Evaluation of the Texas Technology Immersion Pilot

Third-Year (2006–07) Traits of Higher Technology Immersion Schools and Teachers

July 2008

Prepared for
Texas Education Agency

Prepared by
Texas Center for Educational Research

TCER
Texas Center for Educational Research

Texas Center for Educational Research
P.O. Box 679002
Austin, Texas 78767-9002
800-580-TCER (8237)
512-467-3632 512-467-3658 (fax)
www.tcer.org

TCER
Texas Center for Educational Research

Evaluation of the Texas Technology Immersion Pilot:

Third-Year (2006-07) Traits of Higher Technology Immersion Schools and Teachers

July 2008

Prepared for
Texas Education Agency

Prepared by
Texas Center for Educational Research

Credits

Texas Center for Educational Research

The Texas Center for Educational Research (TCER) conducts and communicates nonpartisan research on education issues to serve as an independent resource for those who make, influence, or implement education policy in Texas. A 15-member board of trustees governs the research center, including appointments from the Texas Association of School Boards, Texas Association of School Administrators, and State Board of Education.

For additional information about TCER research, please contact:

Catherine Maloney, Director
Texas Center for Educational Research
12007 Research Blvd.
P.O. Box 679002
Austin, Texas 78767-9002
Phone: 512-467-3632 or 800-580-8237
Fax: 512-467-3658

Reports are available at www.tcer.org and www.etxtip.info

Contributing Authors

Shapley Research Associates, LLC
Kelly Shapley, Ph.D.

Texas Center for Educational Research
Catherine Maloney, Ph.D.
Fanny Caranikas-Walker, Ph.D.
Daniel Sheehan, Ed.D.

Prepared for

Texas Education Agency
1701 N. Congress Avenue
Austin, Texas 78701-1494
Phone: 512-463-9734

Research Funded by

U.S. Department of Education
Texas Education Agency

Table of Contents

Executive Summary

The Technology Immersion Pilot (TIP), created by the Texas Legislature in 2003, called for the Texas Education Agency (TEA) to establish a pilot project to "immerse" schools in technology by providing a wireless mobile computing device for each teacher and student, technology-based learning resources, training for teachers to integrate technology into the classroom, and support for effective technology use. The TEA has used federal Title II, Part D monies to fund Technology Immersion projects for high-need middle schools. Researchers are conducting a four-year investigation of the effects of Technology Immersion on schools, teachers, and students. The Texas Center for Educational Research is the TEA's primary partner for the evaluation that began in the 2004-05 school year and will continue through 2007-08.

Given that TIP is a pilot project, one aspect of the research has centered on studying how the 21 treatment schools implemented the Technology Immersion model. As a way to gauge schools' progress, researchers developed quantitative measures of implementation fidelity (i.e., the extent to which a school implemented the prescribed components of Technology Immersion). Additionally, researchers have explored the nature of implementation through site visits conducted at middle schools on four occasions: fall 2004 (project initiation), spring 2005 (first year), spring 2006 (second year), and spring 2007 (third year). During site visits, we conducted interviews with district administrators, school principals, and technology leaders; focus groups and interviews with core-subject teachers; and focus groups with students. Structured conversations with educators and students solicited their views on project implementation and opinions about project effects on everyone involved.

Purpose of the Present Study

Evidence from the first two project years revealed that some schools struggled to implement the Technology Immersion model as designed, while other schools reached far higher levels of implementation. Thus, in the third year researchers investigated *why* some schools and teachers made notable progress toward creating technology-immersed schools and classrooms, while others had minimal success. Our study of third-year implementation was guided by two major research questions: (a) What are the differences between higher and lower Technology Immersion schools, and what factors explain variations in implementation; and (b) what are the differences between teachers who report higher and lower levels of Classroom Immersion, and what factors are associated with those differences? An overarching purpose of the study was the identification of traits of higher implementing schools and teachers that would provide information on effective implementation practices for other educators wanting to pursue Technology Immersion.

Methodology

Researchers used measures of implementation fidelity to select higher and lower immersion schools and teachers. We used a third-year composite measure of school implementation (Implementation Index) to identify four schools with the highest implementation indices and four schools with the lowest indices. Additionally, we used teachers' second-year Classroom Immersion Index to identify core-subject teachers with indices in the highest quartile and those in the lowest quartile. Subsequently, during third-year site visits, we conducted individual interviews with a sample of 37 teachers, including 19 higher and 18 lower implementers. We also observed lessons in higher and lower immersion classrooms.

Our comparative analysis of higher and lower immersion schools and teachers drew from quantitative implementation indices, state Academic Excellence Indicator System (AEIS) reports, transcripts of interviews and discussions with educators and students, and site-visit reflections written by researchers. For qualitative analyses, we used a constant comparative methodology that involved data coding, identification of key issues and recurrent themes, development of descriptive narratives, and synthesis of narratives to identify and explain prevalent themes. Quantitative demographic and performance data contributed to a more comprehensive understanding of circumstances.

Major Findings

Traits of Higher Technology Immersion Schools

Qualities of higher implementing schools as described below stimulated growth toward higher levels of implementation over time.

Contextual Conditions and Project Initiation

Successful implementation depended on organizational conditions and the actions of people within contexts rather than the characteristics of higher and lower immersion schools and their districts. Although contextual conditions differed to some extent at higher and lower immersion schools, overall evidence suggests that the implementation fidelity of Technology Immersion was largely a function of organizational conditions and the actions of people such as district and campus administrators, teachers, and parents. Contextually, higher immersion schools, similar to lower immersion, were located in districts of varied sizes (about 400 to 15,000 students). Like all TIP grantees, higher implementing schools served large proportions of economically disadvantaged (58%) and minority students (49%). Districts had less property wealth than districts statewide, and the scarcity of local financial resources was one factor that motivated educators to apply for TIP grants. Lower immersion schools had somewhat more disadvantaged (76%) and minority (62%) student populations and slightly fewer financial resources than higher implementers. Nevertheless, information to follow supports our assumptions about the links among organizational circumstances, personal agency, and the quality of implementation.

Higher Technology Immersion schools had authoritative decision makers involved in the TIP grant application process and had more time to plan for project initiation. Each of the four higher implementing schools involved authoritative figures, such as the superintendent, an assistant superintendent, or school board members, in the grant application. Most of the schools (three of four) submitted first-round applications and received awards in May 2004. Conversely, only one lower implementing school received an award in May and three schools learned about their awards in August. Thus, higher implementing schools had more time to plan for project initiation than lower immersion schools. Additional time allowed schools to schedule professional development, prepare for wireless technology, and inform teachers about the grant and its implications.

Three of four higher implementing schools selected the Apple Technology Immersion package, whereas one selected the Dell package. The criteria schools typically used for TIP package selection was alignment with the district's preferred technology platform. Many factors besides the vendor package influenced implementation, but it is noteworthy that the Apple package included more resources that directly supported student content-area learning (e.g., TeenBiz, Explore Learning, My Access Writing) whereas the Dell package included more resources that supported teaching (e.g., eChalk, Dell Exchange). Apple Computer also had substantially greater experience with one-to-one laptop initiatives prior to the TIP project compared to Dell, and this knowledge may have helped Apple schools get off to a better start.

District and School Leadership

Higher Technology Immersion schools had district leaders with authority and clout who were strongly committed to the Technology Immersion concept, maintained a close and ongoing relationship with the middle school, worked as a team with campus leaders, and monitored classroom practices. District leaders, including superintendents, assistant superintendents, and district technology directors, demonstrated strong buy-in for the Technology Immersion project. They maintained frequent contact with schools, helped facilitate project events, and marshaled needed resources. District and campus leaders acted collectively as a team throughout the project. District leaders visited schools regularly and often observed classrooms to monitor the use of technology for instruction and learning. In contrast, district leaders for lower implementing schools were more likely to be district technology directors rather than higher level administrators. They initially provided strong project support but school interactions and direct support diminished over time. Thus, when principals left schools, there was no strong district leadership to sustain project momentum.

Principals at higher implementing schools articulated a vision for Technology Immersion, strongly supported teachers' professional development, provided encouragement for changed practice, expressed expectations for technology use, and monitored teachers' classroom practices. Nearly all of the middle schools experienced fluctuations in principal leadership during three project years; however, principal changes at higher implementing schools had a less disruptive effect because other project leaders helped schools weather the leadership transition period. As a whole, principals at higher immersion schools were strong advocates for Technology Immersion and touted its benefits for students. They addressed teachers' need for professional development on curricular integration of technology. Principals also understood the complexity of change and promoted teachers' changed practices through actions such as verbal encouragement, required participation in training, accountability for technology use, and observations of classroom practices. Conversely, leadership fluctuations at lower implementing schools reduced the clarity of goals for immersion, weakened lines of communication among project staff, and diminished the quality of professional development.

Higher Technology Immersion schools typically had adequate levels of campus support for project implementation (at most, a campus staff-to-student laptop ratio of about 1:250). Technology Immersion requires substantial support to facilitate logistical arrangements, deal with daily technical problems, handle policy issues, interact with parents, and more. At higher implementing schools, staffing patterns varied from 3.5 people at a large school (more than 900 students) to zero campus support persons at a very small school (100 students). Overall, higher implementing schools had a campus staff-to-student laptop load (about 1:250) that was about half the ratio at lower implementing schools (about 1:430). Staffs at higher implementing schools were challenged to fulfill their many roles, but staffs at most lower implementing schools were overwhelmed by project demands.

Supportive Policies

Higher Technology Immersion schools implemented policies that reduced parents' financial risks associated with laptop damage, promoted home laptop use, and held students accountable for behavior yet advanced the use of laptops for learning. Higher implementing schools usually implemented policies that reduced parents' financial risks through laptop insurance policies with reasonable fees and deductibles, and financial accommodations for impoverished families. Nearly all schools had policies that allowed student access to laptops "24/7" (24 hours a day/7 days a week) and required students to have laptops at school each day. Also, higher immersion schools had policies that held students accountable for behavior, yet still advanced the use of laptops as a learning tool. Laptop confiscation generally was used as a last disciplinary option. Lower immersion schools had policies that placed parents at substantial financial risk or did not require parents to assume any risks. These schools often restricted students' laptop use outside of school, failed to enforce home-to-school laptop transport policies, used laptop

confiscation as a penalty for conduct infractions, or enacted policies that punished parents for students' misbehavior.

Parent and Community Support

Higher Technology Immersion schools typically gained parent and community support for the project at the beginning and then continued outreach efforts—informational, educational, and financial—across years. Most of the higher implementing schools initially held orientation sessions that helped parents see how children's experiences with laptops would enrich their lives. Maintaining parent support was a continuing goal as schools provided annual orientation sessions, hosted special events, used the media to disseminate information, enhanced school and teacher websites, offered training sessions, and tried to alleviate financial constraints. Lower immersion schools garnered strong parent and community support initially but support waned substantially due to factors such as ineffective policies, untenable financial risks, and insufficient efforts to build parents' knowledge about computers and the Internet.

Technical Support

Higher Technology Immersion schools were generally successful at maintaining stable networks, providing ongoing technical support that kept laptops in students' hands, and building a school culture that advanced responsible laptop care. Most of the higher immersion schools addressed wireless network and bandwidth problems in the first project year. Thus, most schools had healthy networks and sufficient bandwidth to support laptop computers. These schools also had at least an adequate level of campus support staff to address technical challenges, and they more often had sufficient and timely support from district technicians that helped address the increasing volume of repairs as laptops aged. Some schools promoted a "culture of care" that raised students' awareness of their laptop responsibilities. Lower immersion schools more often had undependable networks, overloaded technicians, unpredictable district assistance, and varied technical problems that discouraged laptop use.

Professional Development

Higher Technology Immersion schools had stable and close relationships with vendor professional development providers. Professional development for teachers was a high priority at these schools. Higher implementing schools typically maintained continuous relationships with vendors that allowed consultants to establish exceptionally positive relationships with teachers. Professional development was characterized by dedicated school days for training, at least some opportunities for all teachers to share experiences, training based on teachers' evolving needs, and progression from the first-year focus on proficiency with immersion package products to an increased emphasis on technology-integrated lessons, subject-specific lesson development, and the use of more advanced technology applications for projects. In contrast, professional development at lower implementing schools was characterized by frequent changes in vendor trainers, brief sessions for teacher groups held during or after the school day, and an emphasis on familiarizing teachers with immersion products and Internet resources.

One large school provided ongoing, campus-based pedagogical support for classroom technology integration. Campus specialists at this school offered training sessions on a variety of topics and met with teams of teachers weekly to plan content-related lessons. Specialists provided additional supports such as in-class modeling, co-teaching, working with students, and working with teachers on classroom management. The school also had an eight-member collegial support team. A cadre of core-content teachers received stipends for providing training and support for their subject-area peers and new teachers. Pedagogical support at this school more closely approximated the kind of support envisioned for the immersion model.

Higher implementing schools held teachers accountable for participation in staff development and for the use of new practices in their classrooms. Teachers also participated in other learning opportunities that advanced classroom integration. Administrators at higher implementing schools recognized the importance of required teacher participation in technology-related professional development and the need to monitor how teachers applied information in their classrooms. Changes in teachers' practices had been observed during administrative walkthroughs and classroom observations. Vendor-provided training also was enhanced through other learning opportunities for teachers, such as interactions with peers at conferences, sessions with specialized consultants (e.g., Texas mathematics teacher of the year), focused subject-area training in partnership with other districts, and assistance from regional education service center specialists. Respondents at lower immersion schools, on the other hand, believed professional development had increased teachers' comfort with technology and their access to resources. Additional learning opportunities often advanced other district priorities rather than Technology Immersion.

Teacher Support

Teacher turnover was a continuing challenge at Technology Immersion schools. Across all schools, gaining and maintaining teacher support for Technology Immersion was demanding as teachers left schools and new teachers arrived. However, teacher instability was a smaller problem at higher immersion schools (three-year turnover rate of 31%) compared to lower immersion (50% turnover rate). The quantity and quality of professional development offered at higher implementing schools helped new teachers make the transition into an "immersed" school.

Teachers at higher immersion schools had positive attitudes and supportive collegial relationships, recognized the high priority administrators gave the project, had high-quality professional development, and grew stronger instructionally over time. Teachers at higher implementing schools generally had a positive attitude about their work, a sense of humor about their new immersion experiences, and a good working relationship with their colleagues. Consistent administrative messages about the benefits of the project for students raised teachers' awareness of *why* immersion was important. The extent and quality of staff development advanced changes in teachers' attitudes as well as their practices. Many respondents described teachers' incremental growth toward greater competency and independence and increased integration of technology into lessons. On the contrary, teachers at lower implementing schools had uneven leadership for immersion, resisted changed practices, and abandoned instructional efforts when faced with technical barriers.

Teachers at higher immersion schools believed laptops improved student learning. Teachers' support for Technology Immersion apparently arose from the benefits they saw for students. Many teachers at higher implementing schools believed laptops had expanded students' world view through widespread access to information, enhanced the relevance of information studied, narrowed the technology equity gap, increased student interest and engagement in learning, and improved the quality of students' products. Some teachers believed laptops had particular benefits for special populations, such as special education and gifted and talented students. Conversely, many teachers at lower implementing schools believed laptops had a negative effect on student behavior, and some teachers linked laptops with lower TAKS scores. Drops in accountability ratings at three of four lower immersion schools at the end of the first year confirmed some teachers' fears about the negative influence of laptops on TAKS preparation.

Student Experiences

Students at higher Technology Immersion schools typically had one-to-one access to laptops within and outside of school. Students at three schools had full access to laptops "24/7" while students at another school checked laptops out each morning and returned them at the end of the day. Students lost their laptops most often for repairs, but most schools had loaner laptops or desktops in classrooms that students could use until their laptops were returned. Students were familiar with laptop rules and penalties

for infractions, and were aware that technicians and administrators monitored their actions. At lower immersion schools, student access to laptops ran counter to TIP provisions. Student access was limited across schools because laptops were distributed as classroom sets, restricted to check-out for special assignments, refused by some parents and students, not provided for all students, or frequently left at home.

Students at higher immersion schools used laptops for an array of assignments in their core classes, and they used laptops for some complex and challenging projects. Eighth graders described their uses of laptops in science and social studies classes. The frequency of laptop use in science varied across higher immersion schools from once or twice a week to nearly every day. Students used laptops in science classes for lab experiments, WebQuests, concept mapping, charts and graphs, Internet research, videos, Brain Pop, note taking, vocabulary, textbook questions, and Study Island. Students' laptop use in U.S. History ranged from seldom (one school with a new teacher) to nearly every day. Students used laptops for WebQuests, educational games, Comic Life collages, note taking, tests, vocabulary, textbook questions and chapter summaries, and Study Island. Eighth graders at higher immersion schools were proud of their work on more complex projects that culminated in the creation of products (e.g., podcasts, presentations, reports, website, video, eight-page story).

At lower immersion schools, eighth graders typically used their laptops in mundane ways in their core-subject classes, such as making PowerPoints on various topics, gathering information from the Internet, and completing activities for basic skill acquisition or test preparation. In general, students used laptops infrequently in core classes (a few times per month), and they had difficulty remembering assignments done with laptops that made them proud of the work completed.

Students at some higher implementing schools used laptops extensively for learning at home. Eighth graders at two schools used laptops at home for schoolwork from several times a week to almost daily. Students had used laptops for U.S. History class (textbook questions, Internet research, projects), Spanish class (study vocabulary), English class (projects), and science class (labs, WebQuests, concept maps, vocabulary, study guides). Students also used their laptops at home in other ways, such as listening to music, playing games, doing Internet research or searches, editing music, drawing with Photoshop, chatting, and visiting social-networking sites. Eighth graders at one school rarely used laptops for schoolwork at home because assignments were usually finished during a homework class. Students at another school never checked out laptops to do schoolwork at home. Students at lower immersion schools rarely used laptops at home for schoolwork or any other purposes.

Teachers at higher immersion schools encouraged students' use of laptops outside of school by engaging students in projects or assignments that motivated them to continue working outside of class. Eighth graders' use of laptops for schoolwork outside of school was spurred by teachers who began work during classes that either required or inspired students to continue working on assignments at home. Also, access to electronic textbooks on laptops allowed many students to continue working on chapter questions or studying vocabulary terms at home.

Students at higher implementing schools believed laptops had improved their learning by making schoolwork more interesting and fun, providing immediate access to diverse informational resources, improving their technical skills, and allowing them to get better grades and prepare for the TAKS test. Eighth graders at higher immersion schools said laptops made schoolwork more enjoyable, and they learned more because of immediate access to information on the Internet or from electronic dictionaries, encyclopedias, and textbooks. Students believed their technical skills had improved especially their keyboarding and familiarity with various applications. Some students believed laptops helped them to get better grades or to be better prepared for TAKS tests.

Eighth graders at two lower implementing schools believed laptops had little if any effect on their learning because of infrequent use, whereas students at two schools cited positive effects, such as having more information from the Internet, completing work faster, getting better grades, and being prepared for the TAKS test.

Students at higher immersion schools believed laptops helped them personally to be more organized and efficient, more responsible, and better prepared for the future. Eighth graders at higher implementing schools thought keeping work in folders on laptops made them more organized and less apt to lose their work, and it was easier to retrieve documents for review. Students liked electronic textbooks instead of heavy books. Some eighth graders thought laptops had made them more responsible because they had to take care of their computers and were held accountable for damages. Many eighth graders believed they were better prepared for future employment because of their technical skills. In contrast, eighth graders at two lower implementing schools thought having laptops had not affected them personally, whereas a few students at two schools cited positive effects relative to responsibility, increased self-esteem, and preparation for college.

Traits of Higher Classroom Immersion Teachers

Findings below describe attributes of higher implementing teachers, including their characteristics, immersion supports, nature of Classroom Immersion, student effects, and observed practices.

Teacher Characteristics and School Context

Higher Classroom Immersion teachers included a mix of White, Hispanic, and African American teachers, who were often mid-career professionals (6 to 15 years experience). Higher implementing teachers included a blend of White (68%), Hispanic (21%), and African American (11%) teachers, whereas lower immersion teachers were predominantly White (83%). Higher implementers had fewer years teaching experience (12.3 years versus 16.8). Only a few higher immersion teachers were late in their careers (5% with 26 years or more experience) compared with more than a quarter of lower implementers (28%). Teachers earlier in their professional careers were more comfortable with technology and more likely to see long-term benefits from efforts invested in professional growth.

The school's implementation fidelity was the contextual condition that seemed to most influence teachers' instructional practices. Higher immersion teachers were concentrated in higher Technology Immersion schools, whereas lower implementing teachers tended to work in lower implementing schools. There were minimal differences between teacher groups in the average size of their schools, the demographic characteristics of students taught, or the TAKS achievement context.

Supports for Classroom Immersion

Higher Classroom Immersion teachers had principals that emphasized technology's positive value for students, allocated time for planning technology-integrated lessons, and monitored classroom technology use. Higher implementing teachers said their principals supported technology integration through a focus on students, such as giving feedback and discussing technology issues with students. Principals also allocated time for teachers to plan technology-integrated lessons, and they monitored teachers' use of technology through periodic classroom visits. In contrast, lower Classroom Immersion teachers described principals' efforts to model technology use by using email, making electronic presentations, or posting information on school websites.

Higher Classroom Immersion teachers either participated in more professional development or they assimilated more information from training. They also took part in a variety of locally sponsored staff development opportunities. Higher implementing teachers provided explicit details about the content

covered in training sessions. Teachers at some schools said third-year training was a refresher on basics and package resources, whereas teachers at other schools said training evolved in the third year to include more complex technology-based projects and advanced topics (e.g., iWeb, iDVD, video cameras and editing). Moreover, higher implementing teachers had participated in additional sessions provided locally on topics such as Inspiration software, Internet safety, website design, podcasting, and Google Earth, or they had attended sessions at technology conferences. Lower implementing teachers strained to recall specific details about any technology training that had been provided during the past school year, and they seldom participated in locally sponsored professional development opportunities.

Higher implementing teachers said participation in professional development had positively affected their technical proficiency, ability to use technology, self-confidence, creativity, and lesson development. Higher implementing teachers said their training had prepared them to use TIP resources, raised their awareness of other resources, and helped them to develop lessons. Higher implementers also said staff development experiences increased their technical proficiency and ability to monitor students' laptop use. Some teachers felt more confident in their ability to think creatively and design new kinds of lessons. Lower implementing teachers found professional development helpful or useful, but they usually did not cite ways that it affected them personally.

Nature of Classroom Immersion

We assessed five key elements of Classroom Immersion: Professional Productivity, Communication, Classroom Activities, Technology Integration, and Learner-Centered Instruction.

Higher Classroom Immersion teachers used technology tools for a wider and more sophisticated range of productivity and communication activities. All teachers used technology for administrative purposes, such as recording attendance, managing grades, and generating lesson plans, and for communication by email with colleagues. Higher implementing teachers, however, were more likely to use email to communicate with students and parents, and to have a class web page they used for student assignments, homework, and resources.

Higher implementing teachers had students use laptops more often and in more innovative ways. All teachers said their students used laptops for activities, including research, vocabulary, review, essays, journals, presentations, WebQuests, note taking, exam preparation, graphs, and games. Even so, higher immersion teachers reported that their students used laptops *four to five days a week* compared to about *once or twice a week* in lower immersion classes. Laptops also allowed higher implementing teachers to enhance routine aspects of lessons by incorporating immersion resources and allowing student innovation and creativity. Lower implementing teachers, in contrast, more often used immersion resources for practice, review, test preparation, games, or free-time activities.

Few teachers assigned homework of any kind, although most said work that was not finished during the class period was often completed at home. Teachers rarely assigned homework, with or without laptops. Teachers said it was difficult to get many students to complete homework assignments, and so to avoid failing grades, students completed work during class time. Teachers also said it would be difficult to assign homework that required Internet use because many students did not have access to the Internet at home.

Higher immersion teachers believed laptops facilitated instructional variations, allowed a more student-centered approach, and broadened the curriculum. They also believed an emphasis on the TEKS prepared students for the TAKS, and self-direction and project-based learning promoted student achievement. Higher implementing teachers thought laptops made it easier to plan differentiated lessons and engaging project-based activities. Laptops also allowed teachers to use more student-centered instruction, which promoted greater student self-direction, choices about topics studied and products

created, and improved performance. Laptops allowed teachers to broaden their instruction to include new resources and content beyond that included in textbooks. These teachers also understood that technology-based lessons, curriculum content, the Texas Essential Knowledge and Skills (TEKS), and the Texas Assessment of Knowledge and Skills (TAKS) were combined components of their instruction. Lower Classroom Immersion teachers believed laptops made teaching easier, but change from established instructional routines was difficult. Teachers believed laptops were useful for TAKS preparation and free-time activities but they thought traditional teaching activities promoted student achievement.

Effects of Laptops on Students

Higher Classroom Immersion teachers believed laptops had positive effects on students' academic achievement as well as positive impacts on special student populations. All teachers reported that laptops positively affected students' engagement in learning, technology proficiency, ability to arrive at more informed opinions, and behavior. Several higher implementing teachers also noted positive effects of laptops on student academic skills, including improved vocabulary, spelling, and writing ability. Additionally, higher implementers were more likely to identify positive effects of laptops on particular student groups, including improvements in the participation and achievement of special education students, greater engagement and self-confidence of lower achievers, improved language acquisition for English language learners, and better products generated by higher achievers.

Observed Classroom Practices

Observations in a sample of higher and lower implementing teachers' classrooms captured teacher and student activities, student engagement, and the intellectual rigor of instruction.

Students in higher implementing teachers' classrooms, compared to lower, spent significantly more time listening to a teacher presentation or discussion, writing responses to lessons, constructing knowledge, and engaging in disciplined inquiry. Students in higher immersion classrooms spent significantly more time working as a whole class. Students spent much of class time listening to a teacher presentation or rote discussion; learning facts, definitions, or algorithms; writing responses to the lesson; constructing knowledge (synthesizing, hypothesizing, generalizing, explaining, etc.), reading individually; and engaging in disciplined inquiry. In comparison, students in lower immersion classrooms spent significantly more time working individually. Students spent the bulk of observed time listening to a teacher presentation or discussion; learning facts, definitions, and algorithms; and taking tests or doing test-like activities.

Higher immersion teachers used technology more often for instructional purposes. About three-quarters of higher implementing teachers compared to half of lower implementers used technology as part of their instruction. Higher implementing teachers typically used PowerPoint or Keynote programs to present information to their classes, or they used the Internet as a resource for lessons. Lower implementers used programs to present information most often.

Students in higher implementing teachers' classrooms spent significantly more time using laptops to create or make presentations and to conduct Internet research on an assigned topic. Surprisingly, students used technology in just half of higher implementing teachers' classrooms compared to three-quarters of lower immersion classrooms. Students in higher immersion classrooms spent significantly more time creating or making presentations and conducting Internet research, whereas students in lower immersion classes spent significantly more time completing assessments and more time learning and practicing skills (using drill and practice, learning systems, or games).

Students in the classrooms of higher implementing teachers were more strongly engaged in their academic tasks. Students in higher immersion classrooms were *moderately* to *highly* engaged in academic tasks more than half of observed time, which indicated that "most students exhibited a sustained commitment to and involvement in their academic tasks" and students were "interested in their assignments." Conversely, students in lower immersion classrooms were engaged at a *moderate-to-high* level about a third of observed time, and students were more likely to exhibit *low* to *moderate* engagement with a few or several students "off task."

The lessons of higher Classroom Immersion teachers were significantly more intellectually challenging than the instruction of lower immersion teachers. The lessons of higher implementing teachers received a significantly higher mean Intellectual Challenge score (2.40) on the 5-point challenge scale than lower immersion teachers' instruction (1.67). The difference between groups represented a large effect size (ES = 1.01). Higher immersion teachers' lessons placed a significantly greater emphasis on Higher Order Thinking (ES = 0.63), Depth of Knowledge (ES = 1.02), Substantive Conversation (ES = 0.70), and Connections Beyond the Classroom (ES = 1.12).

