 (n) and Means**			**Statistics**	
	Intervention		**Comparison**	**2005 Differences Intervention vs. Comparison**	
	All teachers	MTS mentors	All teachers	All teachers	MTS vs. Comparison
enhancing teaching and learning using a spreadsheet to enter and calculate numbers?	(190) 1.82	(49) 2.18	(183) 1.84	t=.04	F=4.38*
enhancing teaching and learning using a spreadsheet to create graphs?	(192) 1.72	(49) 2.12	(184) 1.77	t=.18	F=4.84*
enhancing teaching and learning using a database to enter information?	(191) 1.64	(49) 1.86	(183) 1.69	t=.26	F=1.13
enhancing teaching and learning using multimedia software to create a product?	(194) 1.50	(50) 1.98	(185) 1.38	t=2.09	F=21.9*
enhancing teaching and learning using a search engine to find information on the World Wide Web?	(194) 2.79	(50) 3.18	(184) 3.05	t=(5.40)*	F=.64
enhancing teaching and learning using probes to collect and study information?	(193) 1.35	(50) 1.54	(185) 1.49	t=3.21	F=.12

* $p \leq .05$

Comparison teachers reported a higher level of use than all MTS teachers for the World Wide Web. In the other areas, MTS participant teachers had significantly higher means for three items: use of a spreadsheet to enter numbers, use of a spreadsheet to create graphs, and use of multimedia software to create a product. In the latter two, participant teachers also indicated a higher level of skill (see Table 6), but comparison teachers had indicated a higher skill level for the first four items. Here comparison teachers do not indicate a higher level of use than all teachers in the MTS program.

Another important aspect of improving teaching was the collaborative work of teachers. As noted in Table 13, four items were used to measure teacher collaborative work: sharing, working with others, knowing how others teach, and meeting to talk about technology. The items used different response sets, but in each case 1 is the lowest value and 5 is the highest value.

Table 13. Teacher Collaboration

Item	2005 (n) and Means			Statistics	
	Intervention		Comparison	2005 Differences Intervention vs. Comparison	
	All teachers	MTS mentors	All teachers	All teachers	MTS vs. Comparison
Comfort level: sharing technology projects w/ other teachers.	(192) 3.54	(50) 3.90	(180) 3.67	t=.85	F=1.23
Extent technology supports working w/ other teachers in development of lesson plans.	(190) 2.56	(47) 2.98	(182) 2.58	t=.04	F=6.62*
I know how other teachers in my school use technology in their classrooms.	(195) 3.62	(50) 3.88	(184) 3.72	t=1.05	F=1.15
Teachers in my school meet and share ideas about how to use technology in their classrooms.	(196) 3.22	(50) 3.32	(185) 2.90	t=9.19*	F=6.36*

* p ≤.05

All MTS teachers were higher than the comparison group on only one item, (teachers meeting to share technology uses). However, MTS participant teachers were significantly higher than the comparison group on the extent to which technology supports working with other teachers in developing lesson plans.

What impact has MTS had on students? In addition to the changes in student-teacher roles described in Table 11, teachers responded to seven items about student abilities at the end of 2005, as noted in Table 14. The response scale ranged from 1 to 4 where 1= cannot do this task and 4=can do this task without assistance. Thus, a mean of three would suggest that most teachers believe students can do the task with little need for assistance.

Table 14. Changes in Student Capacity

Item *At this point in the school year*	2005 (n) and Means			Statistics		
	Intervention		Comparison	Growth 2003-2005	2005 Differences Intervention vs Comparison	
	All teachers	MTS mentors	All teachers	All MTS teachers	All teachers	MTS mentors
a typical student can use word processing for assignments.	(154) 3.15	(46) 3.41	(148) 3.12	t=.61	F=.05	F=2.97
a typical student can create a visual presentation.	(147) 2.73	(46) 3.00	(135) 2.41	t=4.02*	F=5.01*	F=8.53*

Item *At this point in the school year*	**2005 (n) and Means**			**Statistics**		
	Intervention		**Comparison**	**Growth 2003-2005**	**2005 Differences Intervention vs Comparison**	
	All teachers	MTS mentors	All teachers	All MTS teachers	All teachers	MTS mentors
a typical student can create a multimedia project using tools such as scanners and digital cameras.	(127) 2.27	(41) 2.46	(126) 2.06	t=2.32*	F=1.97	F=3.75
a typical student can use or create a database/spreadsheet.	(126) 2.06	(41) 2.24	(115) 1.72	t=.83	F=5.77*	F=7.35*
a typical student can use email for communication.	(132) 2.84	(39) 2.87	(114) 2.36	t=(3.27)*	F=7.36*	F=4.02*
a typical student can use the Internet for research or gathering resources.	(155) 3.28	(45) 3.42	(148) 3.03	t=6.13*	F=4.39*	F=4.65*
a typical student can design a Web page.	(111) 1.64	(31) 1.65	(102) 1.55	t=2.26*	F=.47	F=.23

* $p \leq .05$

The MTS teachers, as a whole, report that their students had increased their ability in four of the seven areas. Interestingly, in the use of email, they report a lower ability in 2005 than in 2003. In four areas--creating a visual presentation, creating a multimedia project, using the Internet for research, and using multimedia software to create a product-- they also report means that are significantly higher than those of the comparison teachers. Three of these means are above 2.5 (the highest is 4.0), indicating that from their teachers' perspectives students are able to use these technologies with some ease. MTS participants report a higher ability of their students than that reported by comparison teachers of their own students on the same four areas; three of their means exceed 3.0.

Two additional evaluation items concern the contextual factors that support technology: the degree of skill and knowledge of the school administrator and how the administrator perceives the impact of the program on the school.

Are administrators knowledgeable, skilled, and supportive of educational technology? In addition to reporting on their own teaching and how technology had supported it, teachers were also asked to comment on the level of administrative support and the resources available for effectively using technology in support of instruction. In Table 15, teachers reported on their perceptions of their administrators' understanding and support with resources. The response scale was 1 to 5, with 1 indicating "strongly disagree" and 5 indicating "strongly agree."

Table 15. Teacher Perceptions of Administrator Support and Availability of Resources

Item	2005 (n) and Means			Statistics		
	Intervention		Comparison	Growth 2003-2005	2005 Differences Intervention vs Comparison	
	All teachers	MTS mentors	All teachers	All MTS teachers	All teachers	MTS mentors
The school administration encourages the use of technology.	(196) 4.50	(50) 4.68	(185) 4.37	t=.00	F=3.30	F=8.15*
My school administration understands how technology can be integrated into the classroom to improve student learning.	(196) 4.28	(50) 4.46	(185) 4.25	t=2.59*	F=.16	F=3.28
Integration of technology into classrooms is a high priority for my school administrator(s).	(195) 4.02	(50) 4.12	(185) 3.85	t=.87	F=3.89*	F=4.56*
Teachers in my school are involved in decision making related to implementation of technology.	(194) 3.68	(49) 3.94	(185) 3.48	t=1.52	F=4.98*	F=11.02*
My students have adequate access to computers.	(196) 4.06	(50) 4.32	(184) 4.06	t=3.37*	F=.00	F=3.13
I am provided with adequate access to computers for myself.	(196) 4.47	(50) 4.72	(184) 4.46	t=2.66*	F=.03	F=5.12*
I have sufficient time to integrate technology into my classroom instruction.	(196) 2.87	(50) 3.36	(185) 2.94	t=1.16	F=.31	F=5.62*

* $p \leq .05$

MTS teachers reported improvement from 2003 to 2005 in three of the seven areas: administrator understanding of technology integration, adequate access to computers for students, and adequate access to computers for teachers. They also were significantly higher than the comparison teachers in agreeing with two items on the prioritization the administrator places on technology integration and the involvement of teachers in the decisions about technology. MTS mentors rated administrators higher than comparison teachers for the same two items, as well as on three others: administrator encouragement, adequate access for teachers to computers, and time to integrate technology.

Administrators also were surveyed in both intervention and comparison schools and asked about their abilities as technology users. Both groups typed themselves as between adaptation and appropriation.

Intervention administrators had a mean score of 3.93 and comparison administrators a mean score of 3.71, with 1 being low and 5 being high.

Do administrators report a greater impact of technology in their schools since the beginning of the MTS program? Eight items from the administrator survey measured the impact of technology on the learning environment in schools. There were no statistically significant differences between the two groups of administrators (see Table 17).

CONCLUSIONS

The consistent finding across Tables 5 through 14 is that the MTS mentors report stronger beliefs and more positive attitudes toward educational technology than teachers who were not in the program. These MTS participants reported stronger skills on more complex technology applications and, on average, rated themselves at the "adaptation level" of technology user (whereas the other teachers were at a lower, "adoption level"). In Tables 10 through 13, which deal with different aspects of classroom teaching and learning, these teachers reported a stronger technology use and presence in 15 of 22 instances.

Non-participating teachers in the MTS program schools, also reported significant improvement over the two years of the program in eight out of eighteen instances related to their attitudes, classroom activities, and the role of students in learning. However, these teachers were no different than the comparison school teachers in most cases. Comparison teachers did report stronger skills in the use of more common software as compared to MTS non-participant teachers, but MTS non-participant teachers reported greater agreement with questions relating to teachers sharing ideas about the use of technology.

While the program focuses on teachers rather than students, as always, the impact on students is an important outcome. MTS mentor teachers' mean ratings for whether technology supports using class time for students to work in groups and to work on projects was significantly greater than that of comparison teachers and teachers in MTS schools who were not part of the mentor program. MTS mentor teachers similarly reported a higher level of technology use intended to enhance student understanding and to improve student skills. In addition, they reported that they are better able to evaluate electronic versions of student work and involve students in developing learning activities.

Asked about the skills their students evidence using technology in their school work, teachers in MTS schools but not in the mentor program reported student improvement in visual presentations, developing multimedia projects, using the Internet, and designing Web pages. Their means were higher than the comparison group means in all but designing a Web page. MTS mentors' means were significantly higher than comparison teachers for each of these. Thus, respondents reported that the program had an impact on the overall use of technology in the instructional process for students in the MTS schools.

Finally, teachers in the MTS schools reported higher means than comparison school teachers for the priority their administrators place on technology integration and the involvement of teachers in decision making about technology. MTS mentors also reported higher means for administrator encouragement in the use of technology and for access to computers and time to integrate technology. There were no

significant differences between MTS administrators and a comparison group administrator in responding to the administrator survey on the impact technology has in a variety of areas.

Limitations

Data for this summative aspect of the field test were drawn from teacher and administrator surveys. As self report data they lack the objectivity of independently collected data. Further work on the two instruments should include the development of scales to analyze the data without the need for multiple item level analyses which can influence the probability of a Type I error. The design includes matched comparison schools; a stronger design would have randomly assigned schools to program or comparison condition.

Recommendations

The program had a strong positive effect on the participants, those in mentor/mentee roles, but a limited effect on other teachers in the intervention schools. The program was designed to directly affect 15 percent teachers in each school in the first year and an additional 15 percent of teachers in the second year. Due to teacher attrition, participant teachers left the program after the first year. In one case, two mentee teachers were selected from a total staff of 18 teachers. One of those mentee teachers resigned to take a job in another district at the end of the year. As a result, the second year of the program included only one mentor and one new mentee rather than two of each. In retrospect, it would have been prudent to increase the number of teacher mentees in year one, especially in smaller schools, so that the loss of a single participant would not negatively impact the program.

The MTS is designed so that approximately 60 percent of all teachers will be involved in year three. Each school worked with McREL to develop a transfer plan at the conclusion of year two of the intervention. It is recommended that schools follow the agreed-upon transfer plan as they enter the third year and McREL is no longer present. This will increase the likelihood that the majority of teachers in a school will be a part of the intervention and building capacity for technology integration will increase.

Teachers involved as mentors/mentees in the intervention are required to devote time to collaboration and planning that may fall outside of the daily work schedule. Incentives were provided by each school to compensate teachers in some way for this additional time. These incentives ranged from a small stipend to laptop computers for teacher use, to computer projectors in each teacher’s classroom. Teachers saw these incentives both as partial compensation for time spent and as recognition of their commitment to improving their professional practice. It is important that schools embarking on this intervention determine and budget for meaningful ways to provide incentives for participating teachers.

Teachers should volunteer to be considered as mentors. One field test school assigned teachers to be mentees during the second year of the intervention rather than enlisting volunteers as recommended by McREL. That school did not see the growth experience evidenced in the other field test sites. In addition, the second-year mentees in that site were not prepared to become mentors to others in year three.

Next Steps

The MTS can have a strong positive effect on a school's capacity to integrate technology in the classroom in a meaningful way. As Greg Smith, a science teacher in Wheatridge Middle School in Gardner, Kansas stated,

> Technology integration is spreading like a computer virus at Wheatridge – we're continually looking for more ways to use technology, more sources and projects to keep the kids engaged. As a result, the ways in which my students do research, collect data, and engage in projects have fundamentally changed.

McREL will be working to expand the topics of trainings included in the program and to disseminate the MTS to a wider audience. All of the materials used in each phase of the MTS have been compiled into an MTS Site Facilitator's Guide. This guide contains the surveys and protocols and step-by-step guidance on implementing the MTS in a school. McREL will host a session in early 2006 to train site coordinators in the MTS process, allowing them to go back to their schools and implement the MTS.

Additional research needs to be conducted to further investigate the impact that increased integration of technology into the classroom has on student achievement. Research should also be conducted to determine the impact of technology on student achievement by subject area.

REFERENCES

Barley, Z., Lauer, P. A., Arens, S. A., Apthorp, H. S., Englert, K. S., Snow, D., & Akiba, M. (2002). *Helping at-risk students meet standards: A synthesis of evidence-based classroom practices.* Aurora, CO: Mid-continent Research for Education and Learning.

Brand, G. A. (1997). *What research says: Training teachers for using technology*. Retrieved July 3, 2003, from www.nsdc.org/library/jsd/brand191.html

Byron, E. (1998). Factors that affect the effective use of technology for teaching and learning: Lessons learned from the SEIR*TEC Intensive Site Schools. Retrieved July 3, 2003, from http://www.serve.org/seir-tec/publications/lessondoc.html

Christmann, E., Lucking, R., & Badgett, J. (1997). The effectiveness of computer-assisted instruction on the academic achievement of secondary students: A meta-analytic comparison between urban, suburban, and rural educational settings. *Computers in the Schools, 13*(3/4), 31–40.

Coley, R. J., Cradler, J., & Engel, P. K. (1997). *Computers and classrooms: The status of technology in U.S. schools*. Retrieved August 19, 2003, from ftp://ftp.ets.org/pub/res/compclss.pdf

Collins, James, C. (2001). *Good to great: Why some companies make the leap . . . and others don't.* New York: Harper Collins.

Costa, J. P., & Bobowick, E. (2001). Linking technology to educational improvements. In B. Kallick & J. M. Wilson (Eds.), *Information technology for schools: Creating practical knowledge to improve student performance* (pp. 33–42). San Francisco: Jossey-Bass Education Series.

Cuban, L. (1999). *The technology puzzle*. Retrieved September 3, 2003, from http://www.edweek.org/ew/1999/43cuban.h18

Dirksen, D. J., & Tharp, D. (2000, June 26–28). *Goals 2000: Initial evaluation. Research paper: Moving beyond the crossroads: Teachers as agents for change*. Paper presented at the Connecting @ the Crossroads, NECC 2000: National Educational Computing Conference, Atlanta, GA.

Dynarski, M., Honey, M., & Levin, D. (2002). Designing a study of the effectiveness of education technology: Background material for working group meeting. Washington, DC: U.S. Department of Education.

Fabry, D. L., & Higgs, J. R. (1997). Barriers to the effective use of technology in education: Current status. *Journal of Educational Computing Research, 17*(4), 385–395.

Granger, C., Morbey, M. L., Lotherington, H., Owston, R., & Wideman, H. (2002). *Canada: Factors contributing to teachers' successful implementation of information technology*. Retrieved August 25, 2003, from http://www/york.ca/irlt/reports/aerapaper.htm

Heath, M., Burns, M., Dimock, K. V., Burniske, J., Menchaca, M., & Ravitz, J. (2000). *Applying technology to restructuring and learning. Final report*. Austin, TX: Southwest Educational Development Laboratory.

Holland, P. E. (2001). Professional development in technology: Catalyst for school reform. *Journal of Technology and Teacher Education, 9*(2), 245–267.

Honey, M., Culp, K. M., & Carrigg, F. (1999). *Perspectives on technology and education research: Lessons from the past and present*. Retrieved August 8, 2003, from http://www.ed.gov/rschstat/eval/tech/techconf99/whitepapers/paper1.html

Honey, M., Culp, K. M., & Spielvogel, R. (1999). *Using technology to improve student achievement*. (Pathways to School Improvement-Online). Retrieved July 3, 2003, from http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te800.htm

Knezek, G., & Christensen, R. (2000). *Refining best teaching practices for technology integration: KIDS Project Findings for 1999–2000*. Retrieved July 9, 2003, from http://www.iittl.unt.edu.KIDS2000

Knight, P. J., & Albaugh, P. R. (1997). *Training technology mentors: A model for professional development*. Paper presented at the 49th Annual Meeting of the American Association of Colleges for Teacher Education, Phoenix, AZ.

Lemke, C. & Coughlin, E. (1998). *Technology in American schools: Seven dimensions for gauging progress*. Santa Monica, CA: Milken Exchange on Education Technology.

Lemke, C., Quinn, B., Zucker, A., & Cahill, S. (1998). Report to the Commonwealth of Virginia: An analysis of the status of education technology and usage in the public schools of Virginia. Santa Monica, CA: Milken Exchange on Education Technology.

Lipsey, M. W. (1990). *Design sensitivity*. Newbury Park, CA: Sage Publications.

Mann, D., & Shafer, E. A. (1997). *Technology and achievement*. Retrieved June 5, 2003, from http://www/asbj.com/achievement/ci/ci10.htm.

Mann, D., Shakeshaft, C., Beck, J., & Kottkamp, R. (1999). *West Virginia story: Achievement gains from a statewide comprehensive instructional technology program*. Retrieved July 17, 2003, from http://www.mff.org/publications/publications.taf?page=155

Marzano, R. J., Pickering, D. J., & Pollock, J. E. (2001). *Classroom instruction that works*. Alexandria, VA: Association for Supervision and Curriculum Development.

Means, B. (1997). *Using technology to enhance engaged learning for at-risk students*. Retrieved July 3, 2003, from http://www.ncrel.org/sdrs/areas/issues/students/atrisk/at400.htm

Means, B., Blando, J., Olson, K., Middleton, T., Morocco, C. C., Remz, A. R., et al. (1993). *Using technology to support education reform*. Retrieved August 7, 2003, from http://www.ed.gov/pubs/EdReformsStudies/TechReforms/title.html

Mize, C. D., & Gibbons, A. (2000, February 8–12). *More than inventory: Effective integration of instructional technology to support student learning in K–12 schools*. Paper presented at the SITE 2000: Society for Information Technology and Teacher Education 11th International Conference, San Diego, CA.

Page, M. S. (2002). Technology-enriched classrooms: Effects on students of low socioeconomic status. *Journal of Research on Technology in Education*, *34*(2), 389–409.

Pisapia, J. R., Coukos, E. D., & Knutson, K. (2000, April 24–28). *The impact of computers on teacher capacity, attitudes, and behaviors in elementary schools*. Paper presented at the American Educational Research Association, New Orleans, LA.

Pitler, H., & Barley,Z. (2004, September). McREL Technology Initiative: The development of a technology intervention program: Interim progress report. Aurora, CO: Mid-continent Research for Education and Learning.

Reeves, T. C. (1998). *The impact of media and technology in schools: A research report prepared for The Bertelsmann Foundation*. Retrieved April 30, 2003, from http://www.athensacademy.org/instruct/media_tech/reeves0.html

Ringstaff, C., & Yocarn, K. (1996). Integrating technology into classroom instruction: An assessment of the impact of the ACOT Teacher Development Center Project. Cupertino, CA: Apple Computer, Inc.

Ringstaff, C., & Kelley, L. (2002). The learning return on our educational technology investment: A review of findings from research. San Francisco: WestEd RTEC.

Ross, J. D., McGraw, T. M., & Burdette, K. J. (2001). *Toward an effective use of technology in education: A summary of research*. Charleston, WV: Institute for the Advancement of Emerging Technologies in Education, Appalachia Educational Laboratory.

Russell, J., & Sorge, D. (1999). Training facilitators to enhance technology integration. *Journal of Instructional Delivery Systems*, *13*(4), 6.

Schacter, J. (1999). The impact of education technology on student achievement: What the most current research has to say. Santa Monica, CA: Milken Exchange on Education Technology.

Schacter, J., & Fagnano, C. (1999). Does computer technology improve student learning and achievement? How, when, and under what conditions? *Journal of Educational Computing Research*, *20*(4), 329–343.

Sherry, L., & Lawyer-Brook, D. (1997). Evaluation of the Boulder Valley Internet Project: A theory-based approach to evaluation design. *Journal of Interactive Learning Research, 8*(2), 199–233. Retrieved August 5, 2004, from http://carbon.cudenver.edu/~lsherry/pubs/aera97.html

Shibley, I. A. (2001). Technology integrated learning, staff development: It's a total package. *Educational Technology, 31*(6), 61–63.

Waters, J. T., Marzano, R. J., & McNulty, B. A. (2003). *Balanced leadership: What 30 years of research tells us about the effect of leadership on student achievement*. Aurora, CO: Mid-continent Research for Education and Learning.

Waxman, H. C., Connell, M. L., & Gray, J. (2002). A quantitative synthesis of recent research on the effects of teaching and learning with technology on student outcomes. Naperville, IL: North Central Regional Educational Laboratory.

APPENDIX A: REVIEW OF LITERATURE ON THE USE OF TECHNOLOGY IN THE CLASSROOM

The purposes of conducting a review of the literature were multiple: (1) to build a sound theoretical basis for the need and importance of the MTI; (2) to guide the final design of the MTI intervention; (3) to identify critical factors that will likely impact the success of the intervention; and (4) to inform the design of the MTI field test, including identification of potential outcomes and measures as well as typical effect sizes and the length of time it typically takes to realize such benefits.

Method

The studies selected for this review were chosen as the most methodologically sound. Preference also was given to longitudinal studies that examine change over time. We relied heavily on reviews and meta-analyses that identified patterns across a large number of individual studies. It should be noted that the term *technology*, as used in this report, refers broadly to computer-based tools — hardware, software, the Internet, and a wide variety of multimedia tools. The consensus among scholars seems to be that *technology integration* is defined as the use of technology to improve student achievement and to help students become literate in their use of technology (Costa & Bobowick, 2001; Holland, 2001; Honey, Culp, & Spielvogel, 1999; Pisapia, Coukos, & Knutson, 2000; Ross, McGraw, & Burdette, 2001).

Findings

Statistics show that the presence of technology in schools has grown at an exponential rate throughout the last 20 years (Dirksen & Tharp, 2000; Heath et al., 2000). Although the quest for technology applications in schooling has long made intuitive sense to many administrators, educators, and policymakers, it has become apparent that the full benefits of these educational tools could not be realized by the mere introduction of such technology (Page, 2002). Teachers, within their own classrooms, are the people who decide and prepare the conditions under which students experience and use technology (Reeves, 1998). From this perspective, teachers are the agents of change in the integration of the effective use of technology in the classroom. It is not a surprise, then, that a variety of studies indicate that if teachers are not adequately and appropriately trained in the use of technology, its impact on student performance is minimal (Dirksen & Tharp, 2000; Ringstaff & Kelley, 2002).