Implications for Technology Immersion

Qualitative analyses provide new insights and advance our understanding of how schools reached higher levels of Technology Immersion, and how teachers created technology-immersed classrooms. Importantly, we find that it is not just the characteristics of schools or teachers that made the greatest difference, but consistent with the immersion model, it was the supportive conditions that advanced project goals. District and school leaders at higher Technology Immersion schools set the direction for school change and provided continuous supports that fostered higher levels of implementation. Foremost, leaders championed the benefits of Technology Immersion for students as the justification for arduous efforts aimed at school and classroom change. Notable also was the importance of continual outreach to parents who had to shoulder responsibility for individual laptops along with their children.

Findings also point to the significance of teacher support for Technology Immersion, as teachers act as the gatekeepers to students' experiences with laptops. Teachers, including veterans, who worked in schools with sufficient technical support, extensive opportunities for professional development, encouragement and accountability for changed practices, collegial working environments, and consistent messages from leaders about the importance of immersion for students grew incrementally toward higher levels of Classroom Immersion over time. Moreover, the quality of school and classroom implementation was vitally important for students. Higher levels of implementation allowed students to use laptops more often for learning both within and outside of school, to use laptops for more varied and complex assignments and projects, and to use laptops for more intellectually rigorous schoolwork. Evidence suggests that these kinds of experiences improved the quality of students learning opportunities as well as their academic achievement, particularly for special populations such as English language learners, higher and lower achievers, and special education students. Many students also benefited personally through greater personal organization and responsibility and preparation for college and future employment.

1. Introduction and Methodology

The Technology Immersion Pilot (TIP), created by the Texas Legislature in 2003, set forth a vision for technology immersion in public schools. Senate Bill 396 called for the Texas Education Agency (TEA) to establish a pilot project to "immerse" schools in technology by providing a wireless mobile computing device for each teacher and student, technology-based learning resources, training for teachers to integrate technology into the classroom, and support for effective technology use. In response to this non-funded legislative mandate, the TEA has used more than $20 million in federal Title II, Part D monies to fund Technology Immersion projects for high-need middle schools through a competitive grant process. Concurrently, a research study, partially funded by a federal Evaluating State Educational Technology Programs grant, is evaluating whether student achievement improves over time as a result of exposure to technology immersion. The study also investigates how and under what conditions student effects are achieved. The quasi-experimental research design includes 42 grades 6 to 8 middle schools divided equally between the treatment and control groups. The Texas Center for Educational Research (TCER)—a non-profit research organization in Austin—is the TEA's primary partner for this four-year evaluation that began in the 2004-05 school year and will continue through 2007-08. This report centers on the implementation of Technology Immersion at treatment schools.

Theory of Technology Immersion

The vision for educational technology endorsed by many educators, leaders, and policymakers has shifted in recent years from the use of particular technology software products to technology's incorporation into every aspect of the educational environment. Changing views reflect our growing understanding of how students learn and how to create environments that enhance teaching and learning. Cognitive science and other research reveal that children learn more when they are engaged in meaningful, relevant, and intellectually stimulating work (Bransford, Brown, & Cocking, 2003; Newmann, Bryk, & Nagoaka, 2001). Many believe that technology can support such learning experiences and also enable students to develop competencies needed for the 21st century, such as digital literacy, inventive thinking, and effective communication (CEO Forum, 2001; Lempke, Couglin, Thadani, & Martin, 2003; Partnership for 21st Century Skills, 2006).

Similarly, Texas recognizes that the state's long-term success is tied to the preparation of students for the digital age. The Texas *Long-Range Plan for Technology, 2006-2020*, advances the previous state plan for the integration of technology within schools across four domains: teaching and learning; educator preparation and development; leadership, administration, and instructional support; and infrastructure for technology (TEA, 2006). Senate Bill 396 further defined this comprehensive plan as Technology Immersion. Consistent with the overall Texas vision for technology, the long-term aspiration for Technology Immersion is to "prepare each student for success and productivity as a lifelong learner, a world-class communicator, a competitive and creative knowledge worker, and an engaged and contributing member of an emerging global society" (TEA, 2006, p. viii).

While state statute provided a general description of Technology Immersion, school-based implementation of the intervention required additional detail. In specifying the critical components of the immersion model, TEA staff considered current research on educational technology as well as practical wisdom gained through pilot studies and statewide technology initiatives. Technology Immersion assumes that effective technology use in schools and classrooms requires robust technology access, technical and pedagogical support for implementation, professional development for educators in using

technology effectively, and readily available curricular and assessment resources that support the state's foundation curriculum (English language arts, mathematics, science, and social studies).

First, technology use in schools and classrooms requires *robust access*. Despite school-level improvements in the ratio of students to instructional computers in Texas (Education Week, 2007), recent survey data show that an average of 2.9 or less classroom computers is insufficient to allow every student access (Shapley, Benner, Heikes, & Pieper, 2002; Shapley et al., 2006). In response to prevailing conditions, Technology Immersion calls for one-to-one student access to computers. The Texas project, in contrast to one-to-one laptop initiatives being implemented in other states and school districts (e.g., Maine, Michigan, New Hampshire, Vermont, Henrico County in Virginia) adopts a comprehensive approach. In particular, Technology Immersion assumes that increased access to and use of technology in schools requires adequate *technical and pedagogical support*. Schools must have robust electronic networks to support wireless laptops and digital content. Campus-based support is also vital, as ample studies show the importance of on-site support personnel who assist teachers in learning to use technology, troubleshooting technical problems, and effectively integrating technology into lessons (e.g., National Center for Education Statistics [NCES], 2000; Ringstaff & Kelley, 2002; Ronnkvist, Dexter, & Anderson, 2000; Shapley et al., 2002).

In addition, the Technology Immersion model assumes that teachers must have effective *professional development.* High-quality professional development, as research demonstrates, is of longer duration and provides richer learning experiences, more comprehensive investigation of topics, and time for practice and experimentation (e.g., Garet, Porter, Desimone, Birman, & Yoon, 2001; Lawless & Pellegrino, 2007; Penuel, Fishman, Yamaguchi, & Gallagher, 2007; Smerdon, et al., 2000). Moreover, when a particular technology is mastered over time, it is more likely to be incorporated into instruction (Zhao & Frank, 2003). Teachers also need follow-up support as they acquire and implement new skills in the instructional setting (Bradburn & Osborne, 2007; Garet et al., 2001; Nugent & Fox, 2007; Sulla, 1999). Professional development should also focus on subject-specific content or specific teaching methods. For technology, this means building teachers' basic technology skills as well as their understanding of curricular integration (CEO Forum, 2000, 2001; Denton, Davis, & Strader, 2001; Ringstaff & Kelly, 2002; Web-Based Education Commission, 2000). The alignment of professional development activities with teachers' personal goals for learning is also important in advancing teacher change (Garet et al., 2001; Penuel et al., 2007).

Additionally, technology-related professional development should be part of broader professional growth initiatives in schools (Fullan & Hargreaves, 1996; Mann, Shakeshaft, Becker, & Kottkamp, 1999; Newmann & Associates, 1996). Professional development activities that include collective participation (e.g., whole schools or teachers of the same subjects or grades) are more likely to be coherent with teachers' experiences and needs (Garet et al., 2001). A leadership development component is also crucial, since research points consistently to the important role of school leaders in successful implementation of technology (Bradburn & Osborne, 2007; Johnston & Cooley, 2001; Pitler, 2005).

Technology Immersion also requires *curricular and assessment resources* that support the state's curriculum. Thus, laptops in immersion schools include software that allows students and educators to use wireless laptops as a tool for teaching, learning, communication, and productivity. Digital resources (e.g., online, CD-ROMs, stored on local networks) also provide students with a means for more personalized learning activities, and interactive technologies allow them to build new knowledge by doing, receiving feedback, and refining their understanding. Technologies also help students to acquire more information, visualize difficult-to-understand concepts, and advance understanding (Bransford, Brown, & Cocking, 2003). Online formative assessments enable teachers to diagnose students' strengths and needs or to assess their mastery of curricular standards.

Purpose of the Study

In each of three project years, researchers have investigated the implementation fidelity of the Technology Immersion model in the treatment schools. Evidence at the end of the second year revealed that some of the 21 middle schools struggled to implement the prescribed components of Technology Immersion—yet other schools reached much higher levels of implementation than others. Moreover, information from focus groups with teachers, classroom observations, and teacher surveys revealed substantial variations across teachers, subject areas, and schools in creating technology immersed classrooms.

Given the importance of known links between the quality of implementation and desired outcomes, researchers used a combination of quantitative and qualitative data analyses in the third project year to investigate why some schools and teachers made notable progress toward creating technology-immersed schools and classrooms while others had minimal success. Our comparative study of third-year implementation was guided by two major research questions:

- What are the differences between higher and lower Technology Immersion schools, and what factors explain variations in implementation?
- What are the differences between teachers who report higher and lower levels of Classroom Immersion, and what factors are associated with those differences?

Methodology

Measuring Implementation Fidelity

Researchers used measures of implementation fidelity to identify higher and lower immersion schools and teachers. Implementation is measured as the fidelity with which Technology Immersion *components* and related *elements* attain an envisioned "ideal." This approach involves gathering extensive data on immersion components at each of the treatment schools and comparing school-to-school variations with the vision for "full" implementation. The seven immersion components include five supports for implementation (Leadership, Teacher Support, Technical Support, Parent and Community Support, and Professional Development) and two components related to teacher and student implementation outcomes (Classroom Immersion and Student Access and Use). Consistent with second-year procedures, we used a two-part measurement approach in the third year. First, we used indicators to describe each school's progress on a 4-stage scale toward immersion standards. Rating scales for components and related elements identify four levels of immersion: *minimal* (0 to 1.99), *partial* (2.00 to 2.99), *substantial* (3.00 to 3.49), and *full* (3.50 to 4.00). Second, we used quantitative implementation indices to gauge the level of immersion using standardized scores (*z* scores). *Z* scores allowed the calculation of composite scores across indicators with varying scales and standard deviations.

Implementation Indicators

Both the immersion standard scores and implementation indices are derived from values for the seven components and their related elements. Scores come from spring 2007 surveys of teachers (N = 619, including 371 core-subject teachers) and students (N=6,634) at treatment schools. Table 1.2 provides descriptions of the Technology Immersion indicators. Appendix A includes additional technical detail on the measurement of implementation fidelity and the scoring rubrics that describe the four levels of immersion.

Table 1.2. Description of Implementation Indicators for Technology Immersion

Support for Technology Immersion
Leadership
To what extent do teachers indicate that administrators establish a clear vision and expectations, encourage integration, provide supports, and involve staff in making decisions about instructional technology.
Teacher Support
To what extent do teachers share an understanding about technology use, do teachers continually learn and seek new ideas, are teachers unafraid to learn about and use technologies, and are teachers supportive of integration efforts.
Technical Support
To what extent do teachers indicate that technical problems with computers, Internet access, repairs, and material availability pose barriers to technology immersion.
Parent and Community Support
To what extent do teachers believe that parents and the surrounding community support the school's efforts with technology.
Professional Development
Contact Hours: To what extent does the duration (hours) of technology-related professional development (PD) support the integration of technology into teaching, learning, and the curriculum.
Classroom Support: To what extent do core-subject teachers receive coaching or mentoring from an internal source, such as another teacher or technology coordinator, or an external (non-school) source.
Content Focus: To what extent do core-subject teachers indicate that PD emphasizes curriculum, instructional methods, and lesson development in core subjects.
Coherence: To what extent do core-subject teachers indicate that PD is consistent with personal and school goals, builds on prior learning, and supports state standards and assessments.
Classroom Immersion
Technology Integration: To what extent do core teachers alter instructional practices, allocate time, integrate research on teaching and learning, improve basic skills, and support higher order thinking through technology.
Learner-Centered Instruction: To what extent do teachers have students establish learning goals, use information and inquiry skills, complete alternative assessments, and have active and relevant learning experiences.
Student Classroom Activities: To what extent do teachers have students use particular technology resources for learning in core-subject classes, such as a word processor for writing, a spreadsheet for calculation or graphing, or the Internet for research.
Communication: To what extent do teachers use technology to communicate with students, parents, and colleagues or to post information on a class website.
Professional Productivity: To what extent do teachers use technology to enhance their professional productivity (e.g., keep records, analyze data, develop lessons, deliver information).
Student Access and Use
Laptop Access: To what extent do students have access to wireless laptops throughout the school year.
Core-Subject Learning: How frequently do students use technology resources for learning in core-subject classes.
Home Learning: To what extent do students have access to and use laptops outside of the school for homework and learning.

Note. See Appendix A for a technical description of the measurement of implementation indicators.

Computing Implementation Scores

Scores for Immersion Standards

We used teacher and student survey data to compute implementation scores for indicators that measured progress toward immersion standards (i.e., minimal to full implementation). Adapting a process developed by the RAND Corporation,[1] the value for each indicator was computed relative to the maximum value (4.00—the value assigned to full implementation). Standardization based on the maximum value allowed comparisons across different types of indicators. For each component and element of Technology Immersion, standardization involved the following computations:

[1] Vernez, G., Karam, R., Mariano, L.T., & DeMartini, C. (2006). *Evaluating Comprehensive School Reform Models at Scale: Focus on Implementation.* Santa Monica, CA: RAND.

- **Agreement scales** (i.e., strongly agree or strongly disagree with a prescribed practice or behavior): 4 = strongly agree, 3 = agree, 2 = neither agree nor disagree, 1 = disagree, and 0 = strongly disagree.
- **Frequency scales** (i.e., four- or five-level frequencies of doing a prescribed practice): 4 = highest frequency met, 3 or 2.67 = second highest frequency, 2 or 1.33 = third-highest frequency, 1 = fourth-highest frequency, and 0 = never or do not do.
- **Continuous variables** (i.e., how much time or how often a prescribed practice is done): 4 = meet or exceed requirements, and 0-3.99 = proportional fraction of requirement.

Scores for Implementation Indices

In addition to the standards-based scoring system described above, we used teacher and student survey data to compute standardized implementation indicators (*z* scores with a mean of 0 and standard deviation of 1.0) that could then be aggregated to generate:

- A single implementation score for each Technology Immersion component for each school (e.g., Leadership Index, Classroom Immersion Index, Student Access and Use Index),
- a mean implementation support score for the five support components (Support Index), including Leadership, Teacher Support, Parent and Community Support, Technical Support, and Professional Development, and
- an overall mean implementation score for each school (Implementation Index), which is an average of the Support Index, Classroom Immersion Index, and Student Access and Use Index.

Selection of Schools and Teachers

Researchers used the spring 2007 Technology Immersion Implementation Index generated for each of 19 treatment schools to identify four schools that had the highest implementation indices (*z* scores of 0.87 or higher) and four schools with among the lowest indices (*z* scores of -0.58 or lower).[2] Higher implementing schools tended to have high scores across each of seven implementation components, whereas lower implementing schools had consistently low component scores. Our sample of eight schools drawn from eight districts represented about a third of treatment schools.

We used teachers' spring 2006 Classroom Immersion Index to identify core-subject teachers that had indices in the highest quartile (*z* score of 0.63 or higher) and those with indices in the lowest quartile (*z* score of -0.50 or less). During spring 2007 site visits, we conducted individual interviews with a sample of middle-school teachers that represented both higher and lower implementers. Our interview sample included 37 teachers, with 19 identified as having higher levels of Classroom Immersion and 18 identified as having lower Classroom Immersion levels. Teachers were drawn from each of the 21 treatment schools.

Data Analysis

Three researchers who had been part of site-visit teams conducted the preliminary school- and teacher-level data analyses. The final synthesis of themes across schools and teachers was conducted by the principal investigator using narratives that had been generated by the full team.

[2] Two of the 21 treatment schools had incomplete data sets, so they were excluded from the analysis.

School-Level Analysis

Comparative analyses for schools relied on quantitative implementation indices and state Academic Excellence Indicator System (AEIS) reports as well as qualitative data collected during site visits to schools on four occasions between fall 2004 and spring 2007. Qualitative data sources included (a) transcripts from interviews with district administrators, principals, and technology specialists, (b) transcripts from focus groups with representative samples of core-subject teachers and random samples of eighth grade students, and (c) site-visit reflections written by researchers that summarized their perceptions of school conditions and progress toward implementing the Technology Immersion model.

Transcripts and researcher reflections were imported into the Atlas.ti qualitative data analysis program for coding. Codes described constructs relevant to the Technology Immersion model, including background, grant awards, supports for implementation, and experiences of teachers and students. Codes were designed so that topics could be analyzed across each of the eight selected schools. Once coding was complete for a school, a researcher generated output files for each of the topics. Documents were then analyzed and a case report written to describe how Technology Immersion was implemented at a particular school. District and school demographic and performance data from AEIS reports were also added to provide a more comprehensive view of the school context. The principal investigator used a constant comparative method to analyze school-level narratives. Key topics were explored across higher and lower implementing schools to identify recurrent events or themes that either characterized all schools or distinguished higher and lower implementing schools.

Teacher-Level Analysis

During spring 2007 site visits, researchers conducted individual teacher interviews using structured protocols that included a series of questions soliciting teachers' views on the successes and challenges encountered in implementing technology immersion during the year, how and how often they had students use laptops in the classroom, how having laptops had affected their instructional approach, their use of laptops for homework, their use of resources included in the Technology Immersion packages, the use of technology for communication, and the effects of laptops on students. We also asked teachers how school leaders had provided support for their efforts, and how vendors, the school, and the district had provided professional development and in-class pedagogical support during the past school year.

Using topics from structured interview protocols, researchers collectively developed a set of codes and sub-codes for each topic. Each of three researchers was then assigned a set of topics to analyze. Transcriptions of interviews with higher and lower implementing teachers were coded using the Atlas.ti qualitative data analysis program. Researchers then used a constant comparative method to look for key issues and recurrent themes, and wrote a narrative describing the convergent and divergent experiences and views of higher and lower implementing teachers. Researchers met to discuss their narratives and to identify the most prevalent themes. The principal investigator then synthesized findings from topical narratives to describe higher and lower implementing teachers' experiences and views.

Demographic data from teacher databases submitted by schools and data from AEIS reports provided additional information on the characteristics teachers and the schools in which they taught. Additionally, we included information from classroom observations conducted in spring 2007 in a sample of core-subject classes. Nearly all of the interviewed teachers were also observed (32 of 37). Analyses compared the observed practices of higher and lower Classroom Immersion teachers. Appendix B provides a detailed description of the classroom observation instrument and procedures.

Organization of the Report

The remainder of the report is divided into three sections. The first section describes differences between higher and lower Technology Immersion schools using evidence from three implementation years. This section first describes the characteristics of schools included in the analysis and then compares how higher and lower implementing schools provided supports for the implementation of Technology Immersion, the extent of teacher support for immersion at schools, and the nature of students' experiences. The second section profiles higher and lower implementing teachers, including descriptions of their characteristics, their schools' supports for implementation, the nature of their Classroom Immersion, challenges encountered in creating immersed classrooms, the effects of immersion on students, and finally, the observed characteristics of teachers' classroom instruction. Finally, the report presents conclusions about the traits of higher implementing schools and teachers and the implications of these findings for others who may be considering the implementation of the Technology Immersion model.

2. Differences between Higher and Lower Immersion Schools

The implementation of a complex innovation like Technology Immersion involves profound school and teacher change. Schools as dynamic systems have multiple forces affecting people and events. Thus, school transformation involves the convergence of numerous factors. Change occurs when driving forces prevail over influences that preserve the status quo. In analyzing differences between higher and lower Technology Immersion schools, we have used a constant comparative method to examine multiple facets of implementation and to identify themes that differentiate the two groups of schools. Because of the complexity of the organizations and events studied, reported trends sometimes represent degrees of variation rather than true dichotomies. What emerges, however, is a picture of districts and schools that held very different views of what it means to create a technology immersed school, pursued different paths toward implementation, and had dissimilar school conditions that influenced school change. An overarching purpose of the analysis is helping other districts and schools that may pursue Technology Immersion to recognize effective practices and avoid pitfalls encountered by some schools.

Characteristics of Selected Schools

Districts

- *Higher Technology Immersion schools compared to lower were located in districts with smaller average student enrollments, although district sizes varied from very small to large across comparison groups. The districts of higher implementing schools had slightly more property wealth per student and spent more dollars per pupil on instruction.*

Table 2.1 shows similarities as well as important differences between the districts affiliated with higher and lower Technology Immersion schools. Higher implementing schools were in districts with smaller student enrollments (4,363, on average) compared to lower implementing schools (11,913). However, the range of district student enrollments varied substantially across both groups: from 436 to 14,618 for higher immersion and from 485 to 24,876 or lower immersion. The districts of higher immersion schools had somewhat greater property wealth per student ($156,429 versus $137,394) and spent more dollars per pupil on instruction ($5,097 versus $4,586). However, Technology Immersion districts had less than half as much wealth per student compared to the state average ($360,362). The districts of higher technology immersion schools spent somewhat more than the state average per pupil for instruction ($5,097 versus $4,788), whereas districts with lower immersion schools spent somewhat less than the state overall ($4,586 versus $4,788). Correlation analyses revealed no significant associations between schools' overall level of implementation and district characteristics.

Table 2.1. District Characteristics of Higher and Lower Implementing Schools

	Higher Technology Immersion $n = 4$		Lower Technology Immersion $n = 4$	
	Mean	Range	Mean	Range
Average number of students	**4,363**	436 to 14,618	**11,913**	485 to 24,876
District wealth per student	$156,429	$62,959 to $243,690	$137,394	$75,943 to $209,575
Instructional spending	$5,097	$4,196 to $5,675	$4,586	$3,879 to $5,137
Number of middle schools	1.5	1 to 3	2.5	1 to 4

Source: Texas Education Agency AEIS reports 2007.
Note. Bold text denotes notable differences between school groups.

Student Populations

- *Higher Technology Immersion schools compared to lower were slightly smaller, and enrolled proportionally fewer economically disadvantaged, minority, and limited English proficient students. Nevertheless, students at higher and lower implementing schools were equally likely to report having home computers and Internet access.*

Table 2.2 compares the characteristics of students attending the schools. Higher Technology Immersion schools compared to lower were slightly smaller (371 students, on average, versus 429), enrolled proportionally fewer minority students (49.2% versus 62.0%), and served proportionally fewer economically disadvantaged students (58.1% versus 75.9%). Additionally, nearly a quarter of students at lower implementing schools were limited English proficient (23.8%) compared to about 5% at higher implementing schools. Interestingly, despite differences in demographics, similar proportions of students across groups reported having a home computer (74% to 76%). Students with home computers usually had Internet access (83% to 84%). Similar to district data, correlation analyses revealed no significant associations between schools' overall level of implementation and student demographic characteristics.

Table 2.2. Student Characteristics of Higher and Lower Implementing Schools

	Higher Technology Immersion *n* = 4		Lower Technology Immersion *n* = 4	
	Mean	Range	Mean	Range
Demographics				
Average number of students	371	103 to 910	429	91 to 865
% Minority	**49.2**	8.7 to 72.6	**62.0**	12.1 to 100.0
% African American	8.1	1.8 to 21.1	11.7	0.0 to 40.0
% Hispanic	41.1	2.9 to 69.0	50.3	2.3 to 100.0
% White	50.4	26.9 to 91.3	37.3	0.0 to 87.9
% Economically disadvantaged	**58.1**	41.7 to 68.8	**75.9**	53.8 to 97.2
% Limited English proficient	**5.2**	0.0 to 13.2	**23.8**	0.0 to 71.0
% Special education	15.0	7.8 to 19.4	17.5	14.7 to 22.0
Technology Access				
% Students with home computer	76.3	63.9 to 83.7	73.9	53.7 to 88.9
% Students with Internet at home	83.1	75.4 to 87.7	83.6	72.7 to 88.9
Student Performance				
% Pass TAKS Reading 2007	86.5	79.0 to 94.0	80.8	63.0 to 90.0
% Pass TAKS Math 2007	77.8	64.0 to 86.0	66.8	47.0 to 81.0
% Pass TAKS Writing 2007	90.3	82.0 to 96.0	87.8	83.0 to 92.0
% Pass TAKS Social Studies 2007	86.7	75.0 to 96.0	81.5	72.0 to 90.0
% Pass TAKS All Tests 2007	71.0	59.0 to 79.0	60.0	39.0 to 71.0
% Attendance rate change '06-'07	**-0.9**	-0.1 to -1.7	**-2.1**	-0.2 to -2.3

Source: Texas Education Agency AEIS reports 2007.
Note. Bold text denotes notable differences between school groups. Internet access refers to the percent of students with computers who have Internet access.

Given differences in student demographics, it was not surprising that students attending higher Technology Immersion schools had higher TAKS scores in spring 2007 than students at lower immersion schools across all subject areas. Although students' school attendance declined for all schools between the 2005-06 and 2006-07 school years, the attendance rate decline was larger for lower Technology Immersion schools (-2.1%) compared to higher immersion schools (-0.9%).

Teachers

- *Higher Technology Immersion schools employed mainly White teachers, whereas lower implementing schools had mostly White and Hispanic teachers. Teachers at higher implementing schools had more years teaching experience, on average, and higher immersion schools had a smaller proportion of beginning teachers and novices with just 1 to 5 years experience (about a third of teachers) compared to lower immersion schools (about half of teachers).*

As Table 2.3 shows, schools in each of the groups, on average, employed similar numbers of teachers (32 to 33). However, lower Technology Immersion schools had a substantially larger proportion of minority teachers, primarily Hispanic (28.5%), whereas higher immersion schools employed predominantly White teachers (89.7%). Teachers in higher Technology Immersion schools compared to lower had more years teaching experience (11.3 versus 8.9). Notably, half of teachers at lower immersion schools were beginners (12.0%) or novices with just 1 to 5 years teaching experience (37.4%) compared to a third of teachers at higher immersion schools (34.6%). Schools had similar student-to-teacher ratios.

Table 2.3. Teacher Characteristics of Higher and Lower Implementing Schools

	Higher Technology Immersion *n* = 4	Lower Technology Immersion *n* = 4
Average number of teachers	31.5	32.9
% Minority	**10.3**	**33.6**
% African American	4.0	5.1
% Hispanic	6.3	28.5
% White	89.7	64.7
Average years experience	**11.3**	**8.9**
Beginning	**5.6**	**12.0**
% 1-5 years	**29.0**	**37.4**
% 6-10 years	22.6	18.7
% 11-20 years	23.3	17.7
% More than 20 years	19.7	14.1
Student-to-teacher ratio	10.7	12.3

Source: Texas Education Agency AEIS reports 2007.
Note. Bold text denotes notable differences between school groups.

Initiation of Technology Immersion

The Technology Immersion Pilot (TIP) is a grant-funded project and that fact, in and of itself, affected implementation because districts, who received grants on behalf of schools, received a finite and temporary funding stream to support school change. Evidence from prior research on state-funded grants has revealed that the circumstances surrounding grant applications and awards influence the potential for successful implementation. In particular, grant applications informed by the thinking of various stakeholders can lead to better grant planning, program development, and buy-in, which are all factors associated with implementation fidelity (Shapley et al., 2004). Given the importance of the grant process, researchers in fall 2004 gathered information on the TIP application process.

Applying for the TIP Grant

The timing and the nature of the Request for Application (RFA) process for TIP grants influenced the application planning process and preparation for project initiation. First, districts and schools that applied to become a Technology Immersion school during the first round of RFAs that were awarded in May

2004 had greater opportunities for broad-based input into the application during the school year, and an extended period of time to plan for project initiation at the beginning of the next school year. On the other hand, applications submitted during the second round of RFAs were developed after the school year ended in May, and awards made in August pushed planning for project initiation into the school year.