These studies confirm that "a major implementation pitfall is the failure to provide teachers with adequate professional development on technology" (Means, 1997, p. 5) — particularly in rural schools[1], where internal expertise is often more limited than in larger schools and districts. Teachers need to be trained to use technology and apply it instructionally within their particular curriculum. As Shibley (2001) states, "the challenge is to educate teachers so they can integrate or weave technology into the curriculum and learning process" (p. 62).

What follows is a synopsis of the findings of the literature review organized around three main themes: context, professional development, and student achievement. These findings are derived from a wide range of technology implementations in K–12 classrooms during the last two decades.

[1] Rural schools make up the majority of the Central Region served by Mid-Continent Research for Education and Learning (McREL).

Educational Context

With regard to setting the context for technology integration in schooling, three themes emerged from the literature reviewed: the importance of articulating goals for student learning, viewing technology as part of a broader reform effort, and the value of long-term planning, support, and leadership on observed outcomes.

Goals for student learning need to be articulated. The evidence clearly indicates that to achieve successful learning through technology, the learning objectives need to be clear and the application of such technology unambiguous (Schacter, 1999; Sherry, Lawyer-Brook, & Black, 1997). All the new technologies in the world will not have an impact on student achievement unless learning objectives are clearly focused. Technology can live up to its potential to improve student learning only when the goals for student learning are clearly articulated *prior* to the use of technology (Ringstaff & Kelley, 2002; Schacter, 1999).

Schacter and Fagnano (1999) recommend technology implementations based on socio-cultural and constructivist theories rather than on behaviorist theories. These authors suggest that technology implementations are more effective when focused on the following practices:

(1) Engaging students in discussions and debate that include commenting and reviewing their own and others' work and collaborating with others.

(2) Encouraging students' reflection and thought, so that students analyze multiple perspectives and think independently.

(3) Helping students develop or integrate their learning by having them design "something" (e.g., programs, software) that fosters critical thinking, judgment, and personal involvement — a direct and practical application of integration.

(4) Using project-based learning activities that involve work on questions or problems and activities that help students refine questions, make predictions, design plans, collect and analyze data, draw conclusions, and communicate findings.

(5) Engaging students in contextualized/meaningful projects.

(6) Teaching students to use computers as tools with which to design and carry out projects, rather than as simply machines to operate. Applied effectively, technology implementations not only increase student learning, understanding, and achievement, but also augment students' motivation to learn and encourage collaborative learning and the development of critical thinking and problem-solving skills.

Technology must be part of a broader reform effort. The prospect of integrating technology into classroom instruction can seem burdensome, if not overwhelming, when considered as a separate and additional reform atop a host of other mandated initiatives in process at the time (Pisapia et al., 2000). To avoid this pitfall, technology must be considered as an integrated part of broader reform efforts: administrators and teachers alike must identify from the start *how the technology fits in with what they're already doing*. In other words, technology cannot exist in a vacuum if it is to be effective; it must become part of the overall education environment (Mann, Shakeshaft, Becker, & Kottkamp, 1999). For example, the use of technology to improve student learning is one of the major emphases in

the No Child Left Behind Act of 2001 (Dirksen & Tharp, 2000). The connection between such reforms and technology integration efforts needs to be explicitly articulated.

Effective technology use requires long-term planning, support, and leadership. An essential piece of the school vision for technology integration is the development of a technology plan (Fabry & Higgs, 1997). This plan not only must include clear goals and reflect the ideas of the entire school community, but it also must be connected to the overall school goals (Byrom, 1998; Honey, Culp, & Spielvogel, 1999; Knight & Albaugh, 1997). In addition, it must consider funding, installation and integration of equipment, and ongoing management of technology (Lemke, Quinn, Zucker, & Cahill, 1998).

Part of the planning process should include a thorough evaluation of the infrastructure — wiring and electrical power, air conditioning, ventilation, lighting and security systems, etc. — to be certain that it can support the technology (Byrom, 1998). It is equally important to identify early on how inequity of computer resources among schools and/or students and existing and/or outdated equipment and technology may impact integration into the curriculum to best benefit student learning. Inequitable distribution presents equity issues for learning (Fabry & Higgs, 1997).

Infrastructure evaluation, however, goes well beyond strictly computers and school facilities. According to Fabry and Higgs (1997), "effective access requires connectivity, ubiquity, and interconnectivity" (p. 391). *Connectivity* refers to the capability to access resources within and outside the school. *Ubiquity* refers to placing computers and peripherals, that is, printers and scanners, where teachers and students can access them whenever they need them, not whenever they are available. *Interconnectivity* is the technical capacity of the school community, teachers, and students to communicate with one another via technology. Additional issues of equity and access to technology surface when certain populations (e.g., LEP students, adult learners) do not have access to needed resources (Byrom, 1998).

Ringstaff and Kelly (2002) reflect that a common error schools or districts make is purchasing technology "without a clear vision of how it is to be integrated into the mission of the school or district" (p. 20). A more successful approach is for school administrators and other stakeholders to first develop a plan that clearly defines the standards and goals for the use of technology, and then to implement the technology projects. Following through with this kind of long-term planning improves associated instruction (Ringstaff & Kelley, 2002).

For technology integration to be effective, it needs to be embedded in the overall vision of the school. A school must have a clear vision of its integration strategies, and this vision must be appropriately communicated to all members of the school community (Mize & Gibbons, 2000). The school vision must address what is possible through the use of technology and how technology will benefit students' learning (Byrom, 1998; Honey, Culp & Carrigg, 1999).

The term "support" takes on a variety of forms when it comes to technology integration — from technology to funding to administrative support — all of which depend directly on strong leadership, a factor that is absolutely critical to the success of a technology initiative. According to Ringstaff and Kelley (2002), even when there is adequate access to technology, a major barrier to its use is the lack of technical support. Regardless of how well-trained teachers and administrators are, if technology integration is to be successful, it is critical that technology support staff are available in an efficient and effective manner when needed.

Although teachers perhaps represent the "front line" for the use of technology to improve student learning, a substantive body of research strongly points to the fact that training that does not include a school leadership component will be ineffective. According to Coley, Cradler, and Engel (1997),

"research on the adoption of innovations in schools consistently points to the key role of administrators in successful implementation" (p. 5). Byrom (1998) identifies the leadership and vision that these administrators bring to the table, as they relate to technology integration, as the single most important factor affecting the successful integration of technology. Likewise, teachers' attitudes are strongly impacted by school administrators' support. Administrators need training "in how to provide adequate planning time and observe, coach, and reward teachers in the integration of computers into their instructional strategies. [This support leads to] increases in positive teacher attitudes and beliefs" (Pisapia et al., 2000, pp 18-19).

This critical administrator support can be demonstrated simply, such as by showing an interest on the teachers' instructional objectives in the use of computers, acknowledging teachers' successes in integrating computers into their curricula, and offering support for teachers' efforts (Pisapia et al., 2000). Other incentives, such as release time or extra pay for teachers who have taken on new duties, also have been successful (Sherry et al., 1997). In fact, researchers following the results of the Apple Classrooms of Tomorrow (ACOT) project "found that the most crucial determining factor in whether teachers who participated in the program successfully integrated technology into their classroom was the level of support they received from school and district administrators" (Sandholtz et al., 1997, as cited by Ringstaff & Kelley, 2002, p. 22). On the other side of the coin, the absence of some type of motivating support, or the presence of negative support, can have a "chilling" effect (Pisapia et al., 2000).

To avoid frustrations at the administrative level during project implementation — and the possible failure of innovations — it is important for administrators to make sure that they have mechanisms in place for dealing with unforeseen problems that might arise during implementation. If they do not, they risk communications breaking down and teachers running into problems with which they are unable to cope (Sherry et al., 1997).

Professional Development

Even those schools and districts that do provide teachers with technology-related professional development typically offer limited training that concentrates on the basic mechanics of hardware and software. Oftentimes, technology training for teachers focuses only on the basics of computer skills or the use of particular pieces of software and then the training is terminated (Means, 1997; Ringstaff & Kelley, 2002). Brief sessions about word processing, scanning, or using spreadsheets are commonplace — yet as Means (1997) put it, "it is one thing to be able to open up a piece of spreadsheet software, for example, and quite another to have a repertoire of instructionally useful activities for students to learn mathematical concepts through constructing spreadsheets and graphing the data" (pp. 5–6). Although teachers do need to understand fundamental computer operations, they also need to be taught much more. Teachers themselves feel such limitations acutely; most who participate in these types of short-term trainings report that the training was too short in duration and too limited to be of much use (Ringstaff & Kelley, 2002). Thus, the questions become, "How much training is necessary?" and "What does such training need to consist of in terms of content and format?" A review of the current education research literature provides us with useful guidance in these areas.

Curriculum first, technology second. Training must have an instructional focus that guides teachers to think first about their curriculum and second about how to integrate the technology into that curriculum. Current research on the implementation of computer-based technology in K–12 education indicates that technology needs to be considered as a means and as an instructional tool, not as a goal in itself. However, many schools and districts buy technology even before they know how to use it and know what role it would play in their instructional plans (Ringstaff & Kelley, 2002).

Research indicates that having the latest hardware that runs the latest software applications is of little value in itself. Teachers and administrators must be trained from the beginning to think beyond the technologies themselves to the focused application of those technologies to serve the educational needs of their students. By beginning with curriculum, and then adding technology, teachers will be more able to consider *application* of the technology as they learn it — both in terms of integration into their curriculum and instructional framework and their perception of the relationship of the classroom curriculum to state and district standards. Training also must include instructional strategies and practical applications of technology, and focus upon how technology can fit into the broader curriculum (Honey, Culp, & Speilvogel, 1999). Overall training opportunities with a combination of "teaching skills" and integration methods seem to be highly effective (Mize & Gibbons, 2000).

This is an important lesson that cannot be overemphasized. Several examples were found in the literature of initiatives in which technology was overemphasized while the underlying *content* was underemphasized (Ringstaff & Kelley, 2002). That technology has an instructional focus above all else is a key condition for technology to improve student learning (Reeves, 1998). Such an instructional focus also will facilitate the application of technology in a more systematic fashion across the curriculum. Simply being familiar with new technology and having the ability to apply it in a single context guarantees neither the ability nor the motivation to use it successfully in novel contexts or to integrate it meaningfully into a teaching program (Sherry et al., 1997).

Peer coaching and development of internal expertise are critical. Train-the-trainers models and/or peer mentoring that is ongoing and job-embedded have been shown to be highly effective technology integration tools under certain conditions (Dirksen & Tharp, 2000; Knight & Albaugh, 1997; Sherry et al., 1997). In Project Explore, for example, teachers skeptical of technology integration observed their colleagues already using technology and so assessed for themselves the impact that technology had on teaching and learning. With this evidence in hand, researchers thought that the project "benefited by capitalizing on teachers who were willing and motivated to bring about change and incorporate new technologies into the teaching and learning process" (Chang et al., 1998, p. 42).

Literature shows that greater rates of successful technology integration take place when teachers have ample time to acquire technology skills, when they have opportunities to share their technology-related work with their colleagues, and when their technology-based activities are adequately planned (Means, 1997). These factors also result in larger number of teachers achieving higher levels of technology proficiency.

Mentor teachers need to be provided with time and guidance on working with adult learners, and should be given tools to tailor their work to teachers' varying levels of technology sophistication and varying objectives and goals for the use of technology in their classrooms (Sherry et al., 1997). Holland (2001) found that providing differentiated professional development opportunities according to teachers' needs and interests is critical.

Teacher training needs to include content and opportunities for collaborative work. It is important that the training be extremely deliberate if it is to be successful in achieving its goals. Accordingly, the training should include (Ringstaff & Kelley, 2002) the following:

- Classroom management issues related to technology
- Collaborative teaching strategies
- Research-based materials to help teachers effectively integrate instructional software

- Methods and tools to assess student products created using technology
- Practice sessions in which teachers can “explore, reflect, collaborate with peers, work on authentic learning tasks, and engage in hands-on, active learning” (Ringstaff & Kelley, 2002, p. 15).