- *Most of the higher Technology Immersion schools (three of four), submitted first-round grant applications and received awards in May 2004; half of lower immersion schools submitted first-round applications (two of four), and only one school received an award in May. Thus, higher implementing schools typically had more time to plan for project initiation.*

- *The grant applications developed by each of the four higher Technology Immersion schools involved authoritative decisions makers, such as the district superintendent, an assistant superintendent, or school board members. In contrast, only one of four lower implementing schools mentioned the direct involvement of a superintendent or school board members.*

As expected, the timing of the competitive grants awards contributed to implementation quality. Three of the four higher Technology Immersion schools submitted first-round applications and received awards in May. In contrast, two of the four lower implementing schools submitted first-round applications, and only one school received a first-round award. The nature of the application process was also significant. The grant applications developed by each of the four higher Technology Immersion schools involved authoritative decisions makers, such as the district superintendent, an assistant superintendent, or school board members. In one case, the superintendent collaborated with a university to write the grant application on behalf of a school collaborative. The superintendent and principal of another school worked with a grant writer to craft the application. At another school, the assistant superintendent applied on behalf of the middle school with support from the superintendent.

One school had extensive input into the application process that more nearly approximated an ideal approach. District technology staff first conferred with the district superintendent, school board members, and the principal about the TIP grant. Prior to applying, a group of board members, teachers, administrators, and technical and instructional staff visited another district in Virginia that was implementing a one-to-one laptop initiative. Administrators also consulted with a Texas district pioneering a laptop project. After completing their research, the principal met with teachers, explained the project and the research base, and secured teacher approval for participation.

In contrast, only one of the four lower implementing schools mentioned the direct involvement of a superintendent or school board member in the application process. Instead, applications for these schools were largely driven by district technology directors who may or may not have had strong input from the schools involved. An education service center and grant writer helped one superintendent and district technology director apply for the grant. In another case, district technology directors applied for the TIP grant with little or no involvement of school personnel. In two other cases, district technology directors worked closely with school principals to write grant applications.

In general, the people who were directly involved in the application process tended to shape the subsequent direction of project implementation. District and school leaders who were less integrally involved from the start exerted lower levels of support. Across all schools, teachers were seldom involved in the grant application process, partially due to the timing of the TIP RFAs. This omission proved to be a key deterrent to implementation at many schools.

Selecting the Technology Immersion Package

- *Most of the higher Technology Immersion schools (three of four) selected the Apple package while only one selected the Dell package. Each of the four lower immersion schools selected the Dell package. Schools typically selected packages that aligned with the district's preferred technology platform.*

Also noteworthy were differences related to the Technology Immersion packages. Of the four higher implementing schools, three purchased the Apple package and one the Dell package. All of the four lower Technology Immersion schools purchased Dell packages. While many factors besides the vendor package purchased influenced implementation, it is worth noting that there were substantial differences in the types of instructional and learning resources included in the packages. The Apple package included more resources that directly supported student content-area learning, including programs such as TeenBiz, Explore Learning, Beyond Books, My Access Writing, and NetTrekker. The Dell package, on the other hand, had more resources that supported teaching, such as eChalk and the Dell Exchange, and fewer resources for content-area learning (NetTrekker). Districts almost always selected the package that aligned with their preferred technology platform. However, one district selected the Apple package because of its superior instructional resources. A district administrator at a higher implementing campus explained:

> What our philosophy is…is this is all about student learning. This is about professional development, changing the way teachers teach, and helping students learn in the best and most effective way—not about the boxes and wires.

Given the scarcity of learning resources in the Dell package, the professional development specialists who supported their schools went to great lengths to help teachers find learning resources on the Internet to enhance their lessons. The higher implementing Dell school purchased one of the Apple resources (My Access Writing) as well as other learning programs.

Apple Computer, Inc. also had substantial educational experience and involvement with one-to-one laptop initiatives prior to the Technology Immersion project. Dell Computer, Inc. had scant prior experience with one-to-one laptop projects, and thus, had many lessons to learn about the effective provision of support for schools.

Supports for Technology Immersion

The Technology Immersion model assumes that successful implementation rests on supports at various levels of the educational system. Thus, our analysis focused on differences between schools related to those components as a way to better understand how elements advanced implementation. Figure 2.1 compares the mean third-year level of implementation measured on a 0 (minimal implementation) to 4 (full implementation) scale for support components by higher and lower Technology Immersion schools. Results show that higher implementing schools had substantially higher levels of support for implementation for each of the five components, with the largest differences between groups related to support from parents and the community and the provision of high-quality professional development. Sections to follow draw from qualitative evidence to help explain why these differences existed.

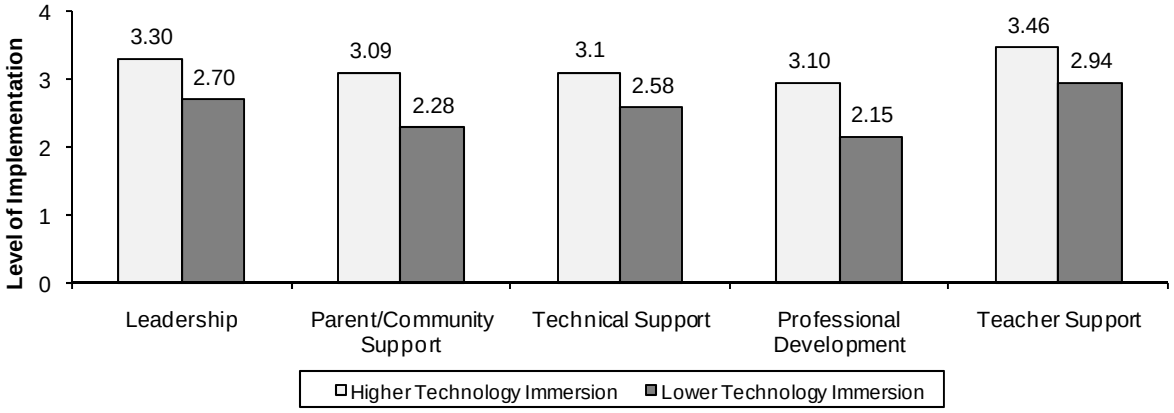

Figure 2.1. Mean level of implementation (measured on a 0 to 4 scale) for higher and lower Technology Immersion schools across five implementation support components.

Leadership

Because grants were awarded to districts rather than schools, district personnel played key implementation roles. District size, to some extent, influenced who would be involved in grant applications and management. Superintendents and assistant superintendents in smaller districts were more likely to be directly involved, whereas superintendents in large districts delegated responsibility to other central administrators and had a peripheral role. More important, however, was the nature of the leadership roles played by district leaders, as illustrated in Exhibit 2.1.

Roles of District Leaders

- *Higher Technology Immersion schools had project leaders with administrative authority and clout and a strong commitment to Technology Immersion, as well as leaders who maintained a close and ongoing relationship with the middle school, worked as a team with campus leaders, and monitored classroom practices.*

Exhibit 2.1. Characteristics of District and School Leadership at Higher Technology Immersion Schools
District Leadership
Project leaders with administrative authority and clout
Strong buy-in and commitment to Technology Immersion
Close and ongoing relationship with the middle school
District and campus leaders work as a team
Leaders monitor teachers' classroom practices
Principal Leadership
Effective leadership transition after principal change
Articulates a vision and goals for Technology Immersion
Strongly supports professional development
Provides encouragement for teachers' changed practice
Expresses goals and expectations for classroom technology use
Monitors teachers' classroom practices
Source: Interviews with district leaders, principals, technology specialists and focus groups with teachers and students at four higher implementing and four lower implementing schools.

Higher Technology Immersion schools. For all of the higher immersion schools, district leadership was stable across the first three implementation years. Moreover, project leaders, including superintendents, assistant superintendents, and district technology directors, demonstrated strong buy-in to the Technology Immersion concept, worked closely with their schools, and monitored teachers' classroom technology use. For example, one district superintendent was heavily involved in every aspect of the project over the course of the first year—from unpacking computers to scheduling professional development. The superintendent's involvement in the day-to-day activities at the middle school diminished during the project's second year when high school students also received individual student laptops. However, he still remained active, visiting the school two to three times a week, speaking with

the principal on a daily basis, facilitating project resources, and marshaling support from school board members.

In another case, an assistant superintendent coordinated project planning, in collaboration with the campus principal and technology coordinator, teacher representatives, and district technicians. The district leader explained: "Well, I've just kind of acted as a facilitator and helped coordinate…We really acted pretty much as a team because none of us had a real clear understanding of what all we needed to do." The assistant superintendent also provided oversight through periodic visits to the school and classrooms to observe how technology was being used for instruction.

The district technology administrator who directed the project for a large district described distinct district and campus leadership roles, but stressed, "It's a big team effort here." The project manager (a full-time administrative position) was located at the middle school campus during the first two project years. The manager assisted with material preparation, parent and teacher training, policy issues, record keeping, and online resources. The district management role evolved over time. During the early phases of the project, when many decisions needed to be made, weekly meetings included central administrators, campus technology leaders, and the principal. After laptop rollout, things progressed more smoothly, so meetings were held bi-weekly and then monthly.

During the second year, the emerging incongruence among various district initiatives triggered the formation of a Leadership Team, which provided oversight for the TIP project. The Leadership Team included the superintendent, assistant superintendents, curriculum specialists, district and campus technology leaders, the principal, and the project manager. A major purpose of the team was deciding how the district curriculum and technology should work together. Part of that task was helping district content specialists understand the integration of curriculum and technology so that they could help teachers understand the same concept. In the third year, the district created SMART Teams of central administrators that visited schools on a weekly basis to meet with principals to discuss goals and how to meet those goals, and to conduct classroom walkthroughs. The SMART Team for the Technology Immersion school deliberately included central administrators who were technology specialists, so they could monitor how well technology was being used to support the school's academic goals.

In contrast to the comprehensive approaches described above, an assistant superintendent in one small district filled multiple roles that kept the TIP project on track during times of superintendent and principal turnover. He had primary responsibility for grant activities, including planning and interfacing with vendors to support immersion at the middle school. The project director also acted as the district technology director, assistant superintendent of instruction, and interim principal during periods of change. The middle school shared a principal with the high school so there was no on-site administrator in the middle school. This configuration, unexpectedly, rather than posing as a barrier to implementation allowed middle school teachers to assume leadership roles that seemed to advance Technology Immersion at their school.

Lower Technology Immersion schools. Project directors for lower implementing schools were more likely to be district technology directors rather than higher level administrators. They supported grant activities, but they were less closely tied to schools and less apt to have a clear understanding of and commitment to the Technology Immersion concept. District support during project initiation was usually strong but diminished over time. Thus, when visionary and highly committed principals or knowledgeable principals left immersion schools, there was no strong district leadership to help sustain project momentum.

For example, the superintendent of one small district was the official project director, but he delegated much of the responsibility for grant activities to the technology director. The superintendent said his role

involved the "acquisition of equipment and resources." He visited the middle school daily to see what teachers and students were doing. Although this district received its award in May, the superintendent was still negotiating with the TEA in September about grant dollar allocations. Thus, no funds had been released and little planning had been done for project initiation. Additionally, despite participation in the grant application process, district administrators reportedly were unaware of the TIP grant provision requiring that students have laptops available for use both within and outside of school. The district dispersed laptops as classroom sets on carts and students were not allowed to take laptops home.

At yet another school, an assistant superintendent of instruction described her initial project leadership role as interfacing with Dell to resolve difficulties with equipment and warranties, purchasing resources, maintaining grant progress and financial reports, and seeking community support for the project. The director interacted with the principal and campus project director on a bi-weekly basis, and due to other responsibilities, visited classrooms from "time to time." In the third year, when a new campus project director was hired at the middle school, she reportedly had received little guidance from either campus or district personnel, and instead, looked to experienced teachers for direction.

In another case, a district's directors of technology and instructional technology provided oversight for the TIP grant. District administrators supported the grant application of a visionary principal, with the understanding that the district could not provide additional funds beyond the grant award because it would be unfair to the other middle schools. During the first year, district directors maintained weekly email and telephone communication with the principal and campus project director. Strong technical support was provided initially to upgrade the school infrastructure and prepare laptops for distribution. District buy-in for the project, however, started to fade as expenses uncovered by the grant began to accumulate (e.g., technical staff for laptop preparation and rollout, wireless infrastructure). The director of instructional technology assisted with planning for professional development and spent some time on campus assisting with rollout, helping with laptop policies, attending staff development sessions, observing classes, and sharing "good practices" with teachers. With a new principal on board in the second year, the director helped to resolve difficulties with teacher resistance, ineffective classroom management, and parent laptop refusals. The district director continued daily email communication and monthly meetings with campus leaders in the third year.

Similar to the situation described above, the district directors of technology and instructional technology provided oversight for the grant, with the technology director focusing on equipment purchases and technical issues, whereas the director of instruction focused on policies, professional development, and oversight for the campus integration specialist. The director of instructional technology attended the "grand celebration" associated with laptop distribution, kept in touch with the principal on a regular basis, and tried to visit the campus at least once a month. The TIP grant was valued because it contributed to one of the district goals, a one to one student-to-computer ratio. Although pleased with district participation, the TIP project was taxing because it required a substantial investment of local resources for laptop security and other expenses. During the second year, district administrators did not visit the campus as much because "they [campus staff] know how it works now…they're pretty much self-sufficient." In the third year, the director of instructional technology was managing the TIP grant along with several other technology-related grant programs. Direct interaction with the middle school was limited to monthly visits and purchasing assistance.

Roles of Campus Principals

Across the first three project years, nearly all of the middle schools experienced substantial fluctuations in principal leadership. Of the four higher implementing schools, only one had their original principal in the third year, and none of the four lower implementing schools had their original principal. Principal changes at higher implementing schools, however, had a less disruptive effect on implementation because

other district, vendor, and teacher leaders helped the school weather the principal transition period. Also, new principals hired at these schools understood and embraced the Technology Immersion concept more strongly.

- *Principals at higher implementing schools articulated a vision and goals for Technology Immersion, strongly supported teachers' professional development, provided encouragement for teachers' changed practice, expressed goals and expectations for classroom technology use, and monitored teachers' classroom practices.*

- *Leadership fluctuations at lower implementing schools reduced the clarity of goals for immersion, weakened lines of communication among project staff, and diminished the quality of professional development.*

Higher Technology Immersion schools. As noted above, principal leadership at higher immersion schools was unstable across the first three implementation years, but changes in principal leadership were generally associated with improved rather than diminished levels of Technology Immersion. Although each school leader had a unique style, commonalties that emerged suggest the kinds of principal leadership actions that contributed to higher levels of implementation (see Exhibit 2.1).

Principals at higher implementing campuses *articulated a vision for Technology Immersion* and its value for students. Principals at these schools were strong advocates for the Technology Immersion project. One principal described himself as a cheerleader, who educated the teachers, students, and the community about the TIP project and its expectations. He believed it was important to communicate his own commitment to the project and expectations for teachers and students, explaining:

> …the administration has got to buy into it from the beginning. And then every opportunity you get from that point onward, it's got to be communicated in a positive way…a way that the teachers are able to visualize what the benefits of it are going to be. What I have communicated to the teachers more than anything is that without a doubt, it's going to make our students better at critical thinking and problem solving, which in the end, is going to help them in every area.

The original principal at one school was an enthusiastic believer in Technology Immersion, yet teacher support had waned for a variety of reasons. The new principal, who learned that laptops were being used infrequently in classrooms, held a leadership retreat prior to the start of the third year to assess teachers' level of commitment to Technology Immersion. An Apple facilitator helped retreat participants, including district and campus administrative staff and grade-level teacher leaders (both technology "cheerleaders" and "naysayers"), understand the research base and rationale for Technology Immersion. By all accounts, the leadership retreat was a transformational experience, with teachers recommitting themselves to the project and vowing to use laptops "every day in the classroom."

At the middle school without an on-site principal, the second new principal played a peripheral role and described herself as a "cheerleader" for the project. At this school, the Apple trainer apparently played an important role in helping middle school teachers understand the vision for Technology Immersion. Key teachers emerged as capable leaders and advocates for the project.

Principals at higher immersion schools *strongly supported teachers' professional development.* One principal understood that teachers needed intensive professional development and "side-by-side" support centered on integrating technology into the curriculum rather than training on technology applications. The principal said teachers struggled to understand how technology could support greater student engagement and learning, and he believed that training experiences could help build that understanding. Another principal described his role as a coordinator of technology training. Other principals provided

resources (e.g., cameras, projectors, interactive whiteboards, and software programs) that supported the application of new knowledge acquired through training in the classroom.

Principals at higher implementing schools *encouraged teachers' changed practic*e. Principals recognized the difficulties inherent in changing teachers' instructional approaches. One principal described Technology Immersion as a "super complex change" for teachers because it involves a transformation from the comfort of traditional practices. Another principal described the difficulty that veteran teachers faced in changing to "a radically different way of teaching." Principals encouraged changed practice through a variety of methods, including verbal encouragement, requiring teacher participation in professional development, attending training events themselves, observing in classrooms, and discussing technology-related topics during faculty meetings. One principal underscored his role in providing encouragement:

> …whenever I meet with the teachers, during staff meetings, during pretty much any opportunity I get. I encourage them and just remind them that this is probably the biggest goal that we have at this time…the technology immersion within the classrooms.

Principals at higher immersion schools *established expectations for classroom technology use and monitored practices*. Principals communicated their expectations about classroom practice in both formal and informal ways. One principal established clear goals for the project, including increased teacher proficiency, increased student technology use, and technology integration that facilitates student learning. To monitor progress toward goals, the principal made regular class visits and led teacher and student discussions. Another principal monitored lesson plans and classroom practices to ensure that technology is being integrated into the curriculum.

The principal at yet another school believed she must not just encourage Technology Immersion but also monitor implementation through class visits, weekly technology observations, and reviews of lesson plans and usage reports. "People do what is monitored," said the principal… "It's one thing to make a commitment, but if the administration never walks in to see that it is being done, they [teachers] stop."

Lower Technology Immersion schools. At lower immersion schools, principal turnover was pervasive. Two visionary and highly committed principals that played major roles in their schools' grant applications left after the first and second project years. At two other schools, the original principals were not involved in the grant application process. One of these schools had a new principal during each of three project years, while another had two principal changes. Campus leadership fluctuations, in combination with other factors, such as unstable district, teacher, and parent support, had detrimental consequences. One new principal described the school situation at the end of the second year:

> Immersion is not at the level I want it to be at all. Teachers have received lots of training…I haven't seen the training implemented in the classroom…Part of that is my fault…we didn't have a plan in place to make sure that every kid has a laptop in class. The excitement has worn off. Many parents and students are choosing not to take them home. Many students are bringing them back, saying that the teachers haven't used them in class, so why bother carrying around this heavy machine.

Campus project leaders cited problems with principal changes, such as new initiatives that compromised time for staff development, failure to make teacher technology use mandatory, and failure to require teacher participation in professional development.

In general, principals at lower implementing schools seemed to have no clear vision for or understanding of Technology Immersion. At one campus, it appeared that the main purpose in applying for the grant was to get the laptops. Campus and district administrators violated grant provisions by distributing laptops as

classroom sets rather than individually to students. The principal at another school, who was not involved in the grant application, sent an assistant principal to the TIP Leadership Conference that outlined project expectations. At two schools, enthusiastic principals with strong visions for Technology Immersion left their schools. New principals, who had not attended leadership training, were unfamiliar with the Technology Immersion concept, and besieged by duties at their new schools, delegated project responsibilities to campus project directors. Because new principals usually did not have a clear understanding of the Technology Immersion concept, they had no objective way of gauging their school's progress, and thus, did not intervene in a timely way to resolve major problems.

Across most of the lower immersion schools, communication among project leaders was weak. In one small district, the superintendent, principal, and district technology coordinator performed their assigned roles with little cross-role communication about the project. At another school, information typically flowed to the school as directives from central administrators who controlled most decisions about technology policies and practices. Once the project was underway, communication between school leaders and the district declined sharply. Weak communication links meant there was no formal mechanism for sharing experiences and knowledge that could inform implementation improvements.

District leaders rather than campus principals often interfaced with vendors to shape the professional development programs for lower implementing schools. Participation in professional development, especially in the second and third year, was more likely to be a teacher's personal choice rather than a principal requirement. Professional development sessions were typically squeezed into the school day rather than scheduled as dedicated days for training.

As a whole, although principals at lower immersion schools reported acting in ways similar to higher immersion principals (observing classrooms, requiring laptop use), these principals' perceptions of campus events frequently did not coincide with the views expressed by their teachers, students, and project staff, and researchers' observations about school conditions.

Roles of Campus Project Leaders

Technology Immersion requires a substantial amount of support to facilitate logistical arrangements, deal with daily technical problems, handle policy issues, interact with parents, and so forth. Most schools had campus project leaders whose services were augmented by district technology staff. The pattern of campus support for implementation took many forms, with the school and district size having a bearing on the number of support persons available. Staffing configurations varied from a high of 3.5 people at a large school (more than 900 students) to zero campus support persons at two small schools (90 to 100 students). Particularly noteworthy was the substantial discrepancy between the staff-to-student ratios for higher and lower immersion schools. Although all schools would like to have had additional campus support, the staff-to-student ratio at lower immersion schools (1:429) was nearly twice as large as the ratio at higher implementing schools (1:247) in the third year.

- *Higher Technology Immersion schools typically had adequate levels of campus support, whereas lower immersion schools often had insufficient campus staff to manage the number of students and laptop computers, and thus, were overwhelmed by the enormity of their assigned tasks.*

Higher Technology Immersion schools. One large higher implementing school (about 900 students) had a comprehensive project team, including a technology specialist, technology integration specialist, technician, and a dedicated district administrator who helped manage activities. At one small school (about 200 students), the campus technology leader split time between the middle and high schools, but the school had a full-time technical support person; a different small school (about 275 students) had just

one dedicated staff member. A very small school (about 100 students) did not have a dedicated support person, but a computer lab teacher provided on-site assistance.

Lower Technology Immersion schools. Lower Technology Immersion schools often had a campus project leader or leaders who were overwhelmed by assigned tasks. At one mid-sized school (nearly 500 students), the principal turned day-to-day grant management over to the campus integration specialist. This person was highly stressed in trying to fulfill her roles as project manager, campus technical assistance provider, and instructional specialist, with just clerical assistance and technical support from the district one day per week. Similarly, a large school (about 850 students) had just one campus integration specialist and one technician supporting implementation, and since district technicians often had other priorities, technical support for the middle school was often delayed. Similar to higher implementing schools, one small campus (about 265 students) had one technology specialist, and a very small school (about 90 students) had no on-site support staff.

Policies

Another important aspect of leadership affecting implementation was the enactment of effective policies governing areas such as financial responsibility for laptops, laptop use outside of school, and student conduct. Given the more efficacious leadership structures cited above, it was not surprising to find that leaders at higher immersion schools compared to lower enacted policies that helped to advance rather than constrain implementation.

All of the TIP districts and schools contacted other educational organizations that had been pioneering one-to-one laptop initiatives to obtain policy documents as a model for their own policies. This networking among organizations was facilitated through the TIP Leadership Conference sponsored by the TEA prior to the first project year, and a one-to-one conference hosted by Irving Independent School District. Almost all schools required their students and parents to sign an acceptable use policy before the child received a laptop, acknowledging that they understood the usage guidelines and accepted responsibility for the laptop. Still, the way that schools shaped those policies and made policy adjustments in response to emerging school conditions differed across higher and lower immersion schools.

- ***Financial Responsibility:*** *Higher Technology Immersion schools were more likely to implement policies that reduced parents' financial risks associated with laptop damage, whereas lower immersion schools had policies that placed parents at substantial financial risk or allocated no financial risk.*

Higher Technology Immersion schools. As an example, given grant stipulations that students have access to laptops "24/7" (twenty-four hours a day/seven days a week), one higher implementing school protected parents against loss and breakage. Under a district self-insurance plan, each student was charged an annual insurance fee ($60), which included a $50 or $100 deductible per accidental damage incident depending on the severity of repair. To accommodate parents for whom these fees were untenable, the school worked with the Parent Teacher Organization (PTO) and other organizations to provide scholarships for students. Despite efforts to accommodate family poverty, insurance fees initially blocked student participation in the second year. Substantially fewer students had laptops in the fall (about 50% to 60%), but that proportion increased to about 95% through outreach to parents and financial accommodations (payment plans).

Another district used local funds to insure laptops, and structured guidelines for the use of deductibles for laptop repair. The district restructured fees when the insurance company increased deductibles. For the first incident, the parents and district split the $250 deductible, for the second incident, parents paid the full deductible, and for the third incident, parents paid the cost of repairs. Another higher implementing

school did not have policies defining parent responsibility during the first year, but after experiencing some laptop damage, the district asked parents pay a $10 laptop fee (refundable if no laptop damage occurred) to raise student and parent awareness of their responsibility. Parents could purchase laptop insurance (for a $40 to $50 fee). The policy change generated resistance from a few parents (about 5%). One higher implementing school, in contrast to the others, did not provide parents with the option to purchase laptop insurance. Instead, a campus committee reviewed each damage situation and decided whether the damage was negligence, accidental, or normal wear and tear. If the committee believed the damage was the student's fault, then the parent had to pay for the computer repair before the laptop could be re-issued to the student. Although the process seemed fair, parents without insurance assumed substantial risk at this school.

Lower Technology Immersion schools. In contrast, the policies at lower immersion schools often placed parents at substantial financial risk or allocated no financial risk. One principal in fall 2004 knew that laptop insurance would be crucial to accommodate the needs of the school's largely impoverished student population. In the end, however, the district decided not to purchase laptop insurance. Each parent was required to pay a non-refundable $25 laptop user fee, which was used for laptop maintenance. Parents also had to pay a "re-image" fee if their child changed the computer settings, and parents had to agree to take responsibility for the full cost of a lost or destroyed laptop (about $1,300). Similarly, the school that barred student laptop use outside of school during the first year implemented policies in the second year that discouraged home laptop use. The district required parents to pay a $25 non-refundable fee and to assume responsibility for damage up to the full cost of the laptop ($1,200).

In contrast to the high-risk scenarios described above, two districts did not ask parents to assume any financial responsibility for laptop damage. The district of one lower implementing school purchased laptop warranties that covered accidental laptop damage and tracing software that minimized the risk of theft, and thus, eliminated the need to hold students and parents accountable for laptop damages. Although students and parents had to sign forms assuming laptop responsibility, the district actually covered damage completely. Another district received a grant to cover insurance costs, so parents did not have to pay for laptop insurance coverage. While no-risk policies were financially advantageous for parents, they also reduced student and parent accountability for laptop care.

- ***Laptop Use Outside of School****: Higher Technology Immersion schools were more likely to enact policies that promoted home laptop use and responsibility for having laptops at school each day*; *lower implementing schools, in contrast, often had policies that discouraged home laptop use or failed to enforce policies requiring students to have laptops at school.*

Higher Technology Immersion schools. Almost all schools, consistent with grant guidelines, initially adopted policies allowing students to take their laptops home. One project director at a higher implementing campus explained:

> The students, we believed from day one, they had to go home with their computer. This is an immersion grant…so, they went home with the kids from day one, and it's the expectation that they are present with the child each and every day, and it's actually part of the agreement the parents and the students sign, that if a student's in attendance, then the computer is in attendance.

Similarly, another higher implementing school viewed Technology Immersion as a "24/7" program with students having access to laptops both within and outside of school, and policies reflected that total immersion perspective. At yet another school, students freely took their laptops home, and the school modified existing policies so that students could enter the building earlier in the morning to access the Internet and work on projects. One very small school adopted a more restrictive approach. Students checked laptops out in the morning and in at the end of the day. Students had to receive permission from a

teacher to take a laptop home. An administrator explained: "We want them to have a specific reason to take it home."

Lower Technology Immersion schools. Lower implementing schools, on the other hand, often had policies that discouraged home laptop use or schools did not enforce policies requiring that students bring their laptops to school each day. At one school, an unreasonable level of parent financial responsibility and lack of insurance coverage affected home laptop access. During the first year, nearly all of the school's economically disadvantaged parents (about 97%) signed agreements to take full laptop responsibility so that their children could have laptops at home. In the second and third years, many students and/or parents decided not to take laptops due to high financial risks as well as students' dissatisfaction with carrying heavy laptops that were seldom used in their classes. Students at this school that had laptops frequently did not bring them to school because they were rarely used in classes. Another school allowed students to take laptops home at will. However, campus leaders and teachers did not enforce policies requiring students to bring laptops to school each day, so many students came to classes without their laptops.

A different lower implementing school did not allow students to take laptops home until they received a grant late in the school year to provide liability coverage. This school designated "homeroom" classes and the laptops were stored in the students' homeroom each night. Students had to receive special permission from a teacher to take a laptop home, which according to students, rarely happened. One very small school did not allow students to take laptops home at all during the first year. In the second year, very few students took laptops home because parents were unwilling to pay a $25 non-refundable fee and assume full financial responsibility for laptops.

- ***Student Conduct***: *All schools had similar student conduct challenges. Higher Technology Immersion schools, however, tended to enact policies that held students accountable for behavior while still advancing the use of laptops as a learning tool. Lower immersion schools were less likely to enforce school-to-home laptop transport policies, more likely to confiscate laptops for student conduct infractions, and often enacted policies that punished parents for students' misbehavior.*

All districts and schools drew from policy documents developed by other organizations to revise their student code of conduct and add acceptable use policies that would raise student awareness about what they could and could not do with laptops, and to address things that might happen at home with electronic equipment. Policies addressed issues such as plagiarism, using electronics to send abusive language, laptop use outside of classes, and laptop care. Schools typically began the first year with liberal policies governing students' laptop use that allowed student-to-student email, game playing, listening to music, and generous Internet access. Experiences encountered early on, however, led school leaders to revise policies to include greater specificity and to more clearly define consequences for disciplinary infractions and laptop damage.

Higher Technology Immersion schools. Although all schools faced similar student conduct challenges, higher implementing schools enacted policies that held students accountable but still advanced the use of laptops in classrooms. Exhibit 2.2 describes the productive student policy context at one higher Technology Immersion school. Other higher implementing schools similarly restricted student laptop activities during the school day but allowed greater freedom outside of school. Student rule violations had logical consequences that fit the severity of the offenses. The most prevalent policy violations involved off-task behavior in class, playing games, sending email, instant messaging, and visiting inappropriate websites. Penalties included warnings, detention, close supervision of the laptop histories, revoking home laptop privileges, and as a last resort, laptop confiscation. Students' laptop activities were closely monitored both electronically and observationally by technicians, principals, and teachers. One student described an incident involving a remote software program:

> I was caught playing a game during school and the little screen popped up on my laptop telling me to come down to the office. He [the principal] told me that if I want to keep my laptop then I should do something more productive than play games during school.

Student and parent education, including informal reminders, mini-courses, or training sessions, promoted laptop care. Students at higher immersion schools were sometimes without laptops due to repairs, disciplinary violations, or parent laptop refusals. Loaner laptops and desktop computers reduced the number of students without laptops in classrooms.

Lower Technology Immersion schools. Lower immersion schools were less likely to enforce school-to-home laptop transport policies, and school policies for student conduct infractions often called for the confiscation of laptops. In addition, some schools enacted policies that punished parents for their children's misbehavior. Lower implementing schools, like higher implementing, took aggressive steps during the first year to restrict students' use of their laptops at school for email, instant messaging, playing games, and downloading music. Although filtering systems were strengthened to block access to inappropriate websites, students accessing unapproved websites appeared to be a critical discipline problem at some schools. In response to concerns, the three schools that allowed students to take laptops home used electronic filters, blocks, and locks to restrict students' ability to use their laptops for games, music, watching DVDs, and to access the Internet. Students found these limitations frustrating and it discouraged home laptop use.

Also, when students at two schools took laptops home, there were no procedures that ensured that students brought their laptops back to school each day. One school restricted students' laptop use during the school day to classrooms only, so when many teachers decided not to use laptops, students carried them around for no purpose. Consequently, many students at this school did not bring their laptops to school. In contrast, at one school that required students to check out computers to take home, the penalty for failing to bring the laptop back to school was so severe (loss of the laptop for one week), that students resisted taking the laptops home.

Exhibit 2.2. Student Conduct Policies at a Higher Technology Immersion School

Students at the middle school take their laptops home, but they are required to have their computer at school each day. Over time, student code of conduct policies were revised to ban email and chatting, gaming or downloading games, and playing music during school hours. However, students are allowed to do such activities at home. The school purchased powerstrips for classrooms to eliminate conflicts about laptop charging. Additionally, the school began to rethink student discipline penalties that took computers away from students. For major offenses (such as having inappropriate materials), students receive two days of community service; lesser offenses (such as downloading and playing games) may result in computer re-imaging or in-school suspension.

Campus leaders also realized that students needed continual reminders about policies and laptop care. "Fireside chats" with students in classes to go over rules and behaviors reduced laptop damage in the first year. When Internet safety emerged as an increasingly important policy issue, the campus sponsored parent training sessions on Internet policies and safety. Advisory teachers trained students on Internet safety and how policies protect them from danger. District and campus technicians monitor student network activity.

Teachers have been trained on methods for monitoring laptop activities, and they are expected to ensure that students do not engage in inappropriate or irresponsible behaviors. Long extension cords allow teachers to have projectors at the front of classrooms and laptops at the back so they can monitor student work. Laptop policy infractions are referred to the assistant principal, as they would be for any other discipline offense.

Students say that principals and teachers tell them about laptop rules and penalties for breaking the rules. They are aware that their activities are being monitored. Students believe that the school's rules are fair because they're easy to follow. Students explained: "You come to school to learn not to play games"…"You can do it [email, listen to music, play games] at home."

Source: Interviews with district leaders, principals, and technology specialists; focus groups with teachers and students.

Lower implementing schools also enforced discipline policies through penalties that tended to punish parents as much or more than students. One school developed a "three strikes you're out" penalty system that called for an increasingly lengthy loss of the laptop and fines. For a first student infraction, the parent was called and assessed a $15 fee. If the fee was paid, the laptop was returned. For the next infraction, an additional $15 fee was assessed, and if paid, the student could use the laptop at school only. For the third infraction, the student lost the laptop for the entire school year. At another school, student consequences for misbehavior seemed loosely defined, with disciplinary actions described as ranging from the loss of the computer for a short time to complete loss of privileges and a fine (assessed to students and parents). A different school gave teachers latitude for defining student laptop misuse. At the teacher's discretion, a student could have their laptop taken away. One school concentrated on Internet behavior. Students who visited unapproved sites lost Internet privileges for one week, the second offense yielded a two-week Internet removal, and for a third offense, students lost Internet privileges entirely.

Across all schools, information on policies was usually provided for students and parents at the beginning of the school year and posted on school websites and in classrooms. Students were aware of rules and consequences for infractions, but students in lower implementing schools were less likely to report that someone in the school had met with them as a group or individually to review laptop policies. In general, students believed that laptop policies were fair. However, eighth grade boys at one school thought policies were unfair because they were penalized for playing educational games (considered inappropriate by the filter) after completing assignments. Most of the lower immersion schools did not mention the teacher's role in enforcing student conduct policies. However, at one school, teachers' ineffective classroom management was blamed for some of students' behavior problems. "We've definitely found that we need to have more professional development in classroom management," explained one campus specialist.

Parent and Community Support

Parents play a critically important role in supporting one-to-one student access to laptops, and the ways that schools structured policies related to parents' financial obligations and the penalties for their children's misbehavior influenced parental support. District and school outreach to parents and the community and efforts to build knowledge about computers and the Internet were also important.

Higher Technology Immersion Schools

- *Higher Technology Immersion schools typically gained parent and community support for the project at the beginning and then continued their outreach efforts—informational, educational, and financial—across years.*

Gaining initial parent and community support. Three of the four higher immersion schools had well-conceived parent and community initiatives that helped garner initial support for the project. One district and campus invested substantial resources in communicating with parents, the community, and policymakers about the project. Staff provided parent orientation trainings in English and Spanish at the school to explain the grant and also held parent sessions at neighborhood centers to accommodate parents with limited transportation. Similarly, staff at another district and school believed that the initial orientation sessions designed to acquaint parents and the community with the grant had contributed to strengthened support over time. At yet another school, administrators devoted considerable effort to communicate information about the project to parents and the community early on, including making presentations in English and Spanish at different locations convenient to parents. One principal explained:

> My philosophy is, rather than you asking them to come to you, why not go to them? It's a whole lot easier. So, we strategically planned meetings in certain spots that we know parents can get to.

Presentations centered on the value of the project to parents and businesses, and helping parents to see how children's experiences enriched their lives. The principal explained how parents were beginning to understand that the laptops could facilitate research without having to visit a university, allow their children to master various technology applications (e.g., PowerPoint, MovieMaker), and even apply new skills to family projects (e.g., archiving family photos). In contrast to these three schools, the extent of communication with parents at another higher implementing school was insufficient to allay parents' fears about laptops and Internet safety and this undermined their support for students' use of laptops at home.

Two of the higher implementing schools sponsored training sessions to acquaint parents with computers. Although attendance was lower than desired at one school, the sessions introduced some mostly Spanish-speaking mothers to computers. "It was so wonderful to see them use computers when they have never touched one before," said an administrator. Similarly, administrators at another school were surprised to learn that many parents had never touched a computer prior to distributing the laptops, so the school arranged to have after-school technology workshops so that parents could learn about technology applications such as Microsoft Word and Excel.

Continuing outreach to parents. Although pleased with initial successes, maintaining parent support was a continuing goal for higher immersion schools. Schools provided annual orientation sessions, hosted special events, used the media to disseminate information, enhanced school and teacher websites, offered training sessions, and tried to alleviate financial constraints. Parent and community support at higher implementing schools was generally either sustained or strengthened through school efforts. However, at one school, parent support in the second year declined and laptop refusals increased due to some parents' financial obligations (insurance fees and unpaid damage fees) and the Internet safety or idealistic concerns of others. To build parental support, the school required that parents of sixth graders and new students participate in sessions, available in several time and format options, focused on Internet safety, financial responsibilities, and laptop requirements. The school also hosted special events, such as a school open house, Internet safety night, and a technology showcase, that provided opportunities for parent and community interactions. Another school adopted a comparable approach, with annual orientation sessions provided for parents of sixth graders and new students. School staff is also available at fall registration to answer parents' questions, clarify acceptable use policies, and address problems.

Two schools continued to offer parent training opportunities. One school offered sessions promoted as "building your job skills," but there was little parent interest. At another school, the computer lab stayed open during the summer to educate parents about technology, and a parent liaison provided computer training in Spanish. Higher implementing schools also used district, school, and teacher websites as well as the media to communicate with parents and the community about the project. At one school, all of the teachers had web pages that informed parents about class activities. "This makes the school 24/7 and transparent to the community," explained the principal. Although some parents do not have Internet access, the school informs parents about Internet availability at libraries and "hot spots" in the city. In another case, a school website gave parents access to student resources and information on academic progress. For example, parents are able to check their children's grades, access homework assignments, and send emails to teachers through the website.

One school broadcasted information about TIP events on the local public access television station to raise parent and community awareness. Articles printed in the regional media raised the visibility of another TIP project across West Texas. Similarly, one district apprised community members of project activities through articles in the local newspaper. "In a small community like this, this grant has been of great interest to the community," explained an administrator. As a sign of community support, civic groups such as the Rotary and Kiwanis sponsored a week of study for a middle school student at a University of Texas technology camp. Afterwards, the student presented information about experiences to the civic

groups. An overt manifestation of community support for Technology Immersion in another district was the decision by the Board of Trustees to extend one-to-one student laptop access to the high school.

Despite notable outreach efforts, challenges in obtaining full-scale parent and community support for Technology Immersion included lingering concerns about financial obligations and Internet safety issues. Teachers at one school believed they had to find ways to accommodate responsible students whose parents simply could not afford to pay laptop fees.

Lower Technology Immersion Schools

- *Lower immersion schools garnered strong parent and community support for the project initially but support waned substantially over time due to factors such as ineffective policies, untenable financial risks, and insufficient efforts to build parents' knowledge about computers and the Internet.*

The principal at one school that served a largely Hispanic and economically disadvantaged student population realized at the outset that it would be a challenge to get all parents involved. She envisioned a two-fold approach involving (a) communication through various media (meetings, phone calls, and home visits), and (b) training to acquaint parents with laptops. Initially, the school was highly successful in garnering parent support. Nearly all of parents attended informational meetings and completed paperwork so their children could have laptops. Less than 3% of parents refused to sign the forms. By the end of the year, however, several factors began to undermine parent support. First, although laptop damage overall was relatively minor, one family had to pay a $500 fee for an accidentally broken laptop monitor because the district did not offer insurance. The school also began to charge parents fees for students' laptop policy violations. Thus, parent support emerged as a major problem in the second year when about 50 to 60 parents (around 13%) chose not to let their child have a laptop. The campus technology specialist explained:

> Part of their fears is that there's no way these parents can pay $1,300 for a replacement…I think we really cracked down hard last year because we didn't want them to think that they could just do whatever they wanted with these and not take care of them and then think they're going to get off scot-free…so we basically, we "nickel and dimed" them last year.

Students, especially seventh and eighth graders, influenced their parents' opinions as well. Some students said they really did not want a laptop because there were too many things that could go wrong, and there weren't many things that they could do with their computer. Parent refusals of laptops continued in the third year.

Parent support at another school was also tied to policies perceived as unfair as well as unfavorable financial risks. At first, families were excited about the TIP grant and laptops were a source of pride, distinguishing this small school from others in the region. Parents received letters outlining laptop policies and the school tried to increase parents' knowledge by opening the computer labs and increasing access to online information. Difficulties, however, arose over the district's stance regarding student access to laptops at home. When students and parents learned that it was a grant requirement, they wanted to know when the laptops would come home. Unfortunately, the district crafted policies in the second year that parents considered unjust. Parents objected to policies requiring them to pay a non-refundable deposit ($25) and to assume responsibility for damage up to the full laptop value ($1,200). Students explained what they perceived as their parents' position:

> …we were supposed to be able to take them home to do work anyway, and the parents said, "Why should we pay this much money when we're supposed to already be able to take them home?"

Consequently, few parents would pay, and only a few students took laptops home in the second year, and home laptop access was abandoned altogether in the third year.

A different school reportedly had a spectacular "kick off" event with support from the Lions Club and Chamber of Commerce that generated a great deal of enthusiasm about the TIP project. The grant was regarded as a way to bring technology resources to an economically depressed area, but administrators and teachers expressed concerns about parents' capacity to provide oversight for laptops at home. These fears contributed to policy decisions that restricted students' access to laptops outside of school. Administrators talked about the need for parent computer workshops, but an unsuccessful workshop in the first year that drew few parents discouraged future efforts. As a whole, there appeared to have been minimal outreach to parents to support students' laptop use beyond securing their permission for students to have a laptop and signing a form agreeing to assume responsibility. Parents assumed little or no financial responsibility because insurance was covered by a district grant.

At a different school, administrators said parents were excited about the TIP grant (announced through the campus website and a "meet the teacher night"), but some parents expressed concerns about laptop damage and student responsibility. The district addressed concerns about financial obligations by providing insurance free of charge and installing laptop tracing software; thus, almost all parents signed documents agreeing to share laptop responsibility with their children. A larger problem was the lack of parental knowledge about computers and the Internet. Substantial problems surfaced in the second year when parents reportedly failed to provide oversight for students' laptop activities at home. The principal explained:

> Policies remained the same, and parents are well aware of it. At home, we're not privy to what they do. However, when we have had to pick up computers, it's very easy to go and check and see what they've been doing. Many times, we've had parents that are not aware of what their kids are doing, and so they get shocked at some of the sites that the kids have been getting into. But by the same token, you have other parents that are really observing what they're doing. So we've got both spectrums there.

Teachers, similarly, believed that the home environment affected how students used and treated the laptop: "A lot of that depends on how the student's brought up…if they treat it as just a portable game center or if they treat it as a kind of an actual workspace." In the third year, Internet danger posed the greatest obstacle to parent support. In response, the district installed Internet filtering systems and configured laptops so that parents and students had to ask permission for the laptop to be configured to access the Internet at home. The principal hoped to offer technology classes so that parents could learn about the dangers of the Internet. The campus specialist believed there needed to be more "involvement with the parents" beyond just the few volunteers to help them understand what the students are doing with laptops.

Technical Support

Technical support for Technology Immersion was expected to be provided by vendor technicians as well as district and campus staff. All of the schools shared some common experiences initiating one-to-one laptop projects and maintaining computers over time, but there were clear differences in the quality of ongoing technical support, the health of school infrastructures, and the unique technical issues that posed challenges at schools. As noted earlier, higher implementing schools usually had at least an adequate level of campus support staff (with a staff-to-student ratio of 1:247), whereas lower implementing schools had insufficient staff to manage the number of student laptop computers (staff-to-student ratio of 1:429). Higher implementing schools also were more likely to have sufficient and timely support from district technicians.

All Schools

- *Nearly all schools had strong initial support for laptop rollouts; every school also reported increasing technical problems each year as student laptops began to age.*

Initial support for rollout. Providing a laptop for each student created a great deal of excitement across all districts, schools, and communities involved. Due to the timing of grant awards and the release of funds, schools distributed laptops to students at different points during the first year. Laptop "rollouts" almost always were accompanied by ceremonies involving district and school staff, TEA and vendor representatives, parents, and sometimes school board members, community members, and state legislators. Given high visibility, district and campus staffs and vendors put forth a great deal of effort to get the project off to a good start. Managing a large number of laptops for the first time created logistical headaches for everyone. Districts with more sophisticated technology services staff fared better than others. For example, an administrator at one higher implementing school described district support for laptop rollout as "phenomenal." Technicians imaged and prepped nearly 1,000 laptops and helped distribute them on rollout days. In general, schools that selected Apple computers had stronger vendor support for start up and reported proportionately fewer problems in preparing and distributing laptops. Schools with Dell computers reported delivery delays, difficulty in adding tracking software, and problems accessing technical support.

Increasing technical problems each year. All schools reported increasing technical problems as student laptops began to age. Damage most often was caused by normal "wear and tear" associated with students' daily use of laptops rather than misuse or abuse, but students' care reportedly diminished over time as the novelty of having laptops waned. Schools reported problems such as damaged cords, chargers, logic boards, hard drives, CDs, screens, and keyboards, and dead batteries. Moreover, schools that allowed students to use laptops extensively outside of school (three higher implementing and two lower implementing) experienced more laptop damage, and thus, a greater demand for staff to deal with repairs. Higher implementing schools, in contrast to lower, dealt with laptop problems and repairs in more efficient ways.

Higher Technology Immersion Schools

- *Higher Technology Immersion schools were more successful in maintaining stable networks, providing ongoing technical support that kept laptops in the hands of students, and building a school culture that advanced responsible laptop care.*

Quality of infrastructure. Most of the higher implementing schools addressed wireless network and bandwidth problems in the first year. By the end of the second year, three of the four schools had established healthy wireless networks and had adequate bandwidth to support the large number of computers at the school. However, one higher implementing school located in a remote area of the state had significant Internet connectivity and bandwidth problems every year despite efforts to improve services.

Ongoing technical support. Higher implementing schools had more effective staffing arrangements for ongoing technical support. For example, one large school had a full-time technology specialist and a full-time technician who managed a Help Desk. The specialist supported faculty members and the technician managed student services. When laptops were new, the volume of repairs was low and turnaround time was short. The number of computers out of service for repairs increased substantially in the second and third years. To address increased demands, student Help Desk workers allowed the technician to concentrate on repairs, and district technicians or contractors assisted when the volume of repairs was too great. The school gave students loaner laptops during periods of service, but more loaner laptops were

needed as technical problems increased. The number of students without laptops increased each year, and this discouraged teachers who had to prepare lessons in both electronic and paper formats. Teachers, however, became less stressed about the problem in the third year as they found acceptable solutions such as students working as partners.

At a smaller school, a half-time technology specialist was assisted by a full-time technician and a district technician in times of crisis. Laptop maintenance was a major challenge in the first year, improved during the second year, and became a major problem as repairs escalated in the third year. The school used loaner laptops to reduce the time students were without their computers. Another small school that had just one campus technology specialist employed a coordinated district-campus system. Laptop problems were first referred to the campus specialist, if the problem could not be resolved, the teacher submitted it via an online system (TroubleTracker) to the two district technicians. Turnaround time for repairs depended on the severity of the problem and availability of parts, but students typically had their laptops back the same day or within one or two days.

Technical support for a very small school was provided by the district technology coordinator, who was assisted by the school's reading lab teacher. Laptop damage at this school was regarded as minimal over the three project years. Moreover, teachers become increasingly proficient at diagnosing and resolving their own technical problems. This school's minor laptop damage was apparently related to restrictions placed on students' use of laptops outside of school. Students could not take laptops home without special permission from teachers, and consequently, few students took laptops home.

Instilling a "culture of care." Respondents at two higher implementing schools talked about the importance of establishing a "culture of care" that raised student awareness of their responsibility for laptops. As students became more accustomed to having laptops in the second and third years, damages attributed to student carelessness increased. One technology specialist explained:

> We've sustained a lot of damages this year and part of that is due to the fact that it is very commonplace to them now to have a laptop in their backpack, and they forget that they have that in there. We constantly have to re-teach taking care of the laptop.

Respondents at another school, likewise, said students had to be taught how to take good care of a computer in order to prevent damages. Continual reinforcement from administrators and teachers was needed to create a "culture of care." Proper care was considered critically important to extending the life of student laptops.

Lower Technology Immersion Schools

- *Lower immersion schools more often had undependable networks, overloaded technicians, and varied technical problems that discouraged laptop use.*

Undependable Internet access. One lower implementing school had difficulty keeping its wireless network functioning during the first year. Both students and teachers reported that the network was often "down." Although service improved slightly in later years, students complained that the Internet was too slow when a lot of people were on it. Another school began the project in a temporary building while the middle school was being renovated. The school experienced major problems in the first year with Internet connectivity, insufficient bandwidth, and inadequate electrical power. Despite the move to the renovated campus in the second year, technical problems persisted. The building had an insufficient number of wireless access points and cinderblock walls inhibited connectivity. In the third year, students reported slow Internet access or no Internet connections as problems. Similarly, at the two other lower implementing schools, undependable Internet connectivity and insufficient bandwidth created problems throughout the project.

Insufficient ongoing support. Lower implementing schools also had difficulty meeting ongoing demands for technical support. One campus specialist at a mid-sized school had been hired as an instructional specialist. Previous experience as a science teacher who became technology proficient through her own initiative equipped the specialist perfectly for the instructional support role, but she was unprepared to assume substantial responsibility for the maintenance of nearly 500 laptops. The campus specialist was assisted by the district Help Desk and a technician that visited the school one day each week. However, the district Help Desk support was reportedly slow and the technician did not come every week because of illness or district reassignments to other tasks. The specialist was overwhelmed with responsibilities related to laptop repairs, laptop reconfigurations, network problems, and malfunctioning filtering systems that slowed her responses to teacher and student technical and instructional requests.

A large school with about 850 students had just two full-time support persons. Although one was supposed to be an instructional "integration specialist," he spent most of his time providing technical support along with the campus technician. Although the district had a cadre of technicians, various respondents indicated that their service response was extremely slow. In contrast to other schools, laptop damages and the need for repairs was a problem at this school in the first year. The campus technician was very busy with repairs, and delays in receiving parts from the vendor kept laptops out of students' hands. In the second and third years, the number of damaged laptops and repair turnaround time increased. The school did not have "loaners," so students were often without laptops for extended periods of time. Technology specialists believed that laptops were "too delicate" for students, whereas teachers said many students did not care for their laptops properly. Laptop repair management also seemed to be a problem. Technical support appeared to be provided on an "ad hoc" basis, with students stopping by the technician's office to ask for help rather than submitting technical requests in a systematic way.

The other two lower implementing schools, including one that distributed laptops on carts and one that restricted students' access to laptops outside of school, had less difficulty managing laptop repairs and providing ongoing technical support. However, the school that placed laptops on carts in teachers' classrooms had a unique set of problems. The school encountered few technical problems in the first year, but in the second year, batteries that were no longer under warranty began to go bad and cost $144 for each replacement. In the third year, the school experienced more problems with "bad motherboards" and "many batteries" that needed to be replaced. Accordingly, keeping laptops charged was a major challenge because classrooms did not have powerstrips to "plug in" individual laptops. Teachers said some laptops "were hard to charge long enough to teach a lesson." Other technical problems included students changing laptop settings, locking laptops so that the next class could not unlock them, and having problems saving work. With shared laptops, it was also difficult to know which student was responsible for laptop damage.

Miscellaneous technical problems. Technical staff at lower implementing schools reported substantial problems with laptop configurations, filtering software, and hardware incompatibility problems that absorbed their time and frustrated teachers. At one school, the campus specialist spent considerable time in the first year reconfiguring laptops because no software had been installed to keep students from changing their laptop settings. With Cyber Patrol installed in the second year, more problems surfaced when for some reason daylight savings time settings had to be updated individually on laptops. At a different school, differences between the software packages installed on teacher and student laptops made it impossible for teachers to use their laptops to project TIP programs on screens. Technical staff also spent considerable time dealing with forgotten passwords.

Professional Development

Technology Immersion packages included a professional development component designed to support all educators on an implementing campus. Professional development was to instruct teachers, particularly

core-content area teachers, in effective classroom integration and be delivered through proven methods such as sustained learning opportunities and ongoing coaching and support. Each school also was expected to provide dedicated instructional support to help teachers effectively integrate technology into their curricula and instruction. Figure 2.2 compares the strength of professional development at higher and lower Technology Immersion schools using four indicators measured on a 0 to 4 scale implementation scale. Mean scores show that core-subject teachers at higher implementing schools compared to lower had participated in substantially more hours of professional development and received more classroom coaching or mentoring from an internal sources (such as another teacher or technology coordinator) or external source (such as a vendor-provided professional trainer). Mean implementation scores also showed that teachers at higher immersion schools believed more strongly that their professional development supported their curricular and instructional goals and was coherent with their personal goals, earlier learning experiences, and state/district curriculum standards and assessments.

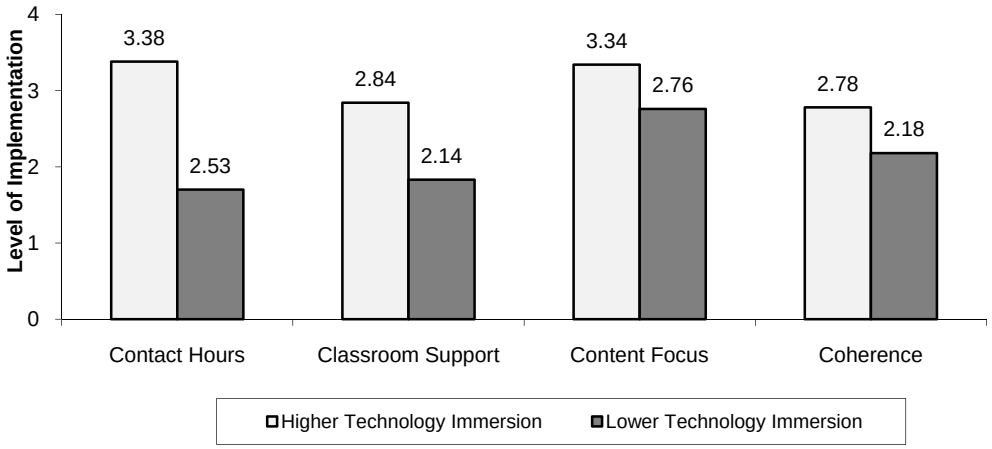

Figure 2.2. Level of Implementation for elements of Professional Development by *mean implementation score* (measured on a 0 to 4 scale) and higher and lower levels of Technology Immersion.

Particularly striking was the difference in time devoted to professional development. Implementation measures indicated that core-subject teachers at higher immersion schools, on average, participated in 38 to 49 hours (about 5 to 6 days) of technology-related professional development during the past school year, whereas teachers at lower immersion schools, on average, participated in 26 to 37 hours (about 3 to 4.5 days). Paragraphs to follow use qualitative information from interviews and focus groups to highlight similarities and differences in the professional development programs at higher and lower immersion schools.