To be sure, integrating technology into the classroom is a difficult, time-consuming process. Only those teachers who believe that technology use will lead to significant benefits for their students are likely to undertake the associated challenges. Researchers from the 10-year Apple Classrooms of Tomorrow study found that “shifts in teachers’ beliefs occurred when teachers began to see firsthand the benefits of technology use” (Ringstaff & Kelley, 2002, p. 16). Thus, observational experiences and “success” stories can often bolster teacher motivation for undertaking the difficulties associated with technology integration.

As with so many education initiatives, technology integration requires developing opportunities for teachers to discuss and work collaboratively with their colleagues or partners to develop, modify, and improve their own instructional use of technology. Holland (2001) reflects that traditional in-service training may not be able to meet the diverse needs of teachers, and identifies a number of alternative professional development models including (1) peer coaching, (2) engagement of teachers in collaborative action research, and (3) providing time to observe one another’s classrooms.

Holland (2001) argues that peer coaching “is an excellent way for teachers at a mastery level to continue to develop in their knowledge and use of technology, particularly in their use of technology in their classrooms” (p. 254). Holland also asserts that teachers must look for opportunities and time for dialogue and collaboration with colleagues “to create, modify, and improve their instructional use of technology” (p. 256). Teachers increase their knowledge and use of technology when they are provided with opportunities to engage with their colleagues in collaborative action research and when they are provided with opportunities “to systematically evaluate the content and effectiveness of their instructional use of technology” (Holland, 2001, p. 257). However, a critical element in peer coaching is time. Teachers need time to plan technology integration collaboratively, “time spent observing classrooms in order to gain new ideas for using instructional technology … [is] also valuable” (p. 257).

Technology Integration and Student Achievement

The preceding discussion leaves little doubt that any undertaking aimed at promoting technology integration in schools is a daunting, time-intensive, long-term, and complex endeavor. There is much literature, however, to suggest the value and worth of engaging in such intensive training efforts. A significant body of research shows that the appropriate use of technology can significantly improve student learning in a variety of areas. When looking at the effects of technology use on students, the literature can be categorized into cognitive outcomes (impacts on student learning as measured by standardized achievement tests, authentic assessments, and other tests); behavioral outcomes (e.g., time on task, interactivity); and affective outcomes[2] (e.g., student self-concept and motivation; attitudes towards school, learning, and computers).

In terms of cognitive outcomes, the research literature can be broken into two types of student learning relating to technology: learning *from* computers and learning *with* computers:

---

[2] A recent meta-analysis calculated effect size for each of these types of outcomes as well as overall. Cognitive outcomes had the largest effect size at .390. Affective outcomes were next with a significant effect size of .279. Behavioral outcomes had a slightly negative effect at -.154. Overall across all outcomes, an effect size of .301 was calculated (Waxman, et al., 2002).

> When students are learning "from" computers, the computers are essentially tutors. In this capacity, the technology primarily serves the goal of increasing students' basic skills and knowledge. In learning "with" by contrast, students use technology as a tool that can be applied to a variety of goals in the learning process, rather than serving simply as an instructional delivery system. Students use the technology as a resource to help them develop higher order thinking, creativity, research skills, and so on. (Ringstaff & Kelley, 2002, p. 2)

There is a large body of research that attests to the effectiveness of learning *from* computers (also referred to as computer-aided instruction, or CAI). Using technology as a tutor to teach basic skills can be highly effective (Dirksen & Tharp, 2000; Page, 2002; Schacter, 1999; Waxman, Connell, & Gray, 2002). A review of nearly a dozen meta-analyses on the effectiveness of computer-based instruction found that effect sizes ranged from .22 to .57[3] (Mann et al., 1999). Other recent meta-analyses have found an average overall effect size of .37 — ranging from .30 to .44 (Dirksen & Tharp, 2000; Page, 2002). Since an effect size of +.25 or more is generally considered to be *practically significant* in terms of producing meaningful positive educational effects on children, the effect sizes found in CAI research can be said to be meaningful (Lipsey, 1990; Barley, et al., 2002).

Moreover, the positive effects of computer-aided instruction on student achievement have been observed across multiple subject areas. A review of 219 research studies from 1990 to 1997 surmised that "students in technology-rich environments experienced positive effects on achievement in all major subject areas" (Schacter, 1999, p. 5). This finding is corroborated by several other studies — although gains in student achievement are not uniform across subject areas (Mann et al., 1999; Page, 2002; Ringstaff & Kelley, 2002).

Although there is substantial evidence that computers can help students improve their performance on tests of basic skills, the application of educational technologies to instruction has progressed far beyond using computers as tutors to teach basic skills. Technology in schools today is dramatically different than the technology that was used in schools several years ago. Today, students use complex multimedia products and advanced networking technologies to learn interactively and work collaboratively on projects; to gather, organize, and analyze information; to solve problems; and communicate information (Ringstaff & Kelley, 2002). As Russell and Sorge (1999) assert, technology is moving teachers into a constructivist approach to learning:

> The new technologies allow students to have more control over their own learning, to think analytically and critically, and to work collaboratively. This "constructivist" approach is one effort at educational reform made easier by technology…. Since this type of instructional approach, and the technologies involved with it, are recent developments, it is hard to gauge their educational effects. (p. 1-2)

To be sure, technology used in these ways leads to outcomes that can be difficult to measure. The difficulty results not only from rapid changes in technology but also because many existing assessments do not adequately capture the higher-order thinking skills that such technology potentially impacts. This rapid change in technology is a relatively recent phenomenon. The research base behind learning with computers is still relatively scant as compared to learning from computers. Still, there is some evidence of positive results (Schacter, 1999).

---

[3] An effect size is a standard means of expressing the strength of relationship between an intervention and an outcome (such as student achievement gains). For example, an effect size of +1.00 indicates that the treatment group outperformed the control group by one full standard deviation. To give a sense of scale, this would be equivalent to an increase of 100 points on the SAT scale – enough to move a student from the 20th percentile to above the 50th percentile (Lipsey, 1990).

A 1996 national study by the Center for Applied Technology that compared the work of 500 students in 4th and 6th grade found that students with online access achieved significantly higher scores on measures of information management, communication, and presentation of ideas (Sherry et al., 1997). Among other findings, a 10-year longitudinal study on Apple Classrooms of Tomorrow (ACOT) found that (1) students "explored and represented information dynamically and in many forms; (2) [students] communicated effectively about complex processes" (Russell & Sorge, 1999, p. 2); and (3) the ACOT experience appeared to result in new learning experiences requiring higher-level reasoning and problem solving (Mann et al., 1999). Researchers evaluating the impact of ACOT reported that, when compared to their non-ACOT peers they "routinely employed inquiry, collaborative, technological, and problem-solving skills uncommon to graduates of traditional high school programs" (Sandholtz et al., 1997 as cited by Ringstaff & Kelley, 2002, p. 7)[4].

As the above discussion implies, some of the most noteworthy effects of technology may not be measurable by standardized achievement tests but, rather, manifest themselves in *how* teaching and learning occur in the classroom. Teaching style, pedagogical approach, classroom organization, student behavior, and student attitudes can be influenced by technology (Pisapia et al., 2000). Ringstaff and Kelley (2002) discuss this impact in technology-rich classrooms:

> The more advanced uses of technology support the constructivist view of learning in which the teacher is a facilitator of learning rather than the classroom's only source of knowledge (Trilling & Hood, 1999; Penuel & Means, 1999; Silverstein et al., 2000; Statham & Torell, 1999). In numerous studies of student learning "with" technology, teachers have reported that technology encourages them to be more student-centered, more open to multiple perspectives on problems, and more willing to experiment in their teaching (Knapp & Glenn, 1996). In technology-rich classrooms, students become more engaged and more active learners. (p. 10)

The literature repeatedly finds that integrating technology into instruction tends to move classrooms from teacher-dominated to student-centered learning environments. In such "constructivist" classrooms, students tend to work cooperatively, have more opportunities to make choices, and play a more active role in their learning (Mize & Gibbons, 2000; Page, 2002; Waxman et al., 2002).

Moreover, technology produces significant affective outcomes in students. Students in technology-rich classrooms tend to have significantly higher levels of self-esteem, work more in cooperative learning groups, and be more engaged learners in terms of the time on task (Page, 2002). Researchers (Pisapia et al., 2000; Russell & Sorge, 1999) have found that students' attitudes towards self and learning improve when they work in technology-rich classrooms, especially when the technology allows them to control their own learning.

Some of the differences in how learning occurs in technology-rich classrooms (as compared to traditional classrooms) may account for consistent findings that technology can be especially effective with at-risk and special needs students (Barley et al., 2002; Page, 2002). A recent research synthesis conducted by McREL (Barley et al., 2002) suggests that the following characteristics of CAI (Computer Assisted Instruction) contribute to the learning of at-risk students:

- CAI is non-judgmental and motivational.
- CAI gives frequent and immediate feedback.

[4] Longitudinal studies have shown positive learning results from the use of media and technology in schools, however, these impacts take a long time to take place.

- CAI can individualize learning through designs to meet students' needs.
- CAI allows for more student autonomy.
- CAI provides a multi-sensory learning environment (images, sounds, and symbols). (p. 97)

Summary of Critical Elements to Successful Technology Integration

Technology interventions are immersed in and cannot be separated from their content and individual contexts — classroom environment; school, district and community support; and integration within the school's mission and vision. From that perspective, interventions must be designed with the whole environment in mind, and not only aimed to individual participants. It is critical that interventions are supported not only in their inception, but also in their sustainability. Resources and policies need to support these goals. Research has shown that educational technology interventions flourish in schools where principals and others have provided the vision and support for technology (Sherry et al., 1997).

Teachers need a reliable technical infrastructure and ongoing support to be able to integrate technology in their classrooms. This support should be available for the kinds of technology being learned and the use planned for it. In addition to the planned professional development, teachers need time to become familiar with available products, software and online resources, and discuss technology with other teachers (Honey, Culp, & Spielvogel, 1999). Simply putting computers in schools is not enough for technology integration. Teachers need to learn how to effectively use technology with a strong connection between their teaching styles and how technology can enhance their classroom instruction. Technology training must have an instructional focus that guides teachers to think first about their curriculum and then helps them address how to integrate the technology into the curriculum. Teachers need to see the relevance of technology to classroom practice (Brand, 1997; Fabry & Higgs, 1997).

Granger et al. (2002) found that informal technology education is seen by teachers as the most influential factor contributing to successful technology integration implementation. By informal, these teachers meant that the professional development was opportune, focused on the jobs, and involved their colleagues. Granger and his colleagues assert that some of the most influential factors in the facilitation of professional development and innovative classroom practices include the importance of having supportive relationships among themselves, "a commitment to pedagogically sound implementation of new technologies, and principals who encourage teachers to engage in their own learning" (p. 2).

Other factors have been identified that affect technology implementation, among them: teachers' resistance to change, teachers' attitudes, teachers' modes of learning, teachers' working conditions, teachers' levels of knowledge and use of technology, and unreliability of technology. Fabry and Higgs (1997) argue that a critical factor against technology integration is people's innate dislike for change. To integrate technology, teachers are asked not only to learn the technology, but also to change the way they teach. They are asked to switch from a teacher-centered to a student-centered classroom, which is a much more difficult transformation than merely using technology. When teachers do not know the technology they feel vulnerable and at risk of losing their status of having adequate knowledge and skills. With regard to teachers' attitudes, these authors explain that only a small percentage of teachers have the positive attitudes to try innovations and adopt new ways of teaching. They also report that other internal variables, that is, self-confidence and locus of control, affect the computer use of practicing and preservice teachers.

In addition to teachers' personal factors affecting technology integration, Cuban (1999) reports that teachers' working conditions, and the day-to-day demands put on them regarding their areas of expertise (i.e., subject area, classroom management, testing, and high standards) keep them so overwhelmed they are unable to learn and implement new technologies. Cuban also explains that the unreliability of technology, not only typical computer problems as they relate to software and hardware, but the lack of technical support, the use of new software, and the limited capacity of computers for use with new software, are another set of barriers to the integration of technology.

Recommendations

The literature indicates a need for staff development for both teachers and administrators in the integration of technology into the classroom. The MIT field test should integrate the lessons gleaned from the review of the literature and lessons learned in the pilot phase of the project to create a coherent and sustainable intervention model to aid schools in successfully integrating technology into instruction so as to improve student learning.

REFERENCES

Barley, Z., Lauer, P. A., Arens, S. A., Apthorp, H. S., Englert, K. S., Snow, D., & Akiba, M. (2002). *Helping at-risk students meet standards: A synthesis of evidence-based classroom practices.* Aurora, CO: Mid-continent Research for Education and Learning.

Brand, G. A. (1997). *What research says: Training teachers for using technology*. Retrieved July 3, 2003, from www.nsdc.org/library/jsd/brand191.html

Byrom, E. (1998). *Factors that affect the effective use of technology for teaching and learning: Lessons learned from the SEIR*TEC Intensive Site Schools*. Retrieved July 3, 2003, from http://www.serve.org/seir-tec/publications/lessondoc.html

Chang, H., Henriquez, A., Honey, M., Light, D., Moeller, B., & Ross, N. (1998). *The Union City story*. New York: Education Development Center, Center for Children and Technology.

Coley, R., Cradler, J., & Engel, P. (1997). *Computers and classrooms: The status of technology in U.S. schools*. Retrieved August 19, 2003, from ftp://ftp.ets.org/pub/res/compclss.pdf

Costa, J. P., & Bobowick, E. (2001). Linking technology to educational improvements. In B. Kallick & J. M. Wilson (Eds.), *Information technology for schools: Creating practical knowledge to improve student performance* (pp. 33–42). San Francisco: Jossey-Bass Education Series.

Cuban, L. (1999). *The technology puzzle.* Retrieved September 3, 2003, from http://www.edweek.org/ew/1999/43cuban.h18

Dirksen, D. J., & Tharp, D. (2000, June 26–28). *Goals 2000: Initial evaluation. Research paper: Moving beyond the crossroads: Teachers as agents for change.* Paper presented at the Connecting @ the Crossroads, NECC 2000: National Educational Computing Conference, Atlanta, GA.

Fabry, D. L., & Higgs, J. R. (1997). Barriers to the effective use of technology in education: Current status. *Journal of Educational Computing Research, 17*(4), 385–395.

Granger, C., Morbey, M.L., Lotherington, H., Owston, R., & Wideman, H. (2002). *Canada: Factors contributing to teachers' successful implementation of information technology*. Retrieved August 25, 2003, from http://www/york.ca/irlt/reports/aerapaper.htm

Heath, M., Burns, M., Dimock, K. V., Burniske, J., Menchaca, M., & Ravitz, J. (2000). *Applying technology to restructuring and learning. Final report.* Austin, TX: Southwest Educational Development Laboratory.

Holland, P. E. (2001). Professional development in technology: Catalyst for school reform. *Journal of Technology and Teacher Education, 9*(2), 245–267.

Honey, M., Culp, K. M., & Carrigg, F. (1999). *Perspectives on technology and education research: Lessons from the past and present*. Retrieved August 7, 2003, from www.ed.gov/Technology/TechConf/1999/whitepapers/paper1.html

Honey, M., Culp, K. M., & Spielvogel, R. (1999). *Using technology to improve student achievement. (Pathways to School Improvement-Online)*. Retrieved July 3, 2003, from http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te800.htm

Knight, P. J., & Albaugh, P. R. (1997). *Training technology mentors: A model for professional development.* Paper presented at the 49th Annual Meeting of the American Association of Colleges for Teacher Education, Phoenix, AZ.

Lemke, C., Quinn, B., Zucker, A., & Cahill, S. (1998). Report to the Commonwealth of Virginia: An analysis of the status of education technology availability and usage in the public schools of Virginia. Santa Monica, CA: Milken Exchange on Education Technology.

Lipsey, M. W. (1990). *Design Sensitivity.* Newbury Park, CA: Sage Publications.

Mann, D., Shakeshaft, C., Becker, J., & Kottkamp, R. (1999). *West Virginia story: Achievement gains from a statewide comprehensive instructional technology program.* Retrieved July 17, 2003, from http://www.mff.org/publications/publications.taf?page=155

Means, B. (1997). *Using technology to enhance engaged learning for at-risk students.* Retrieved July 3, 2003, from http://www.ncrel.org/sdrs/areas/issues/students/atrisk/at400.htm

Mize, C. D., & Gibbons, A. (2000, February 8–12). *More than inventory: Effective integration of instructional technology to support student learning in K–12 schools.* Paper presented at the SITE 2000: Society for Information Technology and Teacher Education 11th International Conference, San Diego, CA.

Page, M. S. (2002). Technology-enriched classrooms: Effects on students of low socioeconomic status. *Journal of Research on Technology in Education, 34*(4), 389–409.

Pisapia, J. R., Coukos, E. D., & Knutson, K. (2000, April 24–28). *The impact of computers on teacher capacity, attitudes, and behaviors in elementary schools.* Paper presented at the American Educational Research Association, New Orleans, LA.

Reeves, T. C. (1998). *The impact of media and technology in schools: A research report prepared for The Bertelsmann Foundation*. Retrieved April 30, 2003, from http://www.athensacademy.org/instruct/media_tech/reeves0.html

Ringstaff, C., & Kelley, L. (2002). The learning return on our educational technology investment: A review of findings from research. San Francisco: WestEd RTEC.

Ross, J. D., McGraw, T. M., & Burdette, K. J. (2001). *Toward an effective use of technology in education: A summary of research.* Charleston, WV: Institute for the Advancement of Emerging Technologies in Education, Appalachia Educational Laboratory.

Russell, J., & Sorge, D. (1999). Training facilitators to enhance technology integration. *Journal of Instruction Delivery Systems*, *13*(4), 6.

Schacter, J. (1999). The impact of education technology on student achievement: What the most current research has to say. Santa Monica, CA: Milken Exchange on Education Technology.

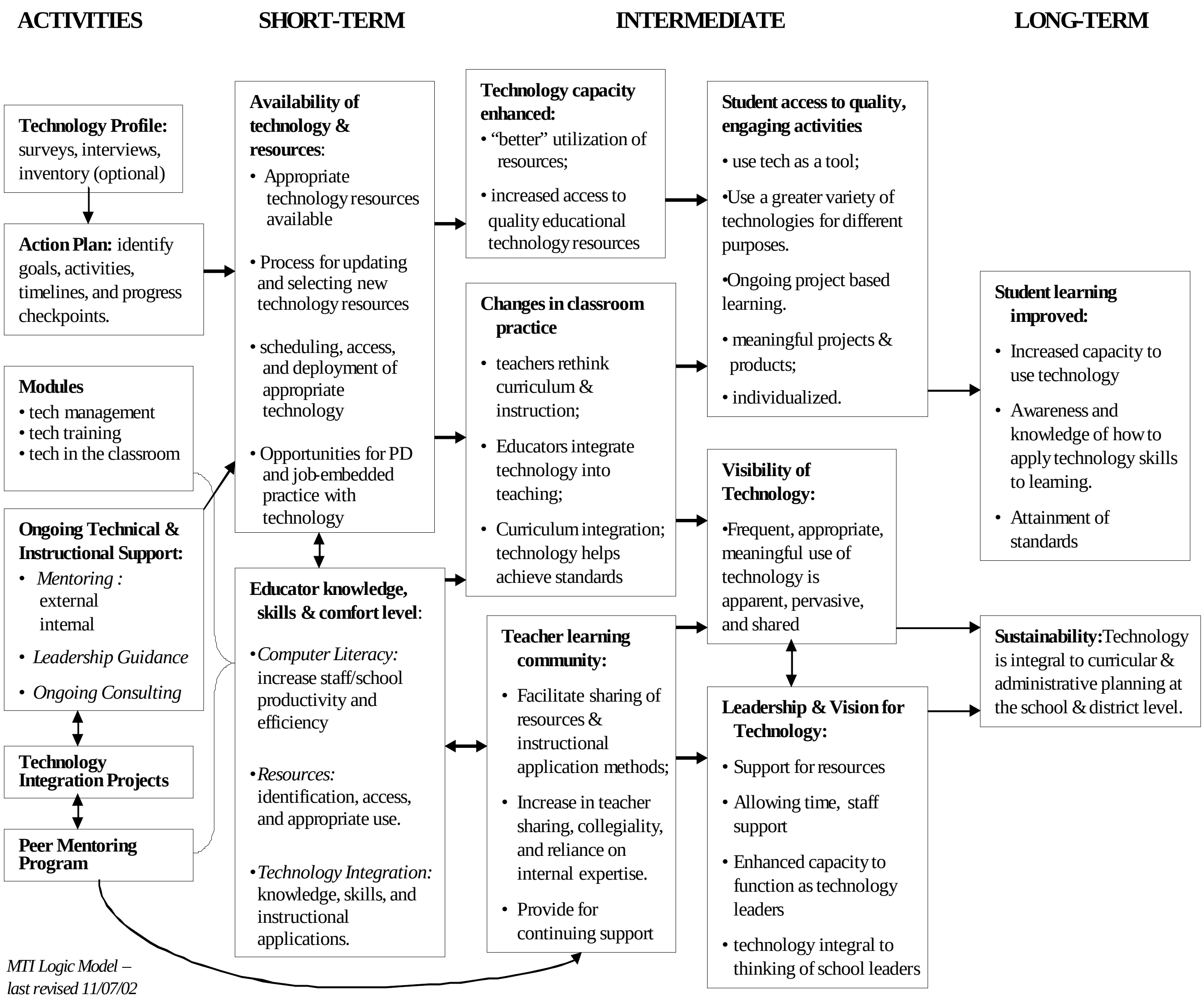
Schacter, J., & Fagnano, C. (1999). Does computer technology improve student learning and achievement? How, when, and under what conditions? *Journal of Educational Computing Research, 20*(4), 329–343.

Sherry, L., Lawyer-Brook, D., & Black L. (1997). Evaluation of the Boulder Valley Internet Project: A theory-based approach to evaluation design. *Journal of Interactive Learning Research*, *8*(2), 199–233.

Shibley, I. A. (2001). Technology, integrated learning, staff development: It's a total package. *Educational Technology, 31*(6), 61–63.

Waxman, H. C., Connell, M. L., & Gray, J. (2002). A quantitative synthesis of recent research on the effects of teaching and learning with technology on student outcomes. Naperville, IL: North Central Regional Educational Laboratory.

APPENDIX B: MTI LOGIC MODEL



MTI Logic Model – last revised 11/07/02

APPENDIX C: TEACHER TECHNOLOGY SURVEY

The purpose of this survey is to gather information about the use of technology in your school. In particular, the information you provide via this survey will help provide your school and district with valuable information that will support technology integration. The survey will also be used by McREL staff to guide their support to your school via the McREL Technology Initiative.

Please be assured that your responses to this survey will be kept completely confidential. Your candidness in responding to the questions is what will make the results from this survey useful – there are no “right or wrong” answers. Your participation in this survey is **greatly appreciated**.

DIRECTIONS

The survey should take about 30 minutes to complete.

The first question on the survey asks for the last four digits of your social security number. This will serve as your anonymous id for this project and is used so that we can compare survey responses over time. Again, please remember that survey results are confidential and reported in aggregate form only[5].

Please answer **every** question

Unless otherwise noted, please mark only **one** response per question.

Thank you for your time and effort!

[5] As well as being used for planning purposes in the McREL Technology Solutions (MTS), the information provided by this survey will be used as part of a formal field test study evaluating the impact(s) of the MTS. Should you have any question about this study, the instruments, or how the information will be used, please do not hesitate to contact Judy Northup at (303)632-5531, jnorthup@McREL.org.

---------------------------------About You ---

1. Please write in the last four digits of your Social Security Number:__________

- ❑ I am a Teacher Leader for the MTS project.
- ❑ I am a member of the Leadership Team for the MTS project.