All Schools

- *All schools worked with the professional development providers designated in the Technology Immersion packages to customize their training programs. Vendor trainers were available at each of the schools to provide in-class pedagogical support for teachers, but few teachers took full advantage of coaching opportunities. Only one school (higher immersion) provided ongoing, campus-based pedagogical support for classroom technology integration.*

Vendor-provided professional development. Apple Computer, Inc. has its own professional development division that provided training for schools, whereas Dell Computer, Inc. contracted with a professional development provider—Pearson Learning (initially owned by Co-nect)—to manage professional development for schools. During the first year, training across all schools largely focused on acquainting teachers with new hardware and the various programs and resources included in the immersion packages. As a way to promote a comprehensive approach, Dell asked Pearson Learning specialists to provide

training on all resources (e.g., NetTrekker, eChalk, and Dell Exchange), whereas Apple had various vendors provide training on their particular products (e.g., NetTrekker, KidBiz, Explore Learning, Beyond Books, and My Access Writing).

Representatives for both Apple and Pearson Learning worked with individual districts and schools to shape professional development programs that fit local preferences. That flexibility contributed to notable differences between higher and lower implementing schools in the priorities that districts and their schools placed on schedules, day allocations, delivery approaches, and content. Moreover, there were differences beyond the services provided by vendors in the ways that districts focused additional professional development for teachers.

Vendor-provided classroom support. Across schools, vendor trainers were available to provide in-class pedagogical support for teachers, such as modeling, demonstrations, or co-teaching. However, at most schools, it seemed that a small number of teachers took advantage of coaching opportunities. Teachers typically reported that it was their "choice" to have vendor trainers in their rooms. Teachers more often indicated that trainers came into their classrooms to observe and make suggestions. In contrast to their reluctance about classroom support, teachers especially appreciated vendors' constant availability for assistance by email or telephone, and they valued resources that vendors frequently sent via email.

Campus-based pedagogical support. Only one of the eight schools studied provided dedicated campus-based pedagogical support for teachers. The approach used by one higher implementing school is described below. At most schools, campus technology or integration specialists had multiple roles involving grant management, technical support, and instructional support that restricted their available time for working with teachers in classrooms. Campus-based instructional support at both higher and lower implementing schools more often involved emailing links to content-related websites and resources, or assisting with the use of a particular application, program, or piece of hardware. Two very small schools (one higher and one lower immersion) had no on-site support person. In general, teachers most often looked to other teachers for help in integrating technology into their lessons.

Exhibit 2.3 shows the characteristics that distinguished the professional development programs at higher and lower Technology Immersion schools. Paragraphs to follow describe those differences.

Exhibit 2.3. Characteristics of Professional Development at Technology Immersion Schools

Higher Technology Immersion Schools	Lower Technology Immersion Schools
Mostly stable and close relationships with vendor trainers	Frequent changes in vendor trainers
Dedicated time for professional development, shared experiences, and needs-driven content and delivery	Training delivered for groups of teachers in brief sessions during or after the school day
Training progression from a focus on proficiency and package products to the creation of technology-infused lessons	Increased teacher comfort with technology and access to resources
Additional learning opportunities that advanced classroom immersion	Additional learning opportunities that often advanced other district priorities
Accountability for participation and classroom use	
Experiences that changed teacher practice	
Access to ongoing, campus-based pedagogical support*	

Source: Interviews with district leaders, principals, and technology specialists; focus groups with teachers.
*One higher implementing school had dedicated campus support.

Higher Technology Immersion Schools

- *Professional development for higher Technology Immersion schools was characterized by stable and close relationships with vendors; dedicated time, shared experiences, and needs-driven approaches; a progression from technology proficiency to technology-integrated lessons; additional learning opportunities that advanced classroom immersion; accountability for participation and classroom use; changed classroom practices; and at one school, dedicated pedagogical support.*

Mostly stable and close relationships with vendor trainers. Three of the four higher immersion schools received professional development from Apple trainers, whereas one school worked with Pearson Learning (Dell's contractor). Two schools, one Apple and one Dell, had a change in their school's lead professional development representative. Personnel changes were regarded as detrimental. In the former case, a first-year change made it difficult for the school to schedule all of its professional development days, and in the later, third-year continuity was disrupted because the new trainer did not have the same rapport with teachers as the previous trainer. Smaller districts and schools especially valued the opportunity to maintain an ongoing relationship with professional development representatives. One district developed an exceedingly positive relationship with their Apple consultant. Both administrators and teachers said the close relationship was integral to their progress with immersion. The principal explained:

> The teachers are very open with him [the trainer], very comfortable with him. He's just been a tremendous benefit throughout the whole process. He's got good experience that he can relate to us what he's seen with other schools, and he's seen us from day one. He's seen a lot of the changes that have taken place, and he can compare that with what he's seen in other places.

Teachers at another small school appreciated their partnership with an Apple consultant. A respondent explained, "They love him, and that's really been a good thing because they've been able to develop a relationship with him. So if they have questions, they're on a first-name basis…They can email him." Across schools, continuing relationships allowed consultants to know what teachers had accomplished and that helped set the direction for future training. One principal said:

> He always has ideas about where we need to go next because he's so familiar with our campus, with our staff. He knows exactly what's going on…Planning is initiated by an email saying, "We need to plan. Here are some ideas that we have. What do you think?"

A larger district, on the other hand, appreciated the quality of Apple professional development provided during the first two project years but decided to facilitate professional development locally in the third year as a way to "grow their own" and move toward sustainability. Even so, the district used an Apple consultant to facilitate a leadership planning retreat prior to the start of the third project year.

Dedicated time for professional development, shared experiences, and needs-driven content and delivery. At higher implementing schools, TIP professional development was a high priority, which was manifested through dedicated staff development days. Professional development, for example, was a "continuous goal" for one small district with substantial days allocated each year for staff development and more than the required 25% of funds invested in training. "That has been essential to us. The success that we feel that we're having, I think is due to that staff development," said an administrator. All of the higher implementing schools had dedicated professional development days in the first year either before school started or during the year to get the project under way. Respondents indicated that at least part of first-year staff development days had been specifically designated for shared staff experiences. Personnel at these schools also reported that teacher training had been or would be conducted during the summer months. Training during the summer promoted a whole-school focus and also reduced the need to pull teachers out of classrooms during the school year. Such schedules also reflected the willingness of those

teachers to invest part of their summer break in training for which, in some cases, they did not receive stipends. Across three of four higher immersion schools, principals reported being actively involved in planning professional development and had identified teachers' needs through surveys as well as observations in classrooms. Thus, professional development whether provided by a vendor trainer or facilitated locally was more often tailored to meet the evolving needs of teachers.

Training progression from a focus on proficiency and package products to the creation of technology-infused lessons. The professional development at higher implementing schools seemed to progress incrementally from the first-year focus on proficiency with immersion package products to an increased emphasis on technology-integrated lessons, subject-specific lesson development, and the use of more advanced technology applications for projects. For example, teachers at two schools participated in multi-day workshops prior to the start of the first school year focused on familiarizing teachers with particular package programs and techniques for integrating laptops in the classroom. Vendor trainers returned periodically to schools throughout the year to meet with teachers in small content-focused groups or to provide co-teaching and demonstrations in classrooms. Similarly, teachers at another school initially spent half-day sessions with their trainer learning about computers and the package resources.

The organization of training shifted in the second year toward teachers working in content-area groups and the development of lessons. At one large school, Apple and its vendors provided a staff development academy for new teachers prior to the second year. Throughout the year, vendor trainers had an assigned group of content-area teachers that they worked with through co-teaching in classrooms. At two smaller schools, the focus was on small groups of teachers with training tailored to teachers' individual subject-area needs. At yet another school, professional development was scheduled during teachers' conference periods. The principal wanted the Dell trainer to observe how teachers integrated technology into their lessons and to make recommendations for improvements. For example, the trainer modeled lessons for three reluctant mathematics teachers.

Training in the third year continued to be provided through subject-area groupings. The use of smaller groups and more specialized trainings, according to an administrator, made management easier because it was easier to cover the classes of 6 to 8 teachers than to provide substitutes for the whole staff. Teachers at one small school appreciated the Apple trainer's emphasis on the integration of technology into lessons. An administrator explained:

> They know that every time they leave one of those professional developments that it's going to be something that they will use in their classrooms. In fact…if they've worked on something since the last time he [trainer] was here, and something's come up, they'll have a list for him to go over…They're always real excited when he comes because they love learning about that stuff.

For one school, third-year professional development centered on helping teachers blend technology with the new district curriculum. In lieu of Apple training, the district hired a full-time campus integration specialist who worked with the campus technology specialist to facilitate teachers' learning opportunities. Training content, offered in a variety of formats, focused on the one-to-one program as well district software programs, podcasting, the Inspiration program, and for new teachers, the Apple product line. In addition to training sessions, instructional specialists met with teachers during content-specific teaming periods to help plan lessons that integrated technology resources.

Additional learning opportunities that advanced classroom immersion. Respondents at higher immersion schools described additional learning opportunities for teachers that augmented their vendor-provided training. For example, after the first year, one district sought opportunities for teachers to interact with other teachers who were integrating technology, so teacher representatives attended a one-to-one computing conference and a state technology conference. The district also hired specialized

consultants. A Texas mathematics teacher of the year, for instance, worked during the summer with mathematics teachers to develop class websites. Another district partnered with other area districts to provide specialized teacher training by subject area. Teachers of related subjects (e.g., math, science, business) met in intermediary locations. Two small districts reported ongoing relationships with their regional education service centers for technology training and support.

Accountability for participation and classroom use. Administrators at one large higher implementing school, in particular, spoke extensively about the importance of requiring teacher participation in professional development and monitoring how teachers apply information from training in their classrooms. The principal monitors teachers' attendance at training events and tracks technology usage through district-generated website and resource reports. Campus and district administrators and specialists observe classroom technology use. An instructional specialist said that holding teachers accountable increased requests for assistance. The principal also believed that "visitors are good for your environment" because teachers want to "show off" their technology-infused lessons for teachers and community members that visit the school.

Experiences that changed teacher practice. Many respondents at higher implementing schools believed professional development had made a difference. Principals and instructional specialists had observed changes in teachers' classroom practices during walkthroughs and observations. At one school, veteran teachers who at first were resistant had made remarkable progress in developing technology-integrated lessons. At another school, teachers were observed incorporating training content, such as podcasts and Inspiration software, into lessons. A campus specialist said the growing number of teacher requests for help with lessons was a positive sign:

> Just the number of things that I am asked for help with, I think has increased a lot…They keep asking me, "Can you help me with this? Can you help me with that?"

Teachers at one school described how the Apple trainer had given them lessons that they had used in their classrooms. Correspondingly, teachers at a different school said they had learned a great deal and were trying new ideas in their classrooms.

Access to ongoing pedagogical support. One large school provided pedagogical support that more nearly fit the goal of having ongoing coaching and support for teachers in designing technology-enhanced lessons. During the first two years, four-member teams including the project director, campus technology specialist, mentor teacher, and professional development specialist supported content-area departments by finding resources and suggesting ideas for technology-integrated lessons. Despite outreach, however, teacher responsiveness varied and specialists believed a "required" rather than "optional" approach was needed. In the third year, the school hired a full-time technology integration specialist who worked in tandem with the campus technology specialist to provide instructional support. Campus specialists offered both mandatory and optional sessions on a variety of topics for teachers. Additionally, they met with teams of teachers once a week to help plan content-related lessons. Supports also included in-class modeling, co-teaching, and working with students, and working with teachers to ensure that they had good classroom management skills. The integration specialist described her approach:

> I will look for things like WebQuests or websites or just a way to use the technology that we have, whether it's word processing or any of our programs, to enhance those lessons and to use those to reinforce learning, as opposed to always doing a worksheet or standing up there and talking quite so much.

The district also provided stipends for eight teachers to serve as members of a collegial support team. According to an administrator, these teachers are the "cheerleaders for the program and content areas who support the integration specialist by offering additional training and support for their peers."

Lower Technology Immersion Schools

- *Professional development at lower Technology Immersion schools was characterized by frequent changes in vendor trainers, brief sessions for teacher groups during or after the school day, additional learning opportunities that often advanced other district priorities, and increased teacher comfort with technology and access to resources.*

Frequent changes in vendor trainers. In contrast to higher implementing schools, lower Technology Immersion schools reported very positive but more transitory relationships with their Pearson Learning trainers. One school had a new trainer each of three years, and the other three schools experienced at least one personnel change over the same time period. Administrators and teachers at these schools appreciated consultants' knowledge and skills, dissemination of links to technology resources, positive interactions with teachers, willingness to go into classrooms to observe or co-teach, and timely responses to inquiries or requests by email or telephone. Administrators also appreciated that trainers would work with districts and schools to accommodate their calendars. Unfortunately, this often put professional development consultants at a disadvantage because many lower implementing districts and schools, especially in the second and third project years, did not want to designate specific days for staff development but instead asked consultants to fit training sessions within brief time segments (generally about 45 minutes) available during or after the school day. This affected teachers' willingness to participate and colored their views about the quality of training provided by the consultants.

Training delivered for groups of teachers in brief sessions during or after the school day. Late grant awards to most of the lower implementing schools made it difficult to schedule professional development during the first year because school calendars were already in place. Moreover, for some schools, the grant represented a paradigm shift from teacher-selected professional development to a prescribed set of professional development experiences. One technology specialist explained that previously teachers decided when and if they would participate in district- or campus-provided sessions designed to help them meet state technology proficiencies. Quite the opposite, the TIP grant "obligated" teachers to participate in technology training. Some teachers begrudged this change.

At one mid-sized school, initial sessions delivered in 45-minute segments helped familiarize teachers with laptops, classroom management, and package resources, but left little time for teachers to "play" with resources. Some teachers resented that training sometimes required after-school participation, and because initial training occurred before receiving their laptops, they had difficulty retaining the content. At the end of the first year, teachers did not want any more professional development or classroom support. They described Technology Immersion as "overwhelming" and they were "tired." The principal wished that the grant had been awarded earlier so that teachers could have gotten off to a better start.

When the Pearson trainer visited another small school, she worked with teachers during their conference periods, after school, and in classrooms to help them master basic computer skills and to introduce them to package products. Teachers at a different small school received initial training on package resources as departmental groups. Persistent problems with Internet service, however, marred many training sessions at the school. Training at a large school, on the contrary, reportedly worked well in the first year. The school provided substitutes so that all teachers could meet in subject-area groups with the Pearson trainer. The principal appreciated the opportunity to have sustained professional development that differed from the "piecemeal" efforts in the past. Teachers said that two full-day sessions in combination with shorter sessions during planning periods acquainted them with TIP resources.

Across lower implementing schools, training in the second year was usually delivered to groups of teachers during planning conferences or after school. The principal at a large school regretted that training did not follow the pattern started in the first year, with a combination of half- or whole-day sessions and

sessions during planning periods. The professional development calendar apparently was out of her control and dictated by district priorities. The school's new Pearson consultant provided training during planning periods that familiarized teachers with TIP products, classroom management, and Internet resources. The principal was concerned about meeting the needs of many new teachers (about a quarter of the school faculty). At another school, the Pearson trainer held one, whole-day session with teachers, including many who were new to the school, to provide information on the laptops and the use of eChalk. On other days, the trainer met with teachers during conference periods, after school, and in their classrooms. Teachers appreciated the resources they received in person or through email, such as websites, TEKS-related games, and ideas for lesson plans. At another school, the Pearson trainer visited the campus about once a month in the second year and maintained ongoing contact by email and telephone. Training focused on procedures for WebQuests, use of Inspiration software, iKnow quizzes, and Marco Polo software. Training sessions typically occurred after school or during teachers' teaming period. The Pearson trainer was available to co-teach or demonstrate lessons, but few teachers were interested in receiving in-class support. Training at another school was delivered for departmental groups of teachers.

All of the four lower implementing schools had new professional development consultants in the third year. Similar to the previous year, the Pearson trainer provided support for teachers at one school during their planning periods, and again, district administrators seemed to determine how professional development services would be configured. Teachers reportedly participated in 45-minute sessions focused on Internet and other specialized resources. At another school, a new trainer shifted training toward individualized teacher support for lesson development. The trainer was available upon request to assist teachers with lesson development and to co-teach or model classroom lessons, but very few teachers asked for support. At two other schools, the transition to new consultants combined with reductions in professional development days affected training continuity. Whole-group sessions at the beginning of the school year reportedly re-introduced teachers, many new to the schools, to the TIP products. Sessions during the year were scheduled during teachers' conference periods and mainly focused on resources purchased with grant funds, such as small interactive white boards, Inspiration software, and other products.

Additional learning opportunities that advanced other district priorities. Additional professional development opportunities reported by teachers at lower implementing schools were often tied to other district initiatives. For example, one school had an ongoing partnership with Texas A&M International University to support their mathematics program, and teachers also received training on the District Data Analyzer, a tool purchased to help teachers monitor students' progress at this lower performing school. Another district adopted a new computer-based reading program (FastForward) for students at risk of reading failure. Reading teachers at the school participated in training and implemented the program. Teachers at another school completed tutorials on programs that the district had recently purchased (Study Island and Odyssey Ware). Another district facilitated a district-wide session with Allan November focused on the "global classroom" and ways to build learning communities. November subsequently provided a whole-day session for teachers at the middle school.

Increased teacher comfort with technology and access to resources. Administrators and teachers at lower implementing schools most often credited professional development with increasing teacher technology proficiency and raising their awareness of resources. Teachers at one school said they now have a lot of resources they can use in their lessons, whereas teachers at a different school appreciated the information on educational websites and other resources provided by the trainers. Teachers at another lower immersion school attributed increased Internet use, completion of online tests, and increased comfort with technology to their professional development experiences. However, administrators at this school felt that many teachers had not made significant strides in using technology in their lessons. Both district and campus administrators expressed concerns about teachers' ineffective classroom management

that escalated problems with laptops and their failure to apply concepts from training in their classrooms. "The bottom line is if it doesn't improve instruction, then it's not going to be worth it," said an administrator. One principal at another school, on the other hand, believed professional development has been helpful because he had recognized greater use of technology programs by teachers.

Teacher Support for Technology Immersion

Given the needed equipment, digital resources, and support for Technology Immersion, teachers should recognize the value of using laptops and other technologies in their classrooms and should design technology-enhanced classroom environments that integrate technology into teaching, learning, and the curriculum. As a way to understand differences between the levels of teacher support at higher and lower implementing schools, we first compare the levels of implementation for five elements measuring teachers' Classroom Immersion. Next, we present findings from the qualitative analysis that reveal some common teacher experiences but also some distinct differences associated with the the schools in which teachers worked.

Classroom Immersion

Figure 2.3 illustrates teachers' level of implementation relative to five elements of Classroom Immersion: Technology Integration, Learner-Centered Instruction, Student Classroom Activities (with technology), Communication, and Professional Productivity. Teachers at higher immersion schools reported substantially stronger levels of implementation across four of the five measures. First, mean scores for teachers at higher implementing schools compared to lower showed much stronger ideological affiliations with the tenets of Technology Integration and Learner-Centered Instruction, and accordingly, those teachers had students use technology more frequently for classroom activities. Teachers at higher immersion schools compared to lower also used technology substantially more often for Communication purposes such as emailing students and parents, and posting homework and class information on a website. In contrast, mean scores showed there was little difference between teacher groups in the use of technology to enhance their Professional Productivity. Both groups of teachers were nearly as likely to use technology for things like administrative record keeping, creating instructional materials, making presentations, and administering assessments. Thus, teachers at lower implementing schools appeared to value technology for their own purposes, but they were less committed to having their students use technology.

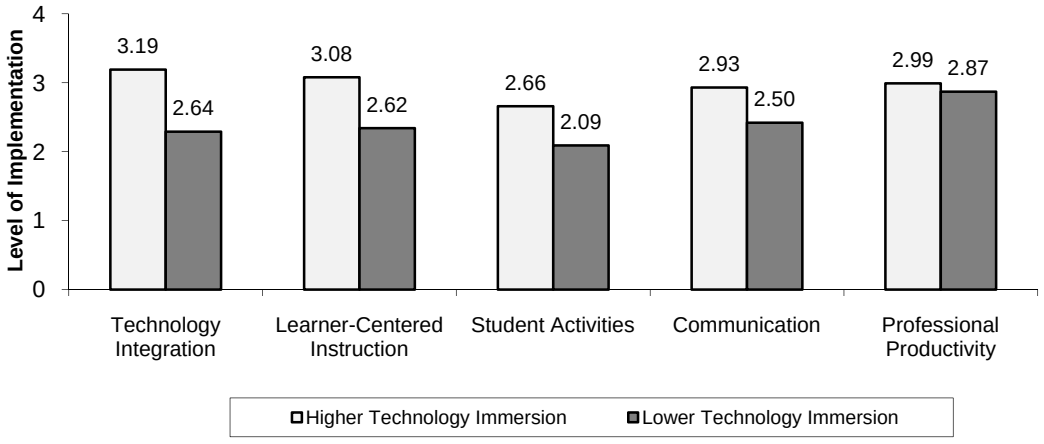

Figure 2.3. Level of Implementation for elements of Classroom Immersion, by the *mean implementation score* (measured on a 0 to 4 scale) and higher and lower Technology Immersion schools.

Teacher Support

Only one of the eight schools studied included teachers in the grant application process, so in fall 2004, a majority of teachers had just learned about the Technology Immersion project, sometimes through presentations by principals who knew little about the project themselves. Teachers at both higher and lower Technology Immersion schools initially shared some common views about the project. However, distinct themes emerged over time that distinguished the views expressed by a critical mass of teachers at higher and lower Technology Immersion schools (see Exhibit 2.4.)

Exhibit 2.4. Teachers' Support for Technology Immersion
All Teachers Initially…
Felt excitement mixed with apprehension
Had no clear conception of classroom technology immersion
Expressed concerns about TAKS scores
Held diverse views about traditional and innovative practices
Teachers at Higher Technology Immersion Schools…
Had positive attitudes and supportive collegial relationships
Recognized the high priority administrators gave the project
Had high-quality professional development
Believed laptops improved student learning
Grew stronger instructionally over time
Teachers at Lower Technology Immersion Schools…
Had uneven leadership
Had very high turnover rates
Were resistant to change
Faced serious technical barriers
Believed laptops had negative effects on students
Linked laptops with lower TAKS scores
Source: Interviews with district leaders, principals, and technology specialists; focus groups with teachers and students.

Across all schools, teacher turnover was a continuing challenge in gaining and maintaining teacher support for Technology Immersion as teachers left schools and new teachers arrived. However, teacher instability was a greater problem at lower immersion schools. Combining turnover statistics from the 2004-05 school year through 2006-07, the average teacher turnover rate for higher implementing schools was 31.1% (with rates ranging from 23.1% to 37.1%) compared to 49.6% at lower implementing schools (with rates ranging from 30.8% to 80.0%).

All Schools

- *Teachers at all schools initially reported excitement about the project tempered by apprehension, had no clear conception of classroom technology immersion, expressed concerns about TAKS scores, and held differing views about traditional versus innovative practices.*

Excitement mixed with apprehension. Initially, teachers were generally excited about getting the laptops, but many expressed fears about their technology proficiency and ability to manage laptops in the classroom, as well as concerns about the minimal role that technology had previously played in their teaching. They expressed hopes that professional development would prepare them to have the knowledge and confidence needed for immersion. One principal explained, "I have some [teachers] who are scared because we don't know anything about the unknown. But, I think they're all excited." Another administrator similarly said, "Well, they've got questions in their mind about it…Maybe it's just that thing of the unknown." Other principals worried about the varying levels of teacher proficiency and some teachers' readiness for integrating technology. Teachers at one school expressed divergent views. One technology advocate described the grant as a "dream come true" while another teacher was concerned about instructional change from proven methods.

No clear conception of classroom technology immersion. Part of teachers' apprehensions stemmed from the fact that many did not have a clear understanding of what a "technology immersed" classroom should be, or how technology, the curriculum, and TAKS preparation could work together. Teachers recognized many of the challenges they might face in a one-to-one classroom, such as technical problems, limited time to prepare lessons, their own and their students' minimal technical skills, and managing a room full of laptops, but instructionally, they did not have a well-formed vision of the direction they should be

going or how a fully immersed classroom might look. Some teachers viewed classroom immersion in terms of accessibility to resources. Teachers at one school wanted to have more readily available access to the A+ Learning program, increased capacity to do research in English and history, and the ability to complete technology-related activities cited in textbooks. Teachers at another school saw immersion as having access to a lot of software programs, such as Flash Player and access to the Internet for students. A teacher at one school viewed technology and the curriculum as a dichotomy saying, "Which of these things am I going to do?"

Concerns about TAKS performance. Teachers at all schools felt a level of stress as they tried to decide how they could use technology and simultaneously address TAKS requirements and ensure that students had acquired the skills necessary to be successful on the test. For example, teachers at one school worried about meeting students' academic requirements asking, "Are they going to get what they need?" Teachers feared that they would be held responsible if students failed to perform well. Some administrators believed that teachers who came from a traditional model of teaching had more difficulty seeing how teaching with technology could enhance TAKS results.

Diverse views about traditional and innovative practices. By the end of the first project year, differences had emerged between teachers who were embracing the use of technology in their lessons and those who were reluctant to change, and who often resented the extra time and effort required to produce technology-integrated lessons. One principal described it this way:

> We've got some great pioneers that are just way out in front of everybody doing great things …and then we've got some people following along pretty close behind them, willing to go that route and explore a little bit when other people are kind of pointing the direction. We've got some people that are kind of camping and doing what they can but they're not quite there yet. I don't know that we've got any people that are resistant to this at all.

Similarly, a principal in another school said teachers comfort with technology varied. Some teachers had begun to use laptops in their classroom to some extent, whereas other teachers were afraid to "let go" of traditional methods that were "tried and true."

Higher Technology Immersion Schools

- *Teachers at higher Technology Immersion schools had more positive attitudes and supportive collegial relationships, recognized the high priority administrators gave the project, had high-quality professional development, believed laptops improved student learning, and grew stronger instructionally over time.*

Positive attitudes and supportive collegial relationships. On the whole, teachers at higher implementing schools seemed to have a positive attitude about their work, a sense of humor about their new experiences, and a good working relationship with their colleagues. For example, some teachers appeared to have been rejuvenated by the project. One teacher said, "It's the best two years in my 32 years of teaching…I can't think of going back." A principal reported increased teacher buy-in over time, and teachers new to the school that had just "jumped on board" and "took over where the other ones had left off." Teachers at a different school described their proactive stance toward technology: "I think it's just a matter of doing it…You just jump in and start doing it." Teachers were excited that high achievers could use laptops to do accelerated work and lower achievers could reinforce their skills. During focus group discussions conducted at several higher immersion schools, teachers responded to interviewer questions, but they also bantered with each other and saw the humor in even taxing situations they had been experiencing with laptops.

Teachers at higher implementing schools also appeared to have close relationships with their colleagues, even though they did not always share common planning times. At one school, a few teachers who really enjoyed the challenge of integrating technology into instruction seemed to energize their colleagues. At another school, teachers enjoyed their shared staff development experiences and looked to one another for technical and instructional support as they implemented new technologies in their classes. At yet another school, teachers were organized as subject-area teams and they used shared planning periods to collectively develop lessons integrating technology. At still another school, teachers felt comfort knowing that they had supportive colleagues to share their journey: "We talk all the time," said one teacher, while another added, "Yeah, we are very close." An administrator at this school linked staff stability and collaborative support with teachers' professional growth saying, "We manage to keep a pretty good group together…I think they do a good job of working together…I think that's about the most successful part."