2. I currently teach the following subject(s): (Mark all that apply)

❑ All Subjects (elementary)	❑ Language Arts	❑ Science	❑ Foreign Language
❑ Social Studies	❑ Mathematics	❑ Visual/ Performing Arts	❑ Vocational Education
❑ Technology	❑ ESL	❑ Special Education	❑ Health/P.E.
❑ Other: specify ________________________________			

3. I currently teach the following grade level(s): (Mark all that apply)

❑ Kindergarten	❑ Third	❑ Sixth	❑ Ninth	❑ Twelfth
❑ First	❑ Fourth	❑ Seventh	❑ Tenth	❑ None of the above
❑ Second	❑ Fifth	❑ Eighth	❑ Eleventh	

4. I have been employed as an educator for__________years.

5. I have actively used technology in my classroom for__________years.

6. I have used technology at home or school for__________years.

7. In a typical 7-day week, I use the computer personally for__________hours and professionally for__________hours.

8. **On average, how many hours per typical 7-day week do you spend using the following?**

Word processing:	_____hrs	Database:	_____hrs	Reference:	_____hrs	Desktop Publishing:	_____hrs
Spreadsheet:	_____hrs	Internet:	_____hrs	Games:	_____hrs	Photo editing:	_____hrs
Multimedia:	_____hrs	Simulations:	_____hrs	Drawing:	_____hrs	E-mail:	_____hrs

9. **Please indicate: 1) how many times <u>you</u> engage in this activity in a typical school <u>month</u>; and 2) your comfort level with each of the following technology activities.**

	Number of times you do this in a "typical" month	**How comfortable are you with this activity?** Very Comfortable				Very Uncomfortable
a. Communicating with other teachers in the district using the email system		1	2	3	4	5
b. Communicating with other professionals outside of the district via email		1	2	3	4	5
c. Sharing technology projects with other teachers (such as lesson plans, multimedia presentations, and web-based activities)		1	2	3	4	5
d. Using electronic grade books for student information		1	2	3	4	5
e. Creating multimedia presentations for my classes		1	2	3	4	5
f. Using scanners and digital cameras to create materials for my classes		1	2	3	4	5
g. Setting up files of Favorites/ Bookmarks for my students to use in research and projects		1	2	3	4	5
h. Conducting online searches to locate resources for my instruction		1	2	3	4	5
i. Publishing materials that I have created on the Internet		1	2	3	4	5
j. Mentoring other teachers in using technology		1	2	3	4	5
k. Discussing technology ideas and resources with other teachers		1	2	3	4	5

10. I would classify myself as the following type of technology user:

(Note: please choose the <u>one</u> response that most closely describes your skill level).

- ❑ **<u>Entry</u>: Teacher who is just starting to use technology for learning**

  Use technology for word processing and data bases

  Use technology predominantly as a student reward activity or specifically for technology training such as keyboarding

- ❑ **<u>Adoption</u>: Teacher who has some comfort level with technology and has taken initial steps to use it in his/her curriculum**

  Use-mail and Internet on a regular basis

  Employ technology in collaborative learning projects with students

  Use technology in student-directed learning where the students designs and implements the projects

- ❑ **<u>Adaptation</u>: Teacher who is shifting toward more student-based project learning and encourages the use of a variety of technology tools**

  Use a variety of multimedia tools and distributes documents electronically

  Student activities become more project based and a wide variety of technology tools are used in

  those projects

  More technology activities involve student-designed projects with the teacher serving as a facilitator

- ❑ **<u>Appropriation</u>: Teacher who is so comfortable with technology that it is integrated throughout all learning activities**

  Use technology for multidisciplinary and problem-solving activities

  Facilitate the use of multiple technologies that result in learner ownership

- ❑ **<u>Transformation</u>: Teacher who creates new ways to use technology tools for real-world applications**

  Involve students in the development of authentic technology-rich activities

  Guide others in applying information resources

----------------------ABOUT YOUR CLASSROOM & WORK SETTING ------------------------

11. Please indicate: 1) whether or not each of the following currently occurs in your classroom; and 2) the extent to which technology supports each.

	How often does this currently occur in your classroom?			Extent to Which Technology Supports				
				No Support	Minor Support	Moderate Support	Major Support	Complete Support
a. I integrate standards into my curriculum.	Frequently	Sometimes	Never	1	2	3	4	5
b. I work with other teachers in the development of lesson plans.	Frequently	Sometimes	Never	1	2	3	4	5
c. I integrate a variety of subjects/content into each of my lessons.	Frequently	Sometimes	Never	1	2	3	4	5
d. I keep students informed of their progress in class.	Frequently	Sometimes	Never	1	2	3	4	5
e. I evaluate electronic versions of student work.	Frequently	Sometimes	Never	1	2	3	4	5
f. I spend my time coaching/advising students.	Frequently	Sometimes	Never	1	2	3	4	5
g. I use class time for students to work in groups.	Frequently	Sometimes	Never	1	2	3	4	5
h. I use class time for students to work on projects.	Frequently	Sometimes	Never	1	2	3	4	5
i. I involve students in the development of learning activities.	Frequently	Sometimes	Never	1	2	3	4	5
j. I use class time for whole group lecture.	Frequently	Sometimes	Never	1	2	3	4	5
k. I use class time for peer tutoring.	Frequently	Sometimes	Never	1	2	3	4	5

12. Please indicate the degree to which the addition of technology to your teaching has changed the learning environment:

❑ **Check here if you do not use technology in your teaching and skip to question #13.**

As a result of adding technology to my teaching …	**Not at All**				**A Lot**
a. My teaching style has changed in that I am more of a facilitator.	1	2	3	4	5
b. I have been able to present more complex materials to my class.	1	2	3	4	5
c. The arrangement of the room has been altered to accommodate technology.	1	2	3	4	5
d. I have used less class time for lecture.	1	2	3	4	5
e. Students direct their own learning.	1	2	3	4	5
f. Students work together in collaborative groups.	1	2	3	4	5
g. Students teach each other.	1	2	3	4	5
h. Student projects include visuals.	1	2	3	4	5
i. Students engage in problem-solving activities.	1	2	3	4	5
j. Students use a variety of resources for their projects.	1	2	3	4	5
k. Student work is creative.	1	2	3	4	5
l. Student work is rigorous.	1	2	3	4	5
m. Student work is shared with a variety of audiences.	1	2	3	4	5

13. Please describe your most recent use of technology in a lesson. What did you do? How did it work?

____

____

____

14. In what content areas do you integrate technology into classroom practices?

❑ Science ❑ Math ❑ Reading/Writing ❑ Social Studies

❑ **Other:____**

15. When I use technology in the classroom, it is ____

(Mark the one response that typically characterizes your usage)

❑ Organized

❑ Chaotic but rewarding

❑ Chaotic and frustrating

❑ **I don't use technology in the classroom**

16. In my class, I get frustrated with technology when:

____

____

17. Please indicate the degree to which you agree or disagree with each of the following statements:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
a. The school administration encourages the use of technology.	1	2	3	4	5
b. My students have adequate access to computers	1	2	3	4	5
c. My school administrator(s) understands how technology can be integrated into the classroom to improve student learning.	1	2	3	4	5
d. I am provided with adequate access to computers for myself	1	2	3	4	5
e. I know how other teachers in my school use technology in their classrooms.	1	2	3	4	5
f. I have sufficient time to integrate technology into my classroom instruction.	1	2	3	4	5
g. Teachers in my school meet and share ideas about how to use technology in their classrooms.	1	2	3	4	5
h. I understand how I can use technology to help me attain school and district standards.	1	2	3	4	5
i. I believe that the use of computers in education almost always reduces the personal treatment of students.	1	2	3	4	5
j. Working with computers means working on your own, without contact with others.	1	2	3	4	5
k. Sometimes I wish that technology would go away.	1	2	3	4	5
l. Integration of technology into classrooms is a high priority for my school administrator(s).	1	2	3	4	5

m. Integration of technology into classrooms is a high priority for me.	1	2	3	4	5
n. I have sufficient training in how to integrate technology into my classroom instruction.	1	2	3	4	5
o. Technology has been helpful in meeting district and state standards.	1	2	3	4	5
p. Technology makes my teaching more effective.	1	2	3	4	5
q. I feel that computers are important for student use.	1	2	3	4	5
r. I use technology in my classroom to enhance student understanding.	1	2	3	4	5
s. I use technology in my classroom to improve student skills.	1	2	3	4	5
t. Technology helps me to accommodate different learning styles.	1	2	3	4	5
u. Computers can be useful instructional aids in almost all subject areas.	1	2	3	4	5
v. Computers can stimulate creativity in students.	1	2	3	4	5
w. Available technology resources are sufficient to support student learning	1	2	3	4	5
x. I am willing to learn or continue to learn about integrating technology into my classroom.	1	2	3	4	5
y. Teachers in my school are involved in decision making related to implementation of technology.	1	2	3	4	5
z. I would like more training in integrating technology	1	2	3	4	5

18. Many of you may have directly or indirectly been involved in the ongoing McREL trainings on technology in your school. The following statements refer to your experiences with the McREL technology training.

Please indicate the degree to which you agree or disagree which each of the following statements:

	Strongly Agree	**Agree**	**Neither Agree nor Disagree**	**Disagree**	**Strongly Agree**	**Don't Know or N/A**
The McREL training has helped me think deeply about how I use technology in the classroom.	1	2	3	4	5	DK or NA
My classroom has benefited as a result of the McREL training	1	2	3	4	5	DK or NA
Teachers in my school share what they learn thru the McREL trainings with one another.	1	2	3	4	5	DK or NA

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Agree	Don't Know or N/A
The McREL training has helped to improve the quality of classroom instruction in my school.	1	2	3	4	5	DK or NA
I receive adequate support from my school/district as I try to implement what I learn thru the McREL training	1	2	3	4	5	DK or NA
As a result of the McREL training, teachers in my school are more proficient in the use of technology	1	2	3	4	5	DK or NA
As a result of the McREL training, students are using technology more in their learning.	1	2	3	4	5	DK or NA

--------------------STUDENT USE OF TECHNOLOGY ----------------------

Because your responses to the questions in this section may be different for different classes/sections you teach, please select a single class/section to use in your responses to these questions. The class you select should represent a typical class you teach in your main subject area.

19. Please indicate: 1) how many times a typical student in your class will have done this activity during the current semester; and 2) <u>your</u> comfort level with each of the following student activities.

	# of times: typical student does this/semester	My comfort level with this student activity is ….	Very Comfortable	Comfortable	Neutral		Uncomfortable
a. Students use word processing for assignments			1	2	3	4	5
b. Students use desktop publishing to create brochures, newsletters, etc			1	2	3	4	5
c. Students create visual presentations			1	2	3	4	5
d. Students design projects that incorporate technology			1	2	3	4	5
e. Students create multimedia projects in which they use tools such as scanners and digital cameras			1	2	3	4	5
f. Students create and/or contribute to electronic portfolios			1	2	3	4	5
g. Students use CD-ROM resources			1	2	3	4	5
h. Students use or create databases/ spreadsheets			1	2	3	4	5

	# of times: typical student does this/semester	My comfort level with this student activity is ….	Very Comfortable	Comfortable	Neutral		Uncomfortable
i. Students use education software, such as Accelerated Reader or Geometer's Sketchpad			1	2	3	4	5
j. Students help other students use technology			1	2	3	4	5
k. Students use e-mail for communication			1	2	3	4	5
l. Students use the Internet for research or gathering resources			1	2	3	4	5
m. Students design web pages			1	2	3	4	5
n. Students use technology to share projects with other students.			1	2	3	4	5

20. Please describe the extent to which most of your students can do each of the following:

	Most of my students ….				
	Cannot do this task	Can do this task with detailed assistance	Can do this task with limited assistance	Can do this task without assistance	Don't Know
a. Search the web for class-related material	1	2	3	4	DK
b. Develop web pages	1	2	3	4	DK
c. Use word processing programs	1	2	3	4	DK
d. Use spreadsheet/database programs	1	2	3	4	DK
e. Use presentation programs (e.g., PowerPoint, etc.)	1	2	3	4	DK
f. Use e-mail	1	2	3	4	DK
g. Develop multimedia class projects	1	2	3	4	DK

21. How many computers (including laptops available on a daily basis) are located in your classroom? ☐

Of these, how many computers are available for student use? ☐

22. How often do you typically use the computer lab or portable lab with your classes? (Mark only one)

- ❑ Almost every day
- ❑ A couple of times per week
- ❑ Once a week
- ❑ Every couple of weeks
- ❑ Once a month
- ❑ Less than that

-----------------------------TECHNOLOGY SUPPORT & NEEDS ----------------------------

23. When I need technology help, I go to:

______________________	______________________
Name	Title
______________________	______________________
Name	Title
______________________	______________________
Name	Title

24. I would like to increase my use of technology in the following ways: (Mark all that apply)

- ❑ Create documents with word processing or databases
- ❑ Conduct research via the Internet
- ❑ Improve classroom record keeping
- ❑ Increase communications with colleagues throughout the country
- ❑ Create multimedia presentations for the class
- ❑ Design more curriculum that integrates technology
- ❑ Use e-mail to communicate with other teachers and staff members within the school
- ❑ Design collaborative projects for my students
- ❑ Individualize instruction for students
- ❑ Let the students use a variety of technology resources to design their own projects
- ❑ Create more units that integrate multiple content areas
- ❑ Provide more authentic, real-world activities
- ❑ Communicate with parents
- ❑ Change the learning environment
- ❑ Conduct online interviews with content-area experts
- ❑ Use graphic organizers
- ❑ Other: Specify ______________________________

25. I would like to have more training in: (Mark all that apply)

- ❑ Using technology with Classroom Instruction That Works (how technology supports the nine effective instructional strategies)
- ❑ Data analysis using Excel
- ❑ Technology planning (developing and implementing a plan)
- ❑ Classroom technology management (managing resources in the classroom)
- ❑ How to use the Internet (searches, downloading files, creating and managing Favorites/ Bookmarks)
- ❑ Using technology with multiple intelligences (linguistic, musical, spatial, etc.)
- ❑ Software evaluation (choosing the right programs for your educational needs)
- ❑ Technology and problem-solving (lesson plan integration with technology)
- ❑ Technology and writing integration (using technology to support writing)
- ❑ Using Microsoft Office applications (Word, Excel, PowerPoint)
- ❑ Technology leadership (making decisions related to technology use)
- ❑ Technology proficiencies and unit planning (research-based strategies for effective unit planning)
- ❑ Other: Specify ______________________________

26. I would like more training in the following types of specific software:

____

____

27. Finally, please complete the following sentence:

My personal vision concerning the use of technology in education is...

____

____

____

____

Thank you for taking the time to complete this survey!

APPENDIX D: ADMINISTRATOR TECHNOLOGY PROFILE

School ____

Your Title ____

About You

1. How many years have you been employed as an educator? ________

2. How many years have you used computers in your job? ________

3. How many years have you personally used computers? _________

4. Indicate your skill level in using the following software: *(circle one response per item)*

	No skill at all		Average		Expert
a. Word processing	1	2	3	4	5
b. E-mail	1	2	3	4	5
c. Desktop publishing	1	2	3	4	5
d. Spreadsheet	1	2	3	4	5
e. Multimedia	1	2	3	4	5
f. Data base	1	2	3	4	5
g. Internet browsers	1	2	3	4	5
h. Student information/ management systems	1	2	3	4	5

5. What type of technology user are you in relation to supporting your teachers? *(Check one box)*

Type I: Educator who is just starting to use technology for learning

- Use technology for personal and professional productivity
- Use technology that is readily available
- Use technology mainly for word processing and data bases

Type II: Educator who has some comfort level with technology and is taking an initial step towards its use in the curriculum

- Use e-mail and Internet on a regular basis

- Use technology for tasks for which he/she has been specifically trained

- Use only one or two technology tools

Type III: Educator who is supporting a teacher's shift toward student-based project learning and encourages the use of a variety of technology tools

- Use a variety of multimedia tools and distributes documents electronically

- Regularly apply technology to meet personal and professional productivity needs

- Organize several technology tools for use in activities and do so with minimal assistance

Type IV: Educator who is comfortable with technology and able to support its integration throughout all learning activities

- Use technology for problem-solving activities and productivity becomes dependent upon technology

- Facilitate the use of multiple technologies among faculty and staff

- Use technology to increase and enhance personal and professional productivity

Type V: Educator who supports the creation of new ways to use technology tools for real-world application

- Provide instruction to peers on how to apply productivity tools to enhance their professional productivity

- Provide demonstrations and assistance to others

6. Indicate the extent to which you agree with the following statements:
(circle one response per statement)

	Strongly disagree	Disagree	Agree	Strongly agree
a. The district encourages the use of technology in your school.	1	2	3	4
b. I encourage staff to use technology.	1	2	3	4
c. The community is supportive of using technology in our school.	1	2	3	4
	Strongly	Disagree	Agree	Strongly

	disagree			agree
d. Teachers in my school are in favor of using technology in their classrooms.	1	2	3	4
e. I know how technology can be integrated into the classroom to improve student achievement.	1	2	3	4
f. Teachers in my school know how technology can be integrated into their classrooms to improve student achievement.	1	2	3	4
g. I believe that the use of computers in education reduces the personal interaction between teachers and students.	1	2	3	4
h. Integration of technology into classrooms is a high priority for me.	1	2	3	4
i. Students have less interpersonal contact with others when working with computers.	1	2	3	4
j. Technology has been helpful in meeting district and state standards.	1	2	3	4
k. Technology makes teaching more effective.	1	2	3	4
l. I feel that computers are useful as instructional aids.	1	2	3	4
m. I believe that computers can stimulate student creativity.	1	2	3	4
n. I use incentives to encourage faculty to participate in technology professional development.	1	2	3	4
o. I help teachers acquire technology for their classroom projects.	1	2	3	4

7. I would like to <u>improve</u> my ability to do the following with technology: *(check all that apply)*

   o Use e-mail to communicate with faculty and parents

   o Conduct research via the Internet

   o Create documents with word processing

   o Create documents using databases

   o Provide better data for decision-making

   o Provide information about students

   o Communicate with colleagues

- o Provide staff development opportunities via the Internet
- o Develop presentations through the use of multimedia
- o Change the learning environment
- o Other ____

About Your School

8. To what extent does your school uses software to: *(circle one response per item)*

	Never	Seldom	Occasionally	Frequently
a. generate spreadsheets	1	2	3	4
b. record finances	1	2	3	4
c. record student registration	1	2	3	4
d. track student demographics	1	2	3	4
e. track student attendance	1	2	3	4
f. track eligibility records	1	2	3	4
g. track IEPs	1	2	3	4
h. generate tests	1	2	3	4
i. score tests	1	2	3	4
j. record student performance	1	2	3	4
k. report student performance	1	2	3	4
l. manage schedules	1	2	3	4
m. record student grades	1	2	3	4
n. generate report cards	1	2	3	4
o. generate transcripts	1	2	3	4

9. Indicate the extent to which you agree with the following statements about planning for technology in your school. (*circle one response per statement)*

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
a. I am familiar with the school's technology plan.	1	2	3	4
b. I was involved in the development of the district's technology plan.	1	2	3	4
c. I was involved in the development of my school's technology plan.	1	2	3	4
d. Teachers were involved in the technology planning process.	1	2	3	4
e. Community members were involved in the technology planning process.	1	2	3	4
f. The school technology plan is reviewed annually.	1	2	3	4
g. The technology plan is being successfully implemented.	1	2	3	4
h. The school technology plan is integrated in the school improvement plan.	1	2	3	4
i. Technology has been integrated into the curriculum plan.	1	2	3	4

10. Indicate the extent to which the following professional development opportunities are used by staff at your school. *(circle one response per item)*

	Never	Seldom	Occasionally	Frequently
a. On-site courses and trainings.	1	2	3	4
b. On-site visits to other schools	1	2	3	4
c. On-site vendor presentations	1	2	3	4
d. Online courses	1	2	3	4
e. Conferences	1	2	3	4
f. Peer training	1	2	3	4
g. Peer mentoring	1	2	3	4
h. Graduate courses	1	2	3	4
i. Summer workshops	1	2	3	4

11. In your school, how much impact has technology had on: (*circle one response for each statement*)

	No impact		Some impact		Major impact
a. providing staff with better data for decision-making?	1	2	3	4	5
b. increasing the amount and types of information people expect from you?	1	2	3	4	5
c. enabling you to do your job more efficiently?	1	2	3	4	5
d. making your job more complicated?	1	2	3	4	5
e. increasing communication with parents?	1	2	3	4	5
f. improving your communication with students?	1	2	3	4	5
g. increasing collaborative learning within classrooms?	1	2	3	4	5
h. increasing individualized curriculum to meet student needs?	1	2	3	4	5
i. increasing class activities that are appropriate for multiple learning styles?	1	2	3	4	5
j. increasing the use of multiple resources for instruction?	1	2	3	4	5
k. increasing student motivation?	1	2	3	4	5
l. reducing tardiness?	1	2	3	4	5
m. reducing absences?	1	2	3	4	5
n. increasing collaboration among staff?	1	2	3	4	5
o. increasing creativity in student projects?	1	2	3	4	5

Thank you...for taking the time to complete this survey.

APPENDIX E: MTS TRAINING MODULE DEVELOPMENT

A series of training modules were developed during the pilot test. These modules addressed specific needs of school leaders and teachers in the infusion of technology into the curriculum. They were designed to be delivered to schools by McREL consultants and were recommended based on the results of the McREL Teacher Technology Survey and in consultation with the school's administrative team. As part of McREL's quality assurance process, each of the MTS modules were pilot tested with educator audiences at least twice, beginning in 2001. The 14 modules are summarized below. The following modules were pilot tested and edited based on participant feedback:

- **Classroom Technology Management** – This module assists teachers in learning how classroom groupings and activities relate to the use of technology, compare present use of technology with desired use of it, identify strategies to reach the desired use of technology, share successful management strategies with peers, and write an action plan to better use classroom- and building-level technology.

- **E-mail and Internet** – This module is designed for teachers who wish to improve their use of Internet resources, both in the classroom and for professional purposes. The e-mail portion of the workshop focuses on using the address book, setting up group e-mails, and sending attachments. It also introduces student e-mail projects as potential classroom activities. Teacher-friendly Internet sites are examined for potential classroom and professional use.

- **Technology Leadership** – This module assists participants in understanding how leadership at many levels builds a technology program. In this module, participants learn to use top-down/bottom-up thinking for successful leadership, and see themselves as leaders.

- **Technology and Lesson Plan Integration** – In this module, teachers discuss technology tools used in education, explore the elements of effective lesson plan design, search a variety of lesson plan websites, design a technology-rich lesson, and design an assessment of student learning for a technology-rich lesson.

- **Proficiencies and Unit Planning** – In this module, participants determine their technological proficiency level, implement an action plan to move to the next level of proficiency, and apply proficiency information and research on effective classroom instructional techniques to their future lesson and unit plan development.

- **Technology Planning** – In this module, participants gain a basic knowledge of the technology planning process, analyze school district technology plan samples, get hands-on experience with a six-step technology planning process, and learn about available resources to aid in technology planning.

- **Technology and Writing Integration** – In this module, participants discuss a five-step writing process and ways technology can support each step, preview websites that support the writing process, practice a variety of strategies in the five-step writing process, preview websites to discover effective methods for developing rubrics, and use rubrics to evaluate student writing samples.

- **Technology and the Problem-Solving Process** – In this module, participants create lesson plans that incorporate problem-solving strategies, create a multimedia presentation to introduce the lesson to their class, learn how to locate and organize resources for use in the problem-solving lesson, and prepare to teach a unit on problem solving.