High administrative priority for the project. Technology Immersion was a priority for administrators at higher implementing schools and teachers sensed that importance. One principal attributed positive teacher attitudes to administrators' messages about the potential value of immersion for students: "I think that they're very well able to see the benefits that this can offer to our students." A teacher at one higher implementing school described the administration as "just totally committed." When implementation progress stalled at one school in the second year, district and campus administrators intervened to help teachers see the value of the project for the school and its students and provided resources and incentives to spur teachers' re-commitment to immersion. The decision by the superintendent and board of trustees in one district to expand one-to-one laptop access to the high school further reinforced teachers' commitment to changed practices.

High-quality professional development. The extent and quality of staff development provided for teachers at higher Technology Immersion schools advanced changes in attitudes as well as practices. One principal explained that after teachers had received their initial training, teacher support shifted from about 50% positive to about 90% of teachers who were "very, very excited" about the project. At the end of the third year, the technology specialist at this school was encouraged by teachers' increasing competence and independence, which reflected their commitment as learners:

> Our teachers have done a really good job of utilizing the staff development…and they work hard to utilize what they learn, and they figure out a lot of things for themselves. We have some teachers who are very good at certain programs, and then they are very good then to help those others who might have questions regarding that. I think our teacher have done a really good job in that, in helping themselves a lot.

Teachers at one school raved about their professional development experiences. Teachers said participation in staff development had "dramatically" affected their instructional practices. They appreciated being actively involved, were excited about what they learned, and proudly shared their new skills with students. Teachers at some higher immersion schools especially valued the assistance they had received from campus technology specialists. Teachers at one school respected the knowledge and skills of the campus specialist, and appreciated her efforts to provide both technical assistance and help for integrating technology into lessons. Continuing support from the specialist motivated teachers to continue despite the "headaches" that accompanied laptops in their classrooms.

Believe laptops improve student learning. Teachers' support for Technology Immersion at higher implementing schools often arose from the benefits that they saw for students. Teachers at one school spoke of the way in which the laptops "expand the world for students" by increasing access to information, enhancing the relevance of information learned, and putting all students "on a level plane." Teachers at another school cited technology's effects on students' greater interest and engagement in their work, and the improved quality of student products, such as book reports. Teachers also believed that

special education students had made gains that exceeded those of general education students, and gifted and talented students could go much further in their studies in an immersed classroom environment. Teachers at one school said they learned about technology from their students. One teacher explained, "We are kind of learning together. I think it makes the students feel more important because sometimes they are able to show us something that we did not know."

Instructional growth over time. Teachers and administrators at higher immersion schools often described teachers' incremental growth over time toward greater competency and independence. At one school, the principal believed teachers had grown "tremendously technology-wise" in the first year, and they continued to evolve in the second and third years as they overcame their initial feelings of "overload" and moved toward greater comfort using technology. A campus technology specialist expressed pride in teachers' accomplishments, saying:

> …they have done what it takes to do it and it's a battle for some of them. Some of them have embraced it wholeheartedly from the very beginning, and are totally comfortable, and use it as a tool, and use it consistently as a tool and think nothing of it, whereas for others it's still very, very hard for them to have students be given the freedom to open up that laptop and do it that way instead of with the old paper and pencil. But again, it's a journey and I'm proud of what we've accomplished and I think we still have a long, long way to go.

Teachers at another school said it had been exciting to be involved in the project and they had learned a great deal. Teachers said they used laptops regularly for instruction, with several reporting computer use about 90% of time. An administrator noted increased teacher confidence and improvement in their troubleshooting ability and expressed excitement about the diversity of students' laptop use and the quality of the products created. Over time, teachers reportedly became increasingly at ease with laptops, enjoyed learning along with their students, improved their ability to manage their classrooms and monitor students' laptops, and increasingly integrated technology into their lessons. At another school, teachers had integrated technology into their lessons more, but technology use still varied from classroom to classroom. Teachers were using electronic textbooks, online resources and assessments, learning programs and games, and researching topics on the Internet. Some teachers had adopted a facilitative or coaching model to help students learn, but other teachers still clung to traditional practices.

Teachers at three of the schools seemed to be on a gradually positive growth trajectory, whereas teachers at one school experienced what is sometimes referred to as the second-year implementation dip. Teacher support for Technology Immersion declined when problems encountered in implementing a new district curriculum, trying to integrate technology into that curriculum, and addressing problems encountered in using laptops (students without laptops, classroom management issues) began to mount. Foremost, teachers saw the new curriculum and technology as two separate things rather than as an aligned process. An administrator explained:

> The biggest challenge, and continues to be so, is to change the mindset of not only the teachers, but also campus leadership, about what this program is geared towards doing. It's not a laptop program. It's not a technology program. It's an instructional program, and it is meant to support the curriculum. It is not a separate entity from curriculum, but a tool to teach the curriculum and to engage students.

Some teachers were having "aha" moments as they saw how technology and curriculum worked together, whereas others "struggled" to see the connection. The administrator believed that more should have been done to help teachers understand why they were pursuing Technology Immersion:

> We didn't do enough *why* behind why we're doing this. You know…how this impacts kids and how other schools have seen this impact their student populations. While they [teachers] were

> excited and motivated by them [laptops], we thought we had done enough; we thought we had done the right thing. We didn't do enough. We didn't continue that, feeding them the good reasons why…because it's a struggle and it's painful and it hurts, that it's irritating and it makes them angry and makes them happy at the same time when they've had those moments of success. But if you don't take the time to continually remind them, 'This is why we do this. This is why this is a good thing to do,' they lose sight of it.'

As many teachers failed to see the purpose for their efforts and became increasingly frustrated, a campus administrator said they tended to "escalate minor problems into large problems." They voiced complaints but when assistance was offered declined help. Teachers at the school expressed dissatisfaction with students generally. Some believed that students did not understand the difference between the usefulness of laptops for academic purposes versus play, and that lost time due to doing "technology-type stuff" negatively affected TAKS scores. One teacher described overall staff support like this:

> I think last year, there was a large percentage of buy-in, and I think this year it's not as much for different reasons besides the computers, that a lot of people are frustrated about. It's not just the computers.

By all accounts, teachers' support for Technology Immersion increased markedly during the third year. The new principal attributed improved teacher attitudes to a summer leadership retreat and a three-hour professional development session at the beginning of the school year. During these events, teachers viewed a video about Maine's one-to-one initiative, talked about the research, and considered "why we're doing" Technology Immersion. The discussion spurred faculty re-commitment to the project, but the district and school also provided support initiatives that helped as well, including a full-time instructional specialist, collegial support team, and coaching by district administrators. An administrator emphasized the importance of ongoing support for teachers:

> I think when people enter this, they think getting the hardware in place is going to be the hard part of it. That's not even close to the hard part. The hard part is changing mindsets. Because when teachers get stressed, they go back to what they've always done, and where the comfort level is. And that is not always the technology. So it's changing the mindsets and embracing the whole concept and knowing that it is better for kids.

Teachers made notable progress in the third year, but continued to encounter problems incorporating technology into the curriculum and preparing for the TAKS test. Campus specialists helped teachers find ways to use technology to support the district curriculum and to prepare students for the TAKS.

Lower Technology Immersion Schools

- *Teachers at lower Technology Immersion schools had uneven leadership and high rates of turnover, resisted change, faced serious technical barriers, believed laptops had negative effects on students, and linked laptops with lower TAKS scores.*

High turnover and uneven leadership. High levels of principal and teacher turnover hindered progress and diminished teacher support at lower implementing schools. Each of the four lower implementing schools also had unique circumstances that affected teachers' receptiveness. Three of the lower implementing schools had extremely difficult first project years, and schools were never able to fully recover teacher support. Two energetic and visionary principals were far ahead of their teachers in their commitment to technology and understanding of its potential contribution to student learning. If these principals had stayed with their schools, things might have been different. One school got off to a good start, but principal changes and extremely high teacher turnover rates each year took a toll. In the first year, teachers were excited about the grant and enthusiastic about using technology in their classrooms.

By year's end, teachers talked about their growth in knowledge and skills and increased technology use. Teachers looked forward to using laptops in better ways the next year, but nearly three-quarters of the core-subject teachers (70%) did not return to the school. In the second year, differences surfaced between continuing teachers who "embraced" technology, and new teachers who had difficulty finding time to use laptops in their classes. Nearly half of those teachers (40%) did not return for the third project year. As might be expected, the level of classroom implementation declined.

Resistance to change. School and district administrators at lower implementing schools initially made clear distinctions between teachers who were excited about Technology Immersion and teachers who might be resistant. One principal was amazed that teachers she thought would be "very resistant" seemed excited about the project. A district administrator, similarly, was surprised about teachers' enthusiasm saying, "You know, there are always some people, that, it doesn't matter what you're doing, they're going to be against it." At the end of the first year, the principal attributed diminishing teacher support to the incredible amount of change driven by laptops. She believed that some teachers resented that laptops required them to take a more active role in the classroom:

> I think there's more responsibility on the teacher now. It's a little bit harder on them, too, because I think it's kind of made them have to be more on their toes, have to be more actively involved in the classroom. You see them monitoring more, walking around more. A lot of our teachers have done away with desks and put tables in because it's easier to monitor the setup of the computers versus when they're all in rows like this…For us as administrators, it really has helped us because we tell the teachers, "You cannot know what the children are doing on their computers if you're not moving around." Even with the paper-pencil, if you don't monitor and correct immediately, they're going to practice incorrectly. So they're having to go from student to student more often making sure that they're getting it done correctly.

A different principal who assumed leadership in the second year summed up teacher support at the end of the third year this way:

> I haven't seen the training implemented in the classroom the way it can be. There are a few teachers who are doing a great job. They're not making excuses. The teachers who use the laptops all the time are the ones who are using them, period. They're assigning all kinds of interesting projects.

A technology specialist at a different school expressed concerns about the project from the start. He believed that teachers were being "pushed by many things" and it was "too much." He said, "TIP is one more thing that of course is great, but you still have to learn a lot of things…and that takes time also." The principal also voiced concerns about teachers who had already attended required district technology training sessions but were still afraid of technology. "They've gone through training, but they have to be gently pushed," he said. At the end of the third year, teachers' support for the project varied. A district administrator explained:

> You know, you'll get all levels of teachers, and the way I see it…there are teachers that accepted the computers and have integrated it into their classroom instruction, and then there are those teachers that kind of refused, but they have to do it.

At yet another school, teachers initially expressed strong resistance to the project, with one teacher in the focus group threatening to leave at the end of the year due to the stress. Teachers felt overloaded by the demands that already were being placed on them. Adding something else to their load was "overwhelming." Teachers concerns arose from their doubts about student responsibility as well as concerns about TAKS preparation and pressure to maintain the middle school's accountability rating. One teacher explained, "We're the only Recognized building in our district, so we're always under the

microscope anyway. So we're under the microscope again." One teacher asked facetiously, "If we're training teachers…what happens when 30 teachers don't come back next year?" Little had changed at the end of the year; some teachers expressed overt resistance and even hostility about the project. Teacher and administrative turnover during the next two years caused additional set backs.

Technical barriers. Teachers at one school, who were doubtful from the start, cited numerous technical problems that made their first year difficult. First, some laptops were not Internet ready, so they had to be "re-imaged" individually. It took weeks to configure the laptops and this interrupted class each time a student was called for service. Teachers also assumed a great deal of responsibility for logging laptop information, such as serial numbers, delivery date, and inserting tags. Teachers also said they were "bombarded" during the first year "with a bunch of software and very little support." Teachers said they forgot passwords, and thus, had difficulty logging onto programs. Technical problems persisted at this school in the second year, with incompatibility between teacher and student laptop programs and difficulty connecting laptops to LCD projectors. Students frequently forgot their passwords for various programs, the network failed to support the email demand, printers were unavailable, battery power was insufficient, and students did not have "floppy disks" or "flash drives" to save their work. Many students also did not have laptops due to excessive turn-around time for needed repairs. Similarly, at other schools problems with laptop configurations, Internet connectivity and bandwidth, filtering systems, and slow turnaround time for repairs undermined teacher support. Some teachers who encountered persistent problems abandoned their efforts to use technology resources.

Negative opinions about laptop effects on students. Teachers across all schools encountered some of the same challenges in managing laptops in their classroom; however, teachers at lower immersion schools tended to have far more negative opinions about their students' behavior than teachers at higher implementing schools, and they were less likely to see positive benefits of laptop use. At one school, difficulties encountered during the first year with student emailing, text messaging, chatting, and engaging in unapproved activities undermined teacher support. Teachers complained about difficulties in monitoring students in their classes and being unable to control student laptop use. One teacher, for example, resented having to always walk around and check what students were doing and make sure that they weren't doing something inappropriate, such as emailing a friend. Teachers wanted limits placed on email, gaming, and downloads. They also were dissatisfied with students' attitudes about laptop ownership, saying they "feel these computers are theirs, and so therefore, they can do anything they want with them." One gifted student, in particular, infuriated some teachers by sending an email to the principal explaining that if they're going to tell her when and where she could use the laptop, she'd rather just "turn in" her laptop. With new policies in place to restrict students' laptop activities in the second year, teachers concerns shifted to students without laptops. A substantial number of students and parents decided not to take laptops, and accordingly, teachers said that a third to two-thirds of students per class did not have computers. Teachers said this made it too difficult to do assignments with laptops. One teacher cited diminished student but not teacher interest in laptops: "Some of the newness and the zeal is definitely not there, and not necessarily in teachers, more in the students."

Teachers at another lower implementing school expressed "doubts" in fall about the viability of providing laptops for the school's economically disadvantaged students. They worried that students would not be responsible enough to bring laptops to school each day or would break or lose laptops. One teacher explained:

> I think I'm for it. But at the same time, I wonder what the kids are going to do with computers. Because I've been in a situation where the books have been issued to them and they never bring them. They leave them at home. I don't care what you do; you can give them a zero, but they don't care.

Consistent with teachers' concerns, students did not bring their laptops to school regularly. One contributing factor was teachers' inconsistent laptop use in classrooms. Some teachers said students became increasingly frustrated in the second year with undependable laptop use, saying: "They don't bring their laptops. They don't want to carry it around. They say, 'What's the use of carrying our laptop around? We can't really use it.'" Teachers also resented students' irresponsible behavior with laptops. Teachers explained that monitoring was difficult because students found a way to hide their activities. Teachers also cited problems with students without laptops who did not want to return to the traditional ways. One teacher explained:

> Now, another downfall that I saw with the computers is that you assign the presentation and I usually tell them, "If you don't have your laptop for whatever excuse there is, do it on a poster board or go to the library and start checking out books." They don't want to check out books. I go, "Regardless of what it is, you have to present."

Teachers in the third year said they increasingly assumed a supervisory role whenever students used the laptops to ensure that they use proper websites and are not just playing music or games. Teachers said they had grown "tired" of the responsibility for keeping students on task. Teachers at still another school initially doubted that their students would be responsible enough to bring computers back to school, and although teachers could see some possible benefits to having laptops, they thought the time investment would be too great. One teacher explained: "It's just going to be so much work for some of them, because some of them can't copy two definitions in 90 minutes, and now you want me to try to teach them technology."

Linked laptops and lower TAKS scores. Teachers at some lower implementing schools believed that Technology Immersion would have a detrimental effect on students' TAKS performance. For example, at the end of the first year, a teacher at one school predicted that standardized test scores would fall because TIP had distracted the school from properly drilling the students for TAKS. Additionally, the principal had agreed that the school would take the TAKS mathematics test online, which teachers as well as the principal thought was "very scary." Reading teachers also worried that students preferred to be on their computers rather than reading TAKS passages. One teacher said, "…kids need to do a TAKS passage with a highlighter, and they need to do a TAKS passage with their pencils." When students ask if they can get on their laptops, the teacher says "no, we're not using them today. You have to get this skill." Actual TAKS outcomes and accountability ratings at the end of the first project year may have confirmed some teachers' fears about the negative influence of laptops on TAKS preparation and further undermined their belief in the value of Technology Immersion. Three of the four lower implementing schools experienced drops in their state accountability ratings at the end of the first project year.

Student Experiences

Given variations across higher and lower Technology Immersion schools in the nature of school supports for implementation plus differences in teachers' ideologies and classroom practices, it came as no surprise that students' experiences differed as well. Understanding students' perspectives first involved comparisons for implementation measures of Student Access and Use (of technology). We also analyzed the spring 2007 focus-group responses for random samples of eighth graders who had attended higher and lower implementing schools during the three project years.

Student Access and Use

Figure 2.4 shows the average level of implementation for three elements of Student Access and Use: Laptop Access Days, Core-Content Learning, and Home Learning. First, in a fully immersed school, all students should have access to their wireless laptops and resources nearly the entire school year (about

170 to 180 days). Students mean scores for Laptop Access Days at higher and lower immersion schools (2.45 and 2.28, respectively) indicated a partial level of immersion, with student access days typically varying within schools to a *large extent* (from about 95 to 175 days). As noted earlier, all of the schools reported an increasing volume of laptop repairs that kept laptops out of students' hands in the third year. Students at higher implementing schools had slightly greater laptop access.

Similarly, students' estimations of the frequency with which they used their laptops in English/language arts, mathematics, science, and social studies classes showed that students at higher implementing schools used laptops somewhat more often (mean score of 2.56 versus 2.28). Still, across all schools, students indicated that, on average, they just *sometimes* (once or twice a month) or *often* (once or twice a week) used laptops for Core-Content Learning. In contrast to these measures, students at higher implementing schools were far more likely to use their laptops outside of school for homework and learning. Students' mean scores for Home Learning (2.27 and 1.40, respectively) indicated that students at higher implementing schools used laptops for homework and learning to just a *small extent*, but students at lower implementing schools used laptops for homework either *not at all* or *to a trivial extent*. Sections to follow, which draw from eighth graders' comments, reveal that the *quality* of students' experiences at higher and lower implementing schools differed substantially more than *quantitative* measures might have suggested.

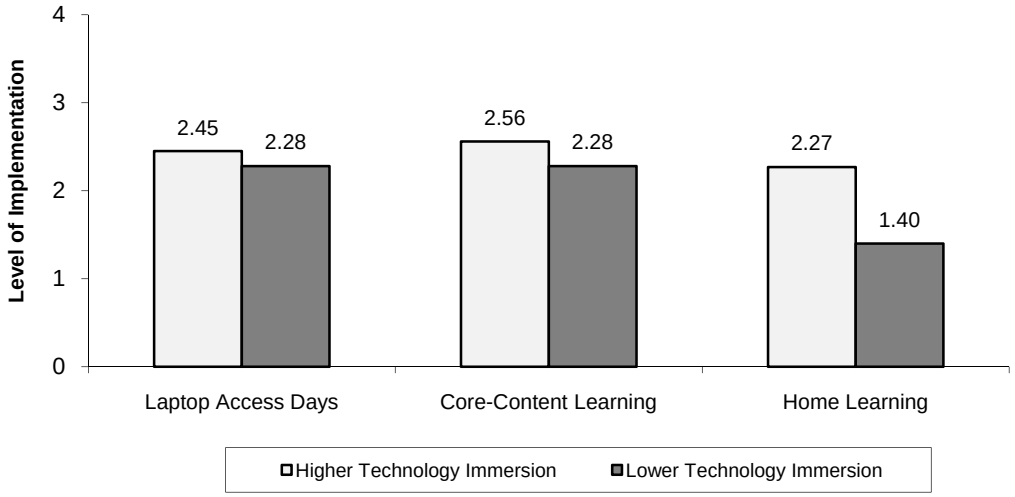

Figure 2.4. Level of Implementation for elements of Student Access and Use by *mean implementation score* (measured on a 0 to 4 scale) and higher and lower Technology Immersion schools.

Higher Technology Immersion Schools

Randomly selected eighth graders described the extent of their access to laptops, including the effects of discipline and behavior policies and other problems.

Laptop Access

- *Most of the higher Technology Immersion schools (three of four) provided one-to-one student access to laptops within and outside of school; students at one school checked their laptops out each morning and returned them at the end of the day. Across schools, students lost their laptops most often for repairs.*

Eighth graders at higher implementing schools were without individual laptops most often due to repairs. The length of time students lost laptops depended upon the severity of problems, with repair periods

varying from minutes to months. Three of four schools had either loaner laptops or classroom desktops that students used until their laptops were returned. Two of the higher implementing schools adopted disciplinary penalties that held students accountable for behavior but did not take the laptops away, whereas the other two schools confiscated laptops for rule violations.

Students at all schools were familiar with laptop rules and penalties for infractions, and they seemed aware that technicians and administrators were monitoring their actions. For example, students at one school received emails from principals or assistant principals about inappropriate activities, and students at another school said messages "pop up" on their screens. Students at these schools also recognized that having a laptop is a unique opportunity. A student at one school believed laptop rules were fair "because having these laptops is just a privilege…if you get in trouble you have to take up on your own actions…You learn not to do that again." Similarly, students at another school understood that having a laptop is a privilege, and if you abuse that privilege, you can lose it. Eighth graders at one school described a growing understanding of their laptops' purposes for learning rather than games:

> We've pretty much gotten over that playing the games during class; none of us really do that anymore. That was in the first or second year. We'd recently gotten the laptops and we were so excited, but now we're over that.

Core-Content Learning

We asked eighth graders to describe one assignment they did with a laptop that made them very proud of the work completed, and also, to describe how and how often they used laptops in science and social studies classes. Science and social studies were of particular interest because eighth graders complete TAKS assessments for those subjects.

- *As a whole, students at higher Technology Immersion schools used laptops for more complex and challenging projects and a wider array of assignments than students at lower immersion schools, and they used laptops more often in their core-content classes.*

Pride in schoolwork. Eighth graders were *most proud* of work on projects that culminated in the creation of a product. For example, students at one school were pleased with "podcasts" they had created for language arts (over a book called *The Pearl*), history (timeline of the Civil War), and science (animals and their habitats). A student at another school had used multiple sources for a Keynote presentation on the Lewis and Clark expedition; another student created a website in a Web Design class that included a football highlight film made with a video camera, iMovie, and Garage Band. A student in a different school was proud of a class presentation. Students made a PowerPoint about animal survival that involved picking an animal, and then writing about where it lived and how it survived in the environment. A student at yet another school was proud of research and a PowerPoint presentation on Rosa Parks for Black History Month, while another student was pleased with an eight-page story that was "the longest I've ever written." Students at two schools tied pride to improved grades and test scores. One student was proud he had used the laptop to do all of his homework because "my grades are going up." Another student was proud of making a "100" on a Study Island exercise. A different student said a PowerPoint presentation summarizing main ideas helped him prepare for the TAKS test.

Science assignments. The frequency of students' laptop use in science classes varied across schools from about once or twice a week (two schools) to nearly every day (two schools). Students reportedly used laptops in science classes to complete lab experiments (e.g., testing the ph levels of chemicals mixed), do WebQuests (on the food chain), make concept maps with Inspiration (diagram the Solar System), make charts and graphs with Excel, research topics on the Internet (Antarctica, animal survival, body parts), watch movies on topics (sounds waves), do Brain Pop activities and online tests, take notes, define

vocabulary words, answer textbook chapter questions, and do either tests or game-like activities on Study Island. All of the schools had science textbooks on laptops.

Social studies assignments. The frequency of eighth graders' laptop use in U.S. History ranged from seldom (one school) to nearly every day (three schools). Students reportedly used laptops in social studies classes to do WebQuests, play a Jeopardy game, do collages with Comic Life, take notes, take tests, define vocabulary words, answer textbook questions, do activities on Study Island, type key points from textbook chapters into PowerPoint, and study the teacher's PowerPoint presentations. Some of the schools had textbooks on laptops. Eighth graders at one school said the teacher who seldom used laptops was a first-year teacher.

Home Learning

Eighth graders described the rules for using laptops outside of school as well as the ways they had used laptops at home for schoolwork or other purposes during the past school year.

- *Students at most of the higher Technology Immersion schools (three of four) had full access to laptops outside of school; students at one school had to receive permission from a teacher to take a laptop home. Students at two schools used laptops extensively for schoolwork at home.*

***Laptop use for schoolwork*.** Eighth graders at two schools frequently used their laptops for schoolwork at home. Students at one school said they used laptops for schoolwork several times a week and more often when they had an assigned project; eighth graders at another school used laptops at home for schoolwork almost daily. Students at one school had used laptops in U.S. History to complete answers to questions and for projects (Civil War battles); to study Spanish vocabulary (using an electronic textbook); for an English project using Comic Life; and for science lab work, vocabulary words, WebQuests, and Inspiration concept maps. In addition, students used laptops at home to do make-up work after absences. Eighth graders at another school used laptops at home to complete science vocabulary assignments, answer questions from their digital science textbook, and to watch a movie on waves and complete a study guide; and for social studies, students completed a Keynote presentation on the Civil War, studied vocabulary, and did research on the Internet.

Although students at one school were allowed to take laptops home, they rarely used them for schoolwork because assignments usually were finished during a special homework class. Students cited a few instances in which they had finished social studies questions or reviewed PowerPoints at home to prepare for tests. At the school that required teacher permission for home use, none of the eighth graders in the spring had checked out a laptop to complete schoolwork at home.

Other home laptop uses. Eighth graders at three schools described a variety of *other* ways besides schoolwork that they used laptops at home. Students said they used their laptops to listen to music, play games or educational games (e.g., Find the Brain, Bubble Math, Study Island), display pictures, do research on the Internet, do Google searches, watch videos on YouTube, edit music, draw with Adobe Photoshop, chat, and visit MySpace. One student let her brothers and sisters use the laptop for their homework, whereas other students were cautious about letting their siblings use their laptops.

Effects of Laptops on Students

We also asked eighth graders if laptops had affected their learning or schoolwork in any way, or if laptops had affected them personally.

- *Eighth graders at higher Technology Immersion schools believed laptops had positively affected their learning in several ways, such as having schoolwork that is more interesting and fun, obtaining immediate access to diverse informational resources, improving their technical skills, and allowing them to get better grades and prepare for the TAKS test.*

- *Eighth graders believed laptops helped them personally to be more organized and efficient, more responsible, and better prepared for the future, and they were proud to attend a middle school with laptops.*

***Effects on learning and schoolwork*.** Eighth graders said their schoolwork was more interesting and fun with laptops. One student for instance explained that there are "more interesting things to learn, more interesting ways to learn," while others said learning is simply "more fun." Students' learning was enhanced by immediate access to diverse informational resources. Eighth graders found it easier to do research on the Internet compared to books. One student said, "It's a whole lot faster to learn more things. Like, if you're researching something, it's easier than to go in the encyclopedia and look at the notes." Students believed they learned more through immediate access to electronic resources such as dictionaries, encyclopedias, and textbooks. Students explained that with textbooks on laptops "we can use them any time we want." Some students learned more from visual displays. One student said with laptops, "You tend to visually see what you're learning. It helps when you visually see something on the screen. You can remember it easier."

Students also cited improvements in technical skills. Eighth graders believed typing was easier than handwriting, and their keyboarding skills had noticeably improved. One student explained: "I've learned typing skills…Before we had laptops, I had no idea how to type, now I can type without even looking." Students also had become proficient at using programs like Photoshop, Sound Studio, and iMovie, and they knew more about the Internet and computers in general. One student felt "smarter" because "I can do things on the computer that I used to not be able to do." Several eighth graders at one school believed laptops had helped them to get better grades. "Because I work faster," said one student. Students at a different school felt better prepared for the TAKS test because laptops were used to review information that will be on the test.

***Effects on students personally*.** Many eighth graders said laptops had helped them to be better organized and efficient because they keep work in folders (it is neater and does not get lost), and they can retrieve information saved on the computer and review it again. "You're not going to lose it if it's on the computer," said one student. Students also liked having their textbooks on laptops so they didn't have to carry books. Students also thought laptops were more efficient because new files can replace those that have been "messed up" and less paper is used. Some eighth graders also said that having laptops had made them more responsible. Several students explained: "One of the things is you have to take care of it," "You have to charge it," "I'm more cautious…If anyone else touches it, except me, I get mad." One eighth grader described growing responsibility over time while another understood the consequences for misbehavior.

> This year I haven't had any problems with it because in the last few years I've learned what to do, how to take care of it, so this whole year, I haven't had any problems with my laptop.
>
> You have to take care of it. It's your responsibility, so if you break it, then you get in trouble and you have to pay for it.

Another student described how he dealt responsibly with temptations: "Sometimes I get sidetracked and want to play games or something instead of doing my work." When that happens, he explained, "I'll close it, put my computer away" and continue with "pencil and paper."

Eighth graders also believed they were better prepared for the future. Some students said, "It's easier if you have like a job, to use the computer" and "You're ready for a job." Another student explained:

> It taught me that when I grow up most businesses have computers and you're already going to be smart enough where you don't have to go take a computer class before you start your job. We're already going to know how to use it and the proper way to handle it.

Students at one school felt pride because having laptops "makes our school stand out more." One student said, "I'm friends with some people from other schools, and they don't have it. It makes us different." Another student elaborated: "For them it's not the same as ours because they don't have the privileges that we have…they're not allowed to take some of the equipment home that we can, so we have more privileges than they do…That's why I like the laptops."

Views on Laptop Access in High School

It was also important to know how eighth graders would make the transition from middle schools with one-to-one laptop access to high schools that usually have computers in labs rather than classrooms.

- *Eighth graders at one school, who would have individual laptops in high school, were happy that they would not have to "start using pencil and paper." Students at the other three schools regretted that they would not have laptops in high school and felt it would be difficult to return to old ways of doing schoolwork.*

Eighth graders at the schools that would not have individual laptops in high school said they would miss having laptops for research and assignments. "I'm so used to not looking it up in the book, just researching it on a computer, and using the calculator or dictionary or something. It's just right there and you don't have to use a book," explained one student. Other students said research would be harder, and they would have to do more work on their own time rather than during class time. One student said, "I think it will be hard because of the changes, switch over from just having everything placed in front of you to having to work to finish assignments." Students also said they had become accustomed to using laptops and dreaded a return to handwriting. One eighth grader said his handwriting had gotten "pretty bad" after having a laptop for three years. Students thought going to high school without laptops was going to be difficult because schoolwork without laptops takes more time. Students said laptops made schoolwork easier, and it would take a lot longer in high school to do their work. One student found the prospect of going to high school without laptops "very depressing."

Lower Technology Immersion Schools

Eighth graders at lower Technology Immersion schools described vastly different kinds of experiences at their schools than students at higher immersion schools.

Laptop Access

- *Allocations of laptops at lower immersion schools ran counter to the TIP vision of providing each student with a wireless laptop and on-demand access to resources. One school distributed laptops as classroom sets, so students did not have individual laptops. Another school used a check-out system with students retrieving laptops from homerooms each morning and returning them in the afternoon. At two schools, access to individual student laptops was limited because students did not bring their laptops to school each day, many students and parents decided not to take laptops, or there was an insufficient number of laptops due to increased enrollments.*

At one school, students did not use the same laptop each day; instead, they just took one from the storage cart at the beginning of class and returned it when class ended. Moreover, eighth graders said that science, social studies, and English classes had laptop carts in the third year, but mathematics and reading classes did not. At another school, laptops were stored on shelves in homeroom classes. Students picked up their assigned laptops in the morning and carried them during the school day, but they returned the laptops to the homeroom in the afternoon unless a teacher gave special permission for a student to use the laptop at home for an assignment. At a different school, most but not all of students had laptops, however, many students did not bring them to school each day because they did not want to carry laptops that were not used in classes. For the same reason, many students decided against having a laptop. Eighth graders explained:

> We just don't see why we should have to bring a laptop—a heavy laptop—every day when we're not going to use it.
>
> I got it [laptop] in sixth and seventh, but in eighth, I didn't get it any more.

Similarly, eighth graders at another school said they were supposed to bring their laptops every day, but many students did not. Although the principal encouraged students to bring laptops by saying, "Where's your laptop…Why didn't you bring it," there seemed to be no formal process for holding students accountable. Also, eighth graders at this school did not receive laptops until late in the school year because of a spike in student enrollment. It took the district nearly the entire year to negotiate a laptop lease agreement. Students at this school also lost their laptops for extensive periods of time for repairs that could take several months.

At the three schools with individual laptops, students had laptops taken away for minor-to-major disciplinary infractions. Students at one school explained that laptops are taken away if you do something inappropriate, and after the third time, you lose the laptop entirely. Students at another school said many ESL students (English as a second language) had their laptops taken away for "watching pornography." Students at the school without individual laptops lost Internet privileges for weeks or the entire school year depending upon the severity of rule infractions.

Eighth graders at lower implementing schools also were discouraged by poor Internet connectivity, slow service, and Internet filtering systems that blocked access to appropriate educational websites. Students at one school said, "they started blocking everything." At two other schools, students complained about difficulties in doing assignments, especially when Internet filters blocked access to pictures. Students at the three lower implementing schools with individual laptops complained about carrying heavy computers that were seldom used in their classes. Part of the weight seemed to stem from the practice of carrying printed textbooks and binders in addition to the laptop bag.

Core-Content Learning

- *At lower Technology Immersion schools, students typically used laptops in mundane ways in their core-subject classes, such as making PowerPoints on various topics, gathering information from the Internet, and completing activities for basic skill acquisition or test preparation. In general, students used laptops infrequently in core classes,*

Pride in schoolwork. Across schools, students had difficulty remembering assignments done with laptops that had made them proud of the work completed. Students who provided examples usually described some kind of activity with PowerPoint. An eighth grader at one school said, "I guess when we do PowerPoints." Students at another school were proud of PowerPoints they had made on topics such as Native Americans and George Washington. A student at yet another school was proud of a PowerPoint in English related to a short story read. Two students mentioned other kinds of work. One eighth grader was

proud of a drawing made with Geo Sketch Pad, while another was pleased about typing the poem *The Spider and the Fly* because it helped with memorization.

Science assignments. The frequency of students' laptop use in science classes varied across schools from about once a month (one school) to about two to three times a month (three schools). Students reportedly used laptops in science classes to research topics on the Internet (rocks and planets), do a virtual dissection, define vocabulary words, do Internet scavenger hunts to answer questions, for PowerPoints, and to complete A+ Learning exercises. Eighth graders at one school said a teacher who had used laptops nearly every day in science left the school, and the new teacher seldom used laptops. Students at another school said they usually worked out of their textbook instead of using laptops. No students mentioned electronic textbooks.

Social studies assignments. The frequency of eighth graders' laptop use in U.S. History varied widely across schools, including almost never (one school), about once a month (one school), several times a week (one school), and nearly every day (one school). Students reportedly used laptops in social studies classes to research topics on the Internet (presidents), find answers to questions on the Internet, define vocabulary words, and do test-preparation activities on Study Island. Eighth graders at the school that used laptops almost daily said they completed activities with a variety of programs, including Sheppard online quizzes on state maps, A+ Learning, Succeeding on TAKS, and Skill Builder. These students also used an electronic textbook. Students whose teacher almost never used laptops had difficulty remembering how they had been used because "it was a long time ago." Students at another school described differences related to being in a regular or Pre-Advanced Placement (Pre-AP) class. Students in regular social studies classes used laptops less often and for more basic and test-preparation purposes; students in Pre-AP classes used laptops more often and were more likely to have projects. For example, eighth graders said they created their own website including information on American History.

Home Learning

- *Two of the lower immersion schools allowed students to use laptops at home, while one school required teacher permission for special assignments and one school did not allow students to take laptops home.*

- *Students at lower implementing schools rarely used laptops at home for schoolwork or any other purposes.*

Laptop use for schoolwork. Eighth graders at one school estimated that they might have used laptops for schoolwork at home four or five times during the entire year. Similarly, students at another school almost never used their laptops for schoolwork at home (about once during the year). At the school that required permission from a teacher to work on a project or an unfinished assignment, eighth graders said they almost never took laptops home. Eighth graders at yet another school said they were supposed to be able to "sign out a laptop" to take it home, but the school "never assigned them to us." The few students across schools who mentioned the use of laptops at home for assignments said they had used laptops to complete social studies projects (on presidents, famous people, and historic events) or to write a paper for English.

Other home laptop uses. Eighth graders rarely used their laptops at home for other purposes. A few students at one school said they listened to music. Students at another school said they did not use their laptops at all because they don't have the Internet. One student thought laptops were "boring."

Effects of Laptops on Students

- *Eighth graders at two lower implementing schools believed laptops had little if any effect on their learning because of infrequent use, whereas students at two schools cited positive benefits, such as having more information from the Internet, completing work faster, getting better grades, and being prepared for the TAKS test.*

- *Eighth graders at two lower implementing schools thought having laptops had not affected them personally, whereas students at two schools cited positive effects relative to responsibility, increased self-esteem, and preparation for college.*

Effects on learning and schoolwork. Eighth graders at two schools thought laptops had little if any effect on their learning and schoolwork. Students at one school said laptops had not affected their schoolwork because "we hardly use them." Students at another school said laptops had not affected their learning beyond getting to do individual research and individual work. Students at both of these schools thought having access to information from the Internet was the best thing about having laptops. In contrast, students at two schools cited several effects. Eighth graders said laptops helped them to have more information from the Internet. One student explained, "When you study out of a textbook, that's just one source you learn from. But when you're learning from a very wide variety of stuff, it's easier to gather information." Students said it was easier to type rather than write, and their improved typing skills allowed them to "get work done faster" than with pencil and paper. Several students said their grades or test preparedness had improved. One student explained that "some of my grades go up because you can get more information on a project that you're doing." Other students at the school said there was no effect on their grades because they didn't use the laptops that much. Students at a different school said that test preparation programs (A+ Learning, Succeeding on TAKS, free online TAKS tests) made studying and learning easier.

***Effects on students personally*.** Students at lower immersion schools had difficulty articulating ways that laptops had affected them personally. Eighth graders at two schools said laptops had not affected them personally, pointing to rare use. Students at one school explained how initial excitement had diminished over time:

> The first year, yes, but after a while, you realize that it's a little pointless to have one, carrying one around, when you're not really going to use it for a while…If you really don't use it, why should you have it?

A few students at the other two schools mentioned personal effects. One student had learned to be more responsible: "You're more careful around laptops because you don't want to break them or anything because you don't want to get in trouble." Students at a different school said laptops made them "feel more grown up" and "important." One student thought having laptops would "help you in college."

Views on Laptop Access in High School

- *Eighth graders at most lower immersion schools (three of four) were glad that they would not take laptops with them to high school; however, students at one school felt it would be difficult to return to old ways of doing schoolwork.*

Many students were happy that they would lose their laptops at the end of the year, mainly because they would not have to carry the heavy bags around. Students at one school had heard rumors that high school classrooms would have laptops, so they weren't concerned about losing their computers. In contrast, students at another school dreaded the loss of laptops because they would have to begin writing "all the

time," and they wouldn't be able to look up information on the Internet, play games, do PowerPoint projects, or be creative. One student explained:

> It's going to be a really big change, from all these years in junior high being able to use them and then all the sudden, it's back to paper and pencil and you're like, "How do I use that again?"

Another student said it would be like being back in elementary school. These students believed they needed laptops in high school.

3. Differences between Higher and Lower Immersion Teachers

Characteristics of Teachers

Researchers used teachers' spring 2006 Classroom Immersion Index to identify teachers that had indices in the highest quartile (*z* score of 0.63 or higher) and those with indices in the lowest quartile (*z* score of -0.50 or less). Accordingly, our interview sample included 37 middle-school teachers, with 19 identified as having higher levels of Classroom Immersion and 18 identified as lower immersion. Teachers were drawn from each of the 21 treatment schools. Analyses of the characteristics of interviewed teachers revealed similarities and important differences.

- *Higher Classroom Immersion teachers included a mix of White, Hispanic, and African American teachers, whereas lower immersion teachers were predominantly White. Higher immersion teachers were less experienced and more frequently mid-career professionals whereas lower immersion teachers were often late in their teaching careers.*

As Table 3.1 shows, female and male teachers were equally likely to have higher and lower immersion classrooms. Similar to middle school teachers as a whole, the distribution was about two-thirds female and one-third male across the comparison groups. In contrast, higher implementing teachers included a mix of White (68.4%), Hispanic (21.1%), and African American (10.5%) teachers, whereas teachers with lower levels of Classroom Immersion were predominantly White (83.3%). This difference between groups may reflect the importance that minority teachers placed on using technology to meet the needs of their largely economically disadvantaged and minority student populations.

Table 3.1. Characteristics of Higher and Lower Implementing Teachers

	Higher Classroom Immersion	Lower Classroom Immersion
Number of teachers	19	18
% Female	68.4	66.7
% Minority	**31.6**	**16.7**
% African American	10.5	0.0
% Hispanic	21.1	16.7
% White	68.4	83.3
% with advanced degree	**10.5**	**16.7**
Average years experience	**12.3**	**16.8**
% Beginning to 5 years	21.1	22.2
% 6-10 years	**21.1**	**5.6**
% 11-15 years	21.1	16.8
% 16-25 years	31.6	27.8
% 26 or more years	**5.3**	**27.8**
Subject-area assignments		
% English language arts	36.8	27.8
% Mathematics	**0.0**	**33.3**
% Science	**26.3**	**5.6**
% Social studies	36.8	33.3

Source: Teacher databases submitted by schools.
Note. Bold text denotes notable differences between teacher groups.

Higher implementing teachers compared to lower implementing teachers also had fewer years teaching experience (12.3 years versus 16.8). Further, frequency distributions showed that lower implementing teachers were typically late in their teaching careers (nearly a third had 26 or more years teaching experience), whereas higher implementing teachers were far more likely to be mid-career teachers (with 6 to 15 years teaching experience). Additionally, mathematics teachers, who often struggled to find ways to integrate laptops into their curriculum, were nearly always lower implementers. On the other hand, science teachers were more often high implementers.

Supports for Classroom Immersion

Researchers also examined the enabling conditions that might advance or hinder teachers' progress in creating technology-immersed classrooms. Accordingly, we investigated the importance of school contextual conditions, the contributions of administrative leaders, and the significance of professional development opportunities.

School Context

Given that the school context might influence teachers' decisions about the use of technology we explored associations between school conditions and teachers' classroom technology use.

- *The schools' implementation fidelity was the contextual condition that influenced teachers' instructional practices. Higher Classroom Immersion teachers were concentrated in higher Technology Immersion schools, whereas lower implementing teachers tended to work in lower implementing schools.*

Statistics reported in Table 3.2 show that higher implementing teachers taught in somewhat larger schools than lower implementers (about 416 students, on average, versus 343). There was little difference between the percentages of minority and economically disadvantaged students in higher and lower implementing teachers' schools, and the overall level of TAKS achievement was similar.

Table 3.2. School Contextual Conditions, by Higher and Lower Implementing Teachers

	Higher Classroom Immersion	Lower Classroom Immersion
Average number of students in schools	415.9	343.4
% Minority students	67.4	67.0
% Economically disadvantaged students	72.1	68.8
% Passing all TAKS tests 2006	52.7	59.1
Average School Implementation Index	0.12	-0.17
% 1st implementation quartile	21.1	**38.9**
% 2nd implementation quartile	21.1	**27.8**
% 3rd implementation quartile	**26.3**	11.1
% 4th implementation quartile	**31.6**	22.2

Source: Texas Education Agency AEIS reports 2006. School-level implementation data.
Note. Bold text denotes notable differences between teacher groups.

Teachers who reported higher levels of Classroom Immersion were more likely to teach in higher Technology Immersion schools, whereas lower implanting teachers more often worked in lower implementing schools. More than half of high Classroom Immersion teachers (58%) taught in the highest implementing schools (the two upper quartiles), whereas two-thirds of the low Classroom Immersion teachers (67%) taught in the lowest implementing schools (the lower two quartiles). As a whole, the

school's level of support for implementation was the contextual condition that appeared to have the greatest influence on a teacher's decision about classroom technology integration.

Leadership

As part of interviews, we asked teachers about leadership support for Technology Immersion. In general, neither higher nor lower implementing teachers were aware of campus or district goals that addressed technology, beyond having a campus improvement plan (CIP) that included a technology focus. About half of all teachers interviewed reported that their principals supported technology-related professional development in various ways, including scheduling sessions on campus, arranging for substitute teachers, allowing teachers to attend self-selected training and paying fees, conducting training during teaming time, or lengthening planning periods to accommodate professional development sessions. Most teachers also noted that their principal or campus administrator supported technology integration in some way. Higher and lower implementing teachers were equally likely to report that their principal would purchase technology equipment or materials teachers requested, if funding was available. Although teachers described many shared leadership experiences, some differences between teacher groups emerged.

- *Higher Classroom Immersion teachers said their principals focused on technology's positive value for students, allocated time for planning technology-integrated lessons, and monitored classroom technology use.*

- *Lower Classroom Immersion teachers described principals' efforts to model technology use by using email, making electronic presentations at faculty meetings, or posting information on school websites.*

Higher Classroom Immersion. Higher implementing teachers were more likely than lower implementers to report that their principal supported technology integration through a focus on students. For example, three higher implementers reported that their principals gave students feedback in classes regarding student progress using technology or discussed technology issues with students in the classroom. In addition, higher implementers were more likely to mention that their principal allocated time for teachers to plan technology-integrated lessons, or monitored teachers' use of technology by conducting periodic classroom visits. In addition, three of the higher implementers, and no lower implementers, suggested that accountability was an important component of leadership for technology integration—either at the campus level or at the individual teacher level. For example, one teacher suggested that the campus should have some sort of system to monitor teacher use of technology.

> I do think, as a campus, that we do need to have more of an accountability system. The majority of teachers use the laptops pretty regularly, but then there are some that choose not to use them much at all, and I think we need to have a more accountability process, or whatever you want to call it, to make sure that it's being used campuswide more.

Lower Classroom Immersion. When asked about principal support for technology, lower implementing teachers more often described administrators' efforts to model technology use for the faculty by sending email or using technology at faculty meetings. For example, teachers reported that communication with staff is by email, principals make PowerPoint presentations, or agendas are posted on eChalk. These principals typically attempted to provide a good example for teachers to follow and they encouraged teachers to use technology.

Professional Development

The Technology Immersion model requires professional development that instructs teachers in effective classroom integration methods. Thus, researchers asked teachers to describe any professional development provided by vendors, the campus, or the district that they had participated in during the third year. We also asked teachers about any in-class support they received and the overall usefulness of professional development.

Professional Development Provided by Vendors and Local Entities

- *Explicit descriptions of professional development experiences offered by higher Classroom Immersion teachers suggested that they either participated in more events or assimilated more information from training. Higher implementing teachers also took part in a greater variety of locally sponsored professional development events.*

- *Lower Classroom Immersion teachers strained to recall specific details about training that had been provided during the past school year. Teachers who remembered involvement in training usually described reviews of TIP package products. Lower implementers seldom participated in locally sponsored professional development opportunities.*

***Higher Classroom Immersion*.** Higher implementing teachers described similar types of professional development activities provided by vendors as lower implementing teachers, but their descriptions included explicit details about the content covered. Greater specificity suggested that these teachers either participated in more events or they assimilated more information during training. At some campuses, teachers said training was a refresher on basics and package resources (e.g., MovieMaker, Dell Exchange, NetTrekker, eChalk, Connected Tech, class webpage, Texas Mathematics Diagnostic System, Texas Science Diagnostic System) or an introduction to new resources (interactive whiteboards). At other campuses, higher implementing teachers described how training had evolved in the third year to focus on individual teacher needs or more complex technology-based projects. A teacher at one campus described individualized support for teachers:

> So at the first of the year, we did a couple [of group sessions], but this year has mainly been going into the teacher's classroom…He [trainer] comes with something prepared for every subject, and then he gets in the classroom and asks the teacher if there is something specific you want to work on, and if there is not, then he says, 'Well I have this'…He will show them how to do it and how to set it up.

At other campuses, teachers described training on more advanced topics, such as iWeb, iDVD, video camera, and video editing, that prepared them for projects later in the school year. One teacher explained:

> When he [trainer] comes back, we're going to work on it some more [taking photos and making a movie] and then get our kids to do a project with the digital camera and then putting them on the computer and putting the sound and everything.

Higher implementing teachers also reported involvement in a greater number and variety of locally sponsored professional development events. Teachers said they had participated in a number of sessions provided by the district, campus, or regional education service center on topics such as Inspiration software, Internet safety, website design, podcasting, advanced PowerPoint, Excel, Google Earth, GradeSpeed, Unitedstreaming, MovieMaker, and Publisher. Additionally, two teachers said they had attended, and thought they benefited the most, from sessions at the Texas Computer Education Association (TCEA) conference and the TIP Leadership Conference. Two teachers at one school were

looking forward to participation during the summer in the Intel Teach training model focused on teaching higher level thinking with technology.

***Lower Classroom Immersion*.** Several lower implementing teachers had difficulty recalling whether the vendor's professional development specialists (Dell, Apple, Region 1 ESC) had provided training during the past school year. Moreover, vague descriptions given by teachers who could remember training events suggested that teachers' involvement was probably obligatory rather than personally motivated. Teachers who recalled events said training typically focused on reviews of TIP package products (e.g., eChalk, TeenBiz, TMDS, MovieMaker, Dell Exchange), introductions to new hardware, or overviews of subject-related websites. A teacher at one campus, in contrast to most teachers, clearly described a professional development program that in the third year allowed personal choice of topics and opportunities to work with colleagues in interdisciplinary sessions (i.e., science and math teachers trained together).

Lower implementing teachers also had little recollection of professional development sponsored by their local district or campus or their participation in such events. A few teachers mentioned sessions geared toward campus priorities that did not link directly to Technology Immersion, such as sessions on GradeBook software or the use of interactive whiteboards. A few teachers mentioned ongoing district-sponsored sessions on technology applications that were available to teachers in the summer or throughout the school year (e.g., digital camera, interactive whiteboard, Unitedstreaming, spreadsheets). However, it many instances, it was unclear whether teachers had actually participated.

In-Class Support by Vendors and Local Entities

- *Only a third of higher and lower Classroom Immersion teachers had received in-class support from vendor trainers during the third year, although assistance was available upon request. In-class support from campus specialists mainly involved help to resolve technical problems; however, a few campuses provided dedicated pedagogical support that appeared to advance classroom technology use.*

Higher Classroom Immersion. About a third of higher implementing teachers, similar to lower implementers, had received in-class support for technology integration from vendor specialists during the third year. Those who did not receive support reported that in-class assistance was available upon request. Teachers described observations or demonstrations in their classrooms that they found helpful. Several higher implementing teachers had received classroom support during the previous school year, and since they were making steady progress with technology integration, they believed trainers' time was better spent with other teachers. For example, one teacher said, the "[trainer] has not been in my room a great deal because I was further along than the other teachers, so from my perspective and his, he needed to be working with them rather than me."

In-class support from district and campus specialists, similar to reports from lower implementing teachers, mainly involved help to resolve technical problems. One teacher described the prevailing trend: "Technology problems have been most of it…troubleshooting. They just look to see what the problem is and try to help us get it going." Still, on one campus with dedicated instructional staff, teachers described opportunities for pedagogical support. One teacher explained how campus specialists supported the science team: "We all have the same conference period, so they would come in to help us with that…They'll come in and say, 'Let's generate some ideas on how to do this. Let me get some information to you in a couple of days. Another teacher on the same campus described outreach by campus specialists: "They always ask and I'll say what I'm doing and they usually say, 'Well, if you need me let me know, but you seem to be well on your way.'"

Lower Classroom Immersion. About a third of lower implementing teachers had received in-class support from vendor trainers, with assistance most commonly involving classroom demonstrations or observations. One teacher described the nature of classroom support:

> Well, one time…she demonstrated math with NetTrekker, and that was helpful to me...It was hard for me to find ways to put it into math because I had been teaching math for so many years without computers. So when she demonstrated that with the NetTrekker, that opened the door for me, and then I felt more comfortable using it and finding a way.

Most teachers who received classroom support appreciated the experiences, but some had difficulty recalling details about the lessons taught and others doubted their ability to emulate the activities. Almost all teachers who did not receive in-class support, said assistance was available upon request, but they had not volunteered. One teacher explained, "I know that they come out quite often. They usually have a schedule…[the technology coordinator] will email out and say, 'These people are going to be here on these days. What do you want them to come do?'"

Similar to higher implementers, in-class support from district or campus specialists for lower implementing teachers almost always involved technical support for the use of hardware (interactive whiteboards, peripherals) or software (TMDS), or assistance to find instructional resources. Most teachers said technical help was available when problems occurred. For example, one teacher said the technology coordinator had "saved" her several times:

> Like yesterday…I used my projector and Interwrite Board. First period, it did fine. And then, I came in third period and I took my laptop off because I had to do grades and put it back on, and put it back on wrong. It wouldn't work. [The technology coordinator] just happened to walk in at the right time.

On a few campuses with dedicated pedagogical support, lower implementing teachers described local efforts to shore up classroom use. A social studies teacher described the process:

> She [instructional specialist] has even come into my class one of the Wednesdays to help me teach…And, she meets with me and my co-teacher on Wednesday mornings during our planning time…We tell her what we're going to be doing that next week and she has helped provide us with some of the Unitedstreaming videos that we've used.

When on-campus pedagogical support was available, many lower implementing teachers seemed open to new ideas and resources when offered, but they did not actively seek instructional help.

Value of Professional Development

Throughout interviews, teachers made statements that communicated what they found most and least worthwhile about technology-related professional development provided during the third year. Exhibit 3.1 compares the perspectives of higher and lower Classroom Immersion teachers.

- *Higher Classroom Immersion teachers thought their professional development experiences had been worthwhile because training had prepared them to use TIP resources, raised their awareness of other resources, helped them to develop lessons, increased their proficiency with new technologies, met their current needs, provided hands-on experiences and step-by-step directions, allowed ongoing support by email, provided opportunities to participate in self-selected classes and conferences, and included training on higher-level student thinking.*

- *Lower Classroom Immersion teachers thought professional development was less useful than higher implementers. However, they valued in-class support from vendor and campus instructional*

specialists, opportunities to learn about technologies such as interactive boards, access to ongoing support via email, and chances to interact with other teachers at conferences.

Higher Classroom Immersion. Almost all higher implementing teachers indicated that their participation in professional development had been worthwhile. Teachers appreciated that training had acquainted them with the use of laptops and the resources included as part of immersion packages. Some teachers also thought training and interactions with professional development specialists had increased their overall awareness of the resources available for their particular subject areas. For example, one teacher said, "He [trainer]…got me to different places on the Internet that concern Texas history, something that we thought the kids might enjoy." Other teachers valued opportunities to develop technology-enhanced lessons. Some teachers described how they learned to teach concepts through technology lessons (podcasts on biomes) or through cross-curricular projects (unit on the Civil War combining social studies and English language arts objectives). One teacher appreciated the introduction to new resources, such as interactive whiteboards.

Exhibit 3.1. Teachers' Perceptions of the Value of Third-Year Professional Development

Higher Classroom Immersion Teachers	Lower Classroom Immersion Teachers
Positive Value	**Positive Value**
+ Prepared teachers to use TIP resources	+ In-class support from a campus instructional specialist
+ Raised awareness of available resources	+ In-class support from a vendor specialist
+ Included the development of specific lessons	
+ Included cross-curricular lesson development	
+ Learned about new technologies (interactive boards)	+ Learned about new technologies (interactive boards)
+ Choices linked to current needs	
+ Hands-on training rather than lecture	
+ Step-by-step directions that ensured understanding	
+ Access to ongoing support by email	+ Access to ongoing support by email
+ Self-selected classes beyond vendor training	
+ Attended conferences (TCEA, TIP Leadership)	+ Attended conferences (TCEA, TIP Leadership)
+ Sessions at conferences presented by other teachers	
+ Training on teaching higher level thinking	
Negative Value	**Negative Value**
- Repetition of vendor basics on resource use	- Insufficient time to use technology after training
- Repetition of campus training on basics	- Sessions during conference period too short
- Technical or resource problems	- Irrelevance to teaching assignment
- Insufficient opportunity to use technology after training	- Other more important priorities (TAKS, teaching methods)

Source: Interviews with 19 higher implementing and 18 lower implementing teachers at 21 Technology Immersion schools.