- **Technology and Multiple Intelligences** – In this module, participants discuss Howard Gardner's theory of multiple intelligences, learn about and use technology resources that support each of the eight intelligence areas, design technology-based activities that support instruction for each of the eight intelligence areas for a theme to use in the classroom, learn how to supply information about multiple intelligence theory and apply it to future lesson plan development, and design at least eight technology-based activities — one for each intelligence area that support classroom instruction.

- **Navigating Desktops and Networks** – In this module, participants learn to identify the basic concepts and classroom uses of networks, identify classroom applications for using group folders on the network, identify the major parts and functions of the desktop, practice switching among open applications on the desktop, learn to discern file and folder structure and appearance, distinguish when to use *Save* and *Save As*, successfully navigate the hard drive and network to retrieve previously saved files, use the *Find* feature to locate previously saved files, and investigate print dialog boxes and how to switch network printers.

- **Software Evaluation and Planning** – In this module participants learn to ask the right questions when selecting software, create a project to evaluate productivity software, develop criteria to evaluate classroom software, and begin to develop a software plan for your school or district.

- **Microsoft Office™ in the Classroom** – In this module, participants learn about the three most widely used components of Microsoft Office: Word, PowerPoint, and Excel in both Windows and Macintosh operating systems. Participants also discuss ways to apply these applications in their classrooms.

- **Data Analysis Using Excel –** In this module, school and district leaders deepen their understanding of data and develop strategies for data utilization and presentation.

- **Using Technology with Classroom Instruction that Works –** In this module, participants examine the nine effective instructional strategies addressed in *Classroom Instruction that Works* (Marzano, Pickering, & Pollock, 2001) from a technology integration perspective.

The **E-Mail & Internet** and **Navigating Desktops and Networks** modules were eliminated from the set of training materials in view of feedback from administrators and teachers in the field, which indicated that this content was no longer relevant to the needs of schools and districts.

APPENDIX F: DESCRIPTION OF PILOT SITES

Deuel School District, Clear Lake, South Dakota
This rural district includes the elementary, middle, and high schools (K–12) located in Clear Lake. In fall 1999, student enrollment was approximately 630, and there were approximately 39 teachers. The district's interest in participating in the MTI was built on a desire to increase students' engagement in learning.

Summit Middle School, Frisco, Colorado
This middle school, which includes grades 6 through 8, had approximately 660 students and a staff of 50 teachers in 1999. Summit has a highly developed technology infrastructure and a strong desire for increased professional development in technology.

Weston County School District #7, Upton, Wyoming
This district includes the elementary, middle, and high schools (K–12) located in Upton. In 1999, the school had 292 students and 26 teachers. The district's long-term goal is to help students use technology to facilitate problem solving and higher order thinking.

Lone Jack School District C-6, Lone Jack, Missouri
Staff at Lone Jack can be characterized as having the lowest level of technology expertise of all six pilot sites. The focus of the MTI intervention in the initial year was to develop basic technology skills among core staff via department professional development, and to increase the visibility of teacher technology use and projects.

Smoky Valley School District #400, Lindsborg, Kansas
Survey responses and administrator nominations were used to identify teachers who would be trained to become mentors. The 2001 plan included working with these teachers on technology integration through applied projects and technology showcases and development of a comprehensive district technology plan. The peer training program began in fall 2002.

Grand Island Senior High School, Grand Island, Nebraska
This site was selected in order to investigate the effectiveness of the MTI process with a large staff and student population. In 2001, there were 125 teachers and 1,700 students in this school. A priority at the school has been the resolution of issues related to the technical infrastructure. Teachers who would be trained to become mentors were identified in 2001. School leaders identified the use of technology to facilitate problem solving as an initial emphasis.

APPENDIX H: TECHNOLOGY INTEGRATION READINESS SURVEY

	1	2	3	4	5	Rating
Hardware and Infrastructure						
Labs (approx 15-20 machines) (include mobile labs)	One per 300 or more students	One per 226 to 299 students	One per 165 to 225 students	One per 131 to 164 students	One per 130 students or less	
	Notes:					
Student to computer ratio (net connected)	8 students or more/ computer	7 students/ computer	5 or 6 students/ computer	4 students/ computer	3 students or fewer/ computer	
	Notes:					
Infrastructure	20% or less of computers are networked and Internet capable	21-60% of computers are networked and Internet capable	61-84% of computers are networked and Internet capable	85-90% of computers are networked and Internet capable	Over 90% of computers are networked and Internet capable	
	Notes:					
Network reliability	• Network frequently down (more than five times in the most recent semester) • Outages last over 2 hours	• Network down often (more than once a month 4-5 times) • Outages usually last for at least an hour	• Network down 2–3 times a semester • Outages usually for an hour or less	• Network down 2–3 times a year • Outages last less than an hour	• Network downtime is less than twice a year • Outages last less than an hour	
	Notes:					

	1	2	3	4	5	Rating
Hardware and Infrastructure						
Network speed	• Slow network login is routine • Speed degraded with more students on internet • Noticeable slowdown during network login and class changes	• Network login time is acceptabl e • Users may experienc e a dip in speed during class changes.	• No speed degradatio n during a full lab • Network login time is acceptable	• Users may experience some slowness during class changes • Graphic-heavy web pages may load slowly when labs are full • Network login is quick	• Even graphic-heavy web pages load quickly • No significant sluggishness during class changes • No speed degradation during a full lab	
	Notes:					
Projection system (not TV monitors)	1/350 or more students	1/250-350 students	1/176-249 students	1/131 to 175 students	1/130 or fewer students	
	Notes:					
Avg. # of computers per classroom (LAN/WAN connected to Internet)	0	1	2	3 - 4	5 or more	
	Notes:					
Multimedia computers (capable of playing audio and video)	1/8 or more students	1/6-7 students (2001 national average)	1/4-5 students	1/3 or fewer students	• 1/3 or fewer students • One multimedia authoring machine per lab (audio and video production)	
	Notes:					

	1	2	3	4	5	Rating
Software Note: In this section, use Ratings 1, 3, and 5 ONLY						
Word Processing	No word processing software on computers.		All computers have word processing software, but different versions or old versions.		All computers have current versions of word processing software.	
	Notes:					
Spreadsheet (mandatory at MS and HS)	No spreadsheet software on computers.		All computers have software, but different versions or old versions.		All computers have current versions of software.	
	Notes:					
Presentation	No presentation software on computers.		All computers have software, but different versions or old versions.		All computers have current versions of software (PowerPoint or HyperStudio type).	
	Notes:					
Gradebook	No gradebooks used	Gradebooks used by some teachers	Different versions of gradebooks are used by all teachers	Gradebook is part of the student information system	Gradebooks tied to standards and DDDM	
	Notes:					
Personnel						
Tech support	• Staff overwhelmed with numerous problems	• Person(s) designated for support, but not	• Designated staff to keep network reliable and maintain	• Adequate staffing to keep network reliable and	• Staff maintains equipment in expeditious	

	1	2	3	4	5	Rating
	and lack level of expertise • No one designated or allocated time for the job	given enough time or training to do so	equipment • Significant or long delays remain	maintain equipment without long delays	manner, network problems few	
	Notes:					
Planning **Note: In this section, use Ratings 1, 3, and 5 ONLY**						
Technology Plan	Has minimal plan required by state and E-rate		• Has a current plan which includes - Needs assessment - Goals - PD strategy - Budget - Evaluation • District tech committee is in place • Plan evaluated annually		• Tech plan is part of district consolidated or strategic plan • Plan is updated based on evaluation 3 or more times per year	
	Notes:					
Administrators participate in Gates grant	No participation		Some administrators have participated		All district administrators (supt., principals) have participated	
	Notes:					

Additional Infrastructure Information

Lab Access (student time) HS- typical 10th grader EL average access	30 min or less/week	Between 30 and 60 minutes/week	between 1 & 2 hrs per week	Between 2 & 3 hrs per week	3 hrs or more per week
	10 minutes or less per week	11-35 minutes per week	35-45 minutes per week	45min-1.5 hr per week	Over 1.5 hr per week
	Notes:				
Operating system (gets to machine capability)	Win 95 Mac 7.6<		Mac 8.x> Win 98		Mac 9.x> Win 2000 or XP
	Notes:				
Web Browser	Internet Explorer <4 Netscape Navigator <4		Netscape Navigator 4 Internet Explorer 5		Netscape Navigator 7 Internet Explorer 6
	Notes:				

Professional Development Information

- School/district will provide substitutes for job-embedded release time _____Yes _____No
- How many substitutes in your district? ____
- Any problems getting enough subs? ____

  Notes: ____

  School/district will utilize PD days in school calendar for MTI _____Yes_____No

  Notes: ____

  School/district offers stipends or other incentives for off-contract hours _____Yes _____No

  Describe incentive - i.e.,

  - Provide teachers with computers or software
  - Credit available
  - Other incentives (describe):
    ____
    ____

- Teachers routinely participate in professional development
  - Evenings __________
  - Weekends__________
  - Summer __________

  Describe Professional Development:

  - _____ hands-on
  - _____ set and get
  - _____ small group collaborative activities
  - _____ teachers can use immediately in classroom
  - _____ teachers expected to use immediately in classroom
  - _____teachers have some choice in professional development activities
  - _____ teachers involved in planning professional development activities
  - _____ teachers involved in teaching professional development activities

- ______ number of professional development days
- How do you integrate technology into professional development opportunities? Explain.
  ____
  ____

Initiatives the school or district is participating in:

____
____
____
____
____

Teacher Scale

	ENTRY	**ADOPTION**	**ADAPTATION**	**APPROPRIATION**	**TRANSFORMATION**
Percentage of teachers at skill levels	Teachers just starting to use technology and for minimal things like word processing.	Teachers have some comfort with technology as a curriculum tool. Some use in student-designed technology projects.	Shifting towards more student-based learning. Uses variety of multimedia tools and acts as a facilitator for student learning.	Technology integrated throughout all learning.	Uses technology integrally in most applications. Provides assistance to peers and engages students in authentic tasks.
	Notes:				

Interest level of site personnel participating in this interview, and other notes:

____
____
____
____
____

APPENDIX I: MTS LESSON PLANNING GUIDE

Name:

Subject Area:

Grade Level:

Lesson Title:

Brief lesson Description:
District content Standard addressed
NETS*S technology standard addressed (http://cnets.iste.org/students/s_stands.html)
Technology resources needed:
Procedure (introduction, activity, technology integration)
Assessment:

APPENDIX J: MTS REFLECTIVE DIALOG PROTOCOL

Purpose:

1. experience another classroom environment
2. engage in reflective conversation about professional practice
3. observe students in another learning environment
4. contribute to professional growth

Method (do this twice a semester):

1. Pair with one or two other teacher leaders.
2. Select a good time to visit each other’s classrooms for a minimum of 20 minutes. Pick a time when technology is being used.
3. Discuss what the lesson will be about ahead of time.
4. Spend a minimum of 20 minutes in each other’s classroom using the *Look For* list below as a guide.
5. When both teachers’ visits are completed, schedule an informal meeting to discuss the lessons and what each teacher saw. This meeting will probably take a minimum of 30 minutes. Use the *Guiding Questions* sheet as a guide for this meeting.

Look For:

To what extent are the following things happening during the lesson?

1. Students are engaged in discussions and debate that includes collaboration and commenting on and reviewing their own and other’s work.
2. Students are encouraged to think independently.
3. Students design something that fosters critical thinking, judgment, and personal involvement.
4. Students are engaged in project-based learning that involves problem solving, making predictions, designing plans, collecting and analyzing data, drawing conclusions, and communicating findings.
5. Students are engaged in meaningful projects.
6. Students are using computers as tools (not as simply machines) to design and carry out projects.

APPENDIX K: REFLECTIVE DIALOG PROTOCOL GUIDING QUESTIONS

Talk with your partner teacher about the lesson and what you saw students doing using the *Look For* list. Then use these questions to guide your discussion about technology integration:

How did the use of technology change your teaching of this lesson?

Has technology changed the way you manage your classroom?

How will this lesson impact student achievement?

Looking back, is there anything you would do differently next time?

Where do you want to go from here?