Higher implementing teachers also described training formats that they found helpful. At some campuses, teachers appreciated that training in the third year allowed personal choices. "Now we're getting to pick and choose what we want to do. We have to go to training, not going is not an option, but what we choose to do sometimes is. We choose something we think we'll use," explained a teacher. One teacher liked that training was "hands-on" and active rather than "lecture" format, while another praised the pace and the trainer's responsiveness. "He holds our hands and walks us through it and makes sure that we understand what's going on. We have his email, and we can email him with a question, and he's right back with us."

Higher implementing teachers pursued learning opportunities beyond professional development requirements more often than lower implementers. Several teachers mentioned their participation in optional technology-related professional development activities, such as university classes, district-sponsored sessions, workshops at education service centers, or attendance at regional and state

conferences. Two teachers had enrolled in the Intel Teach, Teaching Thinking with Technology Course to be held at their campus during the summer, while one teacher planned to become a master teacher for the Intel Teach Program.

For the most part, higher implementing teachers cited different kinds of challenges compared to lower implementers that diminished the quality of their professional development experiences. Several teachers, who had built their technology skills and wanted to move to higher levels, believed that repetitive training on basics and package resources was a waste of time. In one case, new teachers contributed to the problem. "Some of the stuff I have to repeat because we have some turnover, so some new teachers. I have to go through the training a second or third time because I've been here since the beginning and they're new," explained one teacher. A teacher in another school described subject-area differences: "I have been going through the same training, same training, same training so many times because we have people—I'm going to be blunt—that aren't as technology savvy as my science department."

Higher implementing teachers also cited technical or resource issues that marred training experiences. Some teachers were frustrated because they did not have the software or hardware needed for particular projects or the resources they had did not function properly. One teacher explained, "I would really like to branch out and let the kids do a lot of projects using the digital cameras and digital videos…but we don't have those things on our campus. Training was less effective on another campus because the "web was down," and due to ordering errors, "some materials and cameras did not work with the computers." Only two teachers mentioned difficulty retaining the content of training.

Lower Classroom Immersion. Lower implementing teachers generally perceived professional development as less valuable than did higher implementing teachers. For lower implementers, the most important aspect of professional development involved personalized support from vendor or campus instructional specialists. Teachers who received in-class support appreciated assistance that had been tailored to their particular abilities and teaching situation. One teacher explained:

> The reason she [campus specialist] has been most helpful is because she knows what I am teaching. She knows my needs. She brought up many things that I could have chosen to use, at least a dozen, and I've ended up using one all the time. The other one I planned to use and never did learn it, which was videostreaming.

Some teachers also appreciated the ongoing connection with trainers through email. "I email him [trainer] if I have a question, and he's really good about emailing me back or just going ahead and fixing it," said one teacher. Two teachers were excited by the recent acquisition of interactive whiteboards and welcomed training that helped them to use the devices in their classrooms. One lower implementing teacher explained how she benefited from the camaraderie experienced at conferences:

> It's just that motivation that you get from it, hearing other people that are either having the same problems, or they fix some of the problems, or the backing they're getting at their school, and those kinds of things. To me, that's motivational.

Many lower implementing teachers also cited challenges that made professional development experiences less effective. Some teachers said they did not retain the information as well as they should, and the time span between training and classroom use seemed to cause the problem. "We get shown those things in August, and unless I use it immediately, then I don't go on and use it later," said one teacher. Other teachers said there was insufficient "time to practice" after training events, or the pace of training during conference periods was "too fast" to learn new skills. Additionally, some teachers saw little relationship between the training content and their teaching area: "I think I'm still waiting, and it may never happen, but I'm still waiting for more ways to use the technology with my math curriculum," said one teacher.

Similarly, a social studies teacher declared, “Because of the Texas history thing. There’s not usually a lot of it [training] that does apply, unfortunately.”

Several teachers mentioned other things, primarily preparation for the TAKS test, which diminished their interest in professional development and technology use. One teacher said, “All of it [training] is good, but I kind of choose with my priorities on what I have to do. If it can’t get done, then it waits.” For this teacher, using new technologies had to be postponed until after the TAKS test. Similarly, another teacher felt a visit to another immersion school to observe in a classroom had to wait until after TAKS. Technology training held little value for another teacher because “It’s just not my method of teaching.”

Professional Development Effects

Teachers’ comments also revealed their views about how their participation in professional development had affected them or their teaching.

- *Higher Classroom Immersion teachers believed professional development had positively affected their technical proficiency, ability to use technology, self-confidence, creativity, and lesson development.*

- *Lower Classroom Immersion teachers found professional development helpful or useful but they usually did not cite ways that it affected them personally.*

***Higher Classroom Immersion*.** Higher implementing teachers, in contrast to lower implementers, more often associated professional development experiences with positive effects on their technical skills, ability to use technology, self-confidence, creativity, and lesson development. Several teachers indicated that they had mastered the basics and felt ready to move to higher levels. One teacher said, “Personally, I would love to try to do more with the webpage. I’m pretty sure I know how to use most of what we have and that’s been through the trainings.” Another teacher said, “I’ve come leaps and bounds from three years ago, but yes, there are some specific programs that I know I’d like to [be able to] use.”

A different teacher described her increased ability to troubleshoot, resolve technical difficulties, and monitor students’ laptop use from her own computer. Still another teacher spoke for the entire campus: “So we’re progressing, I think, because now people feel more secure with using the different software that we have.” Other teachers were inspired by their ability to think creatively about lessons. A teacher of gifted and talented students said the Internet sites shown during training helped her to think “outside the box,” and as a result, she signed up for a related training session to enhance her skills. At another school, a teacher talked proudly about the development of an interdisciplinary unit on the Civil War that combined reading and social studies activities. Although challenged by the time and technical demands of new kinds of lessons, this teacher and others were motivated by the potential benefits for students.

Lower Classroom Immersion. Although most of the lower implementing teachers regarded the professional development sessions as helpful or useful, teachers rarely mentioned tangible ways that training events affected them personally. Typical comments from teachers included these: “It’s all good because it’s all new to me,” “It was a refresher course…It refreshed my memory,” and “They are all helpful if I found the time to sit down and explore them further.” One teacher said training contributed to increased technology use: “I think I’ve actually used them [laptops] more. It’s become a little easier, because in the summer we’ve talked more about different projects you can do, how you can use it.”

Professional Development Needs

- *Higher Classroom Immersion teachers wanted additional training that moved them to more advanced technology competency, whereas lower implementers needed additional support to enhance their limited technical skills.*

Higher Classroom Immersion. Although some higher implementing teachers felt comfortable with their current technology proficiency and did not feel a pressing need for more training, others talked about wanting professional development that would move them to more advanced levels. Several teachers wanted to learn more about web pages and building their own websites, while others expressed an interest in learning about more complex processes such as podcasting and video editing. One science teacher explained,

> My next move is to learn how to do the podcasting and using blogs as an educational tool in the classroom. One of the things that I swore I was going to be better at this year was utilizing outside sources like *Ask a Scientist* and those kinds of things to integrate more into my classroom. But those are just areas that I'm ready to move into and I just need to work on moving my students into those areas.

Several teachers realized that vast educational technology resources are available, and attending technology conferences had heightened some teachers' awareness and interest in new products. One teacher described the value of attending the TCEA conference in Austin and seeing people demonstrate different kinds of programs, such as Claymation, that might be useful in the classroom.

Lower Classroom Immersion. Most of the lower implementing teachers had difficulty articulating what their current needs might be. For those that offered opinions, teachers most often mentioned a need for additional support to enhance their limited skills, become more computer literate, acquire the basics, or to refresh their memory of various resources. A few teachers wanted to become more familiar with instructional media such as WebQuests, web pages, or interactive whiteboards. Two math teachers wanted to learn more about resources for their math curriculum. One teacher expressed a view apparently held by many:

> I am more computer literate than I used to be. I can find things and I'm not as afraid to touch a button and do things, but there are probably things that I need to know, but I don't know what they are.

Nature of Classroom Immersion

Investments in professional development and technology resources are expected to yield classroom change. As a way to gauge core-subject teachers' progress in creating technology-immersed classrooms, researchers have assessed five key elements of Classroom Immersion. Professional Productivity and Communication reflect a teacher's use of technology tools to accomplish a range of administrative tasks and to communicate with various audiences. Student Classroom Activities reveal the ways that a teacher has students use technology for class lessons and assignments. Technology Integration and Learner-Centered Instruction reflect a teacher's ideological beliefs relative to the value of integrating technology into instruction and the role students play in the instructional process. During interviews, we posed questions that elicited comments from teachers relative to these elements.

Professional Productivity and Communication

- *All teachers were using technology for administrative purposes, such as recording attendance, managing grades, and generating lesson plans, and for communication by email. However, higher Classroom Immersion teachers used technology tools for a wider and more sophisticated range of activities.*

Attendance, Grades, and Lesson Plans

Nearly all interviewed teachers said that they used technology-based programs such as GradeSpeed, GradeBook, Skyward, and eClass to record attendance and manage grades. And most teachers reported that they used technology resources to develop and submit their lesson plans. For the most part, productivity resources were district-provided and predated the TIP project. "I've used an electronic gradebook for 20 years now," noted one teacher. "I have a template that I do all my lesson plans on. I haven't written out lesson plans in probably five years."

Email

Both higher and lower implementing teachers said they used email as a communication tool; however, higher implementing teachers tended to report broader email use. Nearly all teachers reported that they used email to communicate with colleagues and administrators, but lower implementing teachers were less likely to use email as a tool for communicating with students and parents. One lower implementing teacher explained his reticence to send email to students: "I'd rather do it in person, because they say, 'I never got it [email].'" In contrast, many higher implementing teachers relied on email as a means to remind students of assignments, missed work, upcoming activities, as well as a tool for instructional activities, as one teacher explained:

> I can email them [students]…if they're behind on a project or if I haven't gotten a grade, if I'm missing a paper…They have a pen pal from another country…The student letter exchange site is on there and they're typing their letters in Microsoft Word. Sometimes I email them about that. Sometimes they email me their assignments…I even carry on email with kids in seventh and eighth grade that will email me and ask me different things.

A higher implementing teacher at another school reported another advantage of communicating with students by email:

> Sometimes they'll tell us things that they wouldn't normally tell us because then they're not so much being a tattle tail because nobody saw them tell. There have been a few things that have come up that that's been a good thing.

Higher implementing teachers also used email to communicate with parents about students' performance and inappropriate behavior. One higher implementer recounted an experience in which she used email to notify students directly about their behavior:

> In the fall, we were having a few problems…getting a little off task. So I sat down and just wrote them all an email and sent it to them and told them I'm really concerned, and we're wasting class time, and that's your class time. I was amazed at how many wrote me back—"I'm sorry, [teacher's name]. You're right. We should [not waste class time]." I was really quite shocked at that.

Class Web Pages

Similar to email use, higher implementing teachers were more likely to report having a class web page than their lower implementing counterparts. Teachers who had established web pages described them as an effective means of communicating with students. "I remind them [students] if anytime they want to know what their homework is they can go to the website and find out," explained one higher implementer. "Also, there are other links or other resources that they can use while they are working on their report. More than anything, it's a way of communicating messages to my students."

Student Classroom Activities

- *Higher and lower Classroom Immersion teachers had their students use laptops for similar kinds of activities, but higher implementing teachers had students use laptops far more often and in more innovative ways.*

- *Higher Classroom Immersion teachers frequently used immersion package resources as an integrated part of instruction, whereas lower implementing teachers more often used resources for practice, review, test preparation, games, or free-time activities.*

- *Few teachers assigned homework of any kind, although most said work that was not completed during the class period was often completed at home.*

Type and Frequency of Laptop Use

Higher and lower implementing teachers said their students used laptops for similar activities, including research, vocabulary, review activities, essays, journals, presentations, WebQuests, note taking, preparation for exams, creating graphs, and playing games. However, higher implementing teachers had students use laptops more frequently and many reported having students use laptops four to five days a week, whereas students in lower implementing teachers' classes generally used laptops once or twice a week.

Higher implementing teachers also noted that they used laptops to expand routine aspects of lessons to incorporate online resources and to facilitate student innovation and creativity. One higher immersion teacher explained how she used laptops to extend weekly vocabulary assignments:

> They [students] have to put it [vocabulary word] in their own words—exactly what this word means—and then they have to illustrate the word. They have to find an illustration, a graphic that they can put into it and make a sentence about that picture using that word in the context that it was used in the novel. From there…we'll stretch that into adding synonyms and antonyms of the vocabulary word. Then we'll stretch it into root word and where the word originated from, word origin, and then we even, finally end up with mnemonic devices. They will use the word. It sounds like this word, and they'll use both the word and the sound like word in their sentence and do a silly goofy picture to help them to remember the word better.

Technology Resources

Both higher and lower implementing teachers reported wide use of technology resources provided as part of immersion packages, but their descriptions revealed differences in their approaches to using resources in class. Higher implementing teachers frequently reported using resources as an integrated part of instruction. For example, one high implementing science teacher described a lesson on biomes:

> When we studied the biomes we gave them [students] several websites to look up information to fill out a spreadsheet on all of the biomes, and later on they picked a specific biome for

> themselves…They created podcasts about the biomes and the podcast was made like a brochure. It was like watching a commercial and that's what we wanted them to do. We wanted them to include several aspects of that biome, the climate, the animals, the plants that live there, everything about that different biome, but to make it like a commercial.

Lower implementing teachers were more likely to say they used resources for practice, TAKS preparation, review, games, or as a reward for students who had completed assigned tasks before the end of class**.** Several lower implementing teachers said that they became frustrated trying to use resources. In some instances, the resources did not work as expected and teachers simply gave up. "They [students] typed their essays that I asked them to type. But when they submitted it for evaluation for feedback, it didn't come back," explained one writing teacher. "I tried that twice, so I quit using it [the resource]." In other cases, teachers felt package resources were not well matched to their subject areas, as one social studies teacher noted:

> The problem I face, especially with a lot of these items that we get that come with these things [resources], is that most places don't have a lot for Texas history because we're the only place that they can market it. So lots of times we have to find our own stuff.

Some lower implementers pointed to lack of training as the source of their aggravation with package resources:

> I am still disappointed that I didn't ever have anybody come in and help me figure out ways to use them [resources] more. I had been assured of this by you all, I was assured by somebody when we started this that they were going to come in and show me exactly how I could use them in here. So pretty much anything that I had figured out, I had either figured out on my own or, you know, colleagues.

Homework

An advantage of individual laptops is the potential to extend student learning outside of school. However, when asked about the use of laptops for homework assignments, few teachers said they assigned homework, although most said that work that was not completed during the class period was frequently completed at home. "I prefer things to be done in class," said one teacher. "That way I know who's doing the work." Another teacher explained, "We have a hard time getting the students to complete their homework assignments as it is, so we do most of our stuff in class." "I mean, you can't fail every kid because they just don't do stuff that they need to do at home," said a teacher on another campus. "It's just one of those where you pick your battles." Both higher and lower implementing teachers said it would be difficult to assign homework that required Internet use because many students did not have access to the Internet at home.

Technology Integration and Learner-Centered Instruction

As a way to capture teachers' views about instructional practices, we asked teachers to describe how laptops and resources had changed or affected their instructional approach. Although commonalities existed across teachers, there also were distinct differences in the professed beliefs of higher and lower implementing teachers that helped to explain *why* teachers embraced or resisted instructional technology. Differences between teacher groups are contrasted in Exhibit 3.2.

- *Higher Classroom Immersion teachers believed laptops facilitated instructional variations, allowed a more student-centered approach, and broadened the curriculum. These teachers also believed an emphasis on the TEKS prepared students for the TAKS, and self-direction and project-based learning promoted student achievement.*

- *Lower Classroom Immersion teachers believed laptops made teaching easier, but change from established instructional routines was difficult, and teachers' weak technical skills undermined laptop use. Lower implementing teachers believed laptops were useful for TAKS preparation and free-time activities but thought more traditional teaching activities promoted student achievement.*

Higher Classroom Immersion Teachers

Exhibit 3.2. Teachers' Beliefs about Technology Integration and Learner-Centered Instruction
Higher Classroom Immersion Teachers
Instructional variations are easier with laptops
Laptops allow a student-centered approach
Laptops broaden the curriculum
Emphasis on TEKS prepares students for TAKS
Self-direction and project-based learning promote student achievement
Lower Classroom Immersion Teachers
Teaching is easier with laptops
Change from established routines is difficult
Technical skills are weak
TAKS preparation is paramount
Laptops are useful for free-time activity
Traditional teaching activities promote student achievement
Source: Interviews with 19 higher implementing and 18 lower implementing teachers at 21 Technology Immersion schools.

Instructional variations are easier with laptops. Both higher and lower implementing teachers said that technology made their work easier, but the reasons for their comments varied across the two groups. Higher implementing teachers were more likely to speak of the effects of laptop on instruction, noting that technology made it easier for teachers to plan differentiated lessons and engaging project-based activities. For example, one higher implementing teacher explained how laptops allowed special and regular education students to work on individualized projects without drawing attention to differences between their assignments. An English teacher said the frequency of research projects had increased from a couple of projects a year in the computer lab to doing research projects weekly. A science teacher had students complete a project with each curricular unit. For instance, students had used Inspiration concept mapping software to make food chains and food webs. A higher immersion teacher at another school described an interdisciplinary project on the Holocaust that combined language arts and social studies activities. In language arts, students read stories and poems, conducted research on Holocaust survivors, and made butterflies for children that had died. The project culminated with a visit to the Holocaust museum.

Laptops allow a student-centered approach. Higher implementing teachers said that technology enabled them to change their teaching practices to include more student-centered instruction. They explained that laptops allowed students to have greater self-direction in learning, noting that students were able to choose topics of study as well as the format of their projects and relied less on the teacher. One higher implementing teacher explained:

> It's [technology] allowed me to let the kids have more freedom in their learning. I've been totally amazed at how well they are self-learners, how they really will dig. They come up with things I never would have thought of. It's just more of a…child-controlled classroom than a teacher-controlled…It's really changed a lot how I teach.

A higher immersion teacher on another campus shared a similar experience:

> One of my strengths I've always felt teaching is the direct instruction. I feel really comfortable talking and telling stories and that's why I like being a history teacher because I get to explain things…The laptops have given me a way to incorporate more of the students into it, so it's not me just saying, "Here's what we need to know: this, this and this," and then, "Here's your assignment." Instead I can use the students to do some of the research. I can say, "You guys find five things about this part of Presidential Reconstruction and use the Internet. Find five sources and tell me five facts." I use that a lot more and the students can participate in it so it's not so much me standing up and speaking, it's the students incorporated in the learning process more.

> So I think the technology has definitely helped me to do that a lot better.

Higher implementing teachers said that changing their instructional practices was difficult at first but grew easier over time. "It's getting easier," said one teacher, "I find it getting easier all the time." Teachers attributed the increased ease to their own as well as students' improved proficiency using technology, greater familiarity with online resources that reduced planning time, and the use of laptops as an organizational tool.

Laptops broaden the curriculum. Teachers, primarily higher implementers, who were able to adapt their classroom practices to include technology, noted that laptops enabled them to broaden their instruction to include new resources and content. "It has opened my classroom up out into the world, especially in science, where things are changing so rapidly," explained one higher implementing teacher. "I can get them [students] online. I can show them things that are happening. We can bring that into what we're studying today…So it has opened the door of my classroom in regards to the ways that I teach as well. A teacher on another campus said that laptops enabled her to "stretch the curriculum" to include cross-curricular projects. Teachers said that laptops enabled them to access more current and relevant information than was contained in textbooks, and that the use of websites such as Study Island enabled students to practice skills using learning games that provided immediate feedback.

Emphasis on TEKS prepares for TAKS. Generally speaking higher implementing teachers were more likely to emphasize the link between technology-based lessons, curriculum content, the TEKS, and TAKS, noting that these were combined components of instruction. "I have a hard time understanding why people think, well, if you're teaching TEKS, you have to teach to the TAKS test," explained one higher implementing teacher,"… I believe that if you cover all the TEKS without even having the kids think about the test, they'll do fairly well just by covering the TEKS." The comments of higher implementing teachers also suggested they had discovered ways to include technology and still prepare students for paper and pencil testing formats. As one higher implementing teacher explained:

> My greatest fear when we started this [laptop immersion] is the TAKS test, as it is for every teacher, and is this really going to prepare them for the TAKS test…I thought well, okay, we're going to see, and the test results have been good. It hasn't affected them [students], me not drilling them all the time, but in essence I am drilling them on the same types of things, only instead of doing it with paper and pencil and everybody's going to read this passage and answer questions, we've done it in a different way...talking about inferencing and conclusions from other [laptop] activities that we're doing, and that, I really think has helped them, get the scores up there.

A higher implementing teacher on another campus noted the value of technology-based lessons in developing many of the skills tested by TAKS but acknowledged the challenges of preparing students for testing formats that are inconsistent with laptop use:

> Using this technology, when done the right way, can help these kids with a lot of critical thinking that you need on TAKS; however, I think there is a huge, huge drawback…We go back to a pencil and paper test. We go back to multiple-choice answers only. We do not evaluate how we are practicing in the classroom, or how we are evaluating with our Science curriculum. How we…evaluate what they've learned is not the way TAKS is evaluating it…I don't know the answer of how to do that…You really want to create lessons for them that are fun and interesting, so that's where the technology comes in, but those lessons have also got to contain those critical thinking skills that they need to pass that TAKS test. But I have seen kids turn off like a light switch as soon as they do a paper/pencil project, as soon as they do that paper/pencil test; it is like night and day when they are not able to use that computer and I think it's a huge problem. I think it's a problem with the way we access the TAKS.

A higher implementing teacher on another campus noted that the format of the TAKS test "needs to catch up with us, where we have it all online."

Self-directed and project-based learning promotes student achievement. We asked teachers to describe the classroom activities—irrespective of technology use—that they felt had the greatest effect on student achievement. Teachers' responses revealed differences between higher and lower implementing teachers that may explain some of the variance in their classroom use of technology. Generally speaking, higher implementing teachers were more likely to report that self-directed and project-based activities that enabled student to be creative had a greater influence on students' achievement. "So it's just projects where they're [students] given the freedom to be creative. That's where they do their best," explained a higher implementing teacher. Higher implementing teachers also said they organized instruction to allow for greater student collaboration, noting that students learned a great deal from one another.

Lower Classroom Immersion Teachers

Laptops make teaching easier. In contrast to laptops' facilitation of more varied instruction for higher Classroom Immersion teachers, some lower implementing teachers said that technology made their work easier because students' interest in laptop activities alleviated the pressure to develop engaging lessons. Others focused on the logistical benefits of technology, noting the convenience of using laptops rather than scheduling time in a computer lab and the advantages of LCD projectors, SmartBoards, and document cameras over overhead projectors. As one teacher explained:

> With the [overhead] transparencies, normally that would have been the way to go. And by the end of the day, they're green looking because you've erased them so many times and your hand is green. Being able to do that using the InFocus and the laptops has been wonderful. I can't imagine going back anymore.

Change from established routines is difficult. Some lower implementing teachers were reluctant to change their teaching practices. "I'm used to teaching the old-fashioned way," explained one such teacher. In many instances, these were veteran teachers with established classroom routines. One teacher explained:

> Being a 30-year teacher, it has been hard to change my ways. You know, I've been used to doing things for so long without the technology, so it's been hard for me. These other teachers have stepped in and done amazing things with their classes with these laptops. I think it's my age and experience that have hindered me in being as flexible in implementing these things that we've been learning.

For some lower implementing teachers, discomfort with technology prevented them from fully integrating laptops into instruction:

> I'm just getting that feel of being comfortable with the technology and just saying, "Oh, okay, we can use this here." I have not done well this year. If I had to rate myself on it, like I said, we've used the computer with the projector a lot, but as far as the kids doing as much as I would have liked them to do, we haven't.

Other lower implementing teachers acknowledged that their ability to use technology for instruction had gotten easier as they gained more experience using laptops. "I know, and I do not claim that I know it all, for sure," explained one lower implementer, "But it is getting better. It is improving, and the resource is there, and it's easier to work it into the lessons with them [laptops]."

Technical skills are weak. For some teachers, the lack of technology skills was at the root of their discomfort using laptops in the classroom. "And even though we have been trained on a lot of that

[technology], I really have not yet I guess immersed myself enough in it to where I feel comfortable using it yet," said one lower implementing teacher. "I'm still working on my own technology skills." Lower implementing teachers with weak skills were more likely to report that technical problems were a deterrent to using laptops for instruction. One such teacher described the challenge of helping students connect to the Internet:

> Sometimes when they [students] can't get on [the Internet], sometimes they have problems and get frustrated. Then sometimes, there are too many of them that need help when you would get started with something, and I'm having to go from one person to another to try to help out. Then it gets a little bit stressful sometimes in that sense. I guess that would be about the biggest thing sometimes, just the frustrations of not being able to get on [the Internet] and not being able to get around to as many of them [students] as I might need to.

TAKS preparation is paramount. Lower implementing teachers were more likely to speak of isolated laptop activities designed to prepare students for tests. These teachers commented that they often used online test preparation activities such as Study Island to prepare students for TAKS exams. Such teachers often pointed to the pressure of TAKS preparation as a central barrier to using technology in the classroom. "I would say I use them [laptops] more earlier in the year," explained a lower implementing teacher, "I'll admit, when we got close to TAKS, we weren't on the computer much." Some teachers said they postponed using laptops until after TAKS testing was complete. "I feel that when TAKS is over then we can play more and do some things that go above and beyond," said a lower implementing teacher on another campus. For some teachers, the paper and pencil format of the TAKS test was a deterrent to using laptops in the classroom. One teacher explained:

> Well, before the TAKS, it [laptop use] wouldn't be that much because the TAKS is really dealing with reading, and if I let them use the laptops, I felt like I was losing time with them for the TAKS, because the TAKS is really important…if I let them use the laptops always, they're not going to be used to reading; they're going to be used to using the laptops more. Now, if the TAKS was on the laptop—then no problem. But it's not like that.

Laptops are useful for free-time activity. Some lower implementing teachers had difficulty recalling using technology in their classrooms and offered vague descriptions of activities that incorporated laptops, suggesting that laptops were used infrequently if at all for instruction. For example, one teacher strained to remember using laptops for instruction:

> We did a few others [laptop activities] earlier in the year, but I can't remember what things that we did. There were some problems, but I don't know where they're from or what they're called. There were some problem-solving ones where you had to set up an equation and solve it with story problems. I really did like that and those, but I can't remember the name of them.

These teachers were more likely to use laptops as a free-time or sponge activity to absorb students' attention and keep them occupied. "I use this [laptops] more as a reward than anything because the kids are fascinated with it," explained one teacher. "If I have free time and the youngsters ask to go ahead and get on their computer because they've finished with their main assignments, then I'll allow them to go there." Another explained, "[It] works really well for rewards because it's an incentive for them [students] to do their work."

Traditional teaching activities promote student achievement. When asked to describe the classroom activities that had the greatest impact on student achievement, the responses of lower implementers in contrast to their counterparts revealed a greater reliance on traditional teaching activities, such as bellringers, workbooks, modeling problems on the board, worksheet activities, and answering text questions. "I'll give them a list of questions from a chapter, and I'll say, 'Answer these. Explain, discuss.

Compare, contrast,' " said one lower implementing teacher. Another teacher reported that "the old-fashioned talking through a problem as a group" provided the greatest benefit for her students. Higher and lower implementing teachers were in agreement that hands-on activities increased student achievement. "I think hands-on activities, things that they can dig into are the ones they remember the most," said one teacher, "Even when I ask them more than two years [later], they remember doing this or when we did that. Not when we talked about stuff. It's when we do things that they [remember].

Classroom Immersion Challenges

- *Higher and lower Classroom Immersion teachers generally faced similar challenges in creating technology-immersed classrooms: students without laptops, unreliable networks, monitoring laptop use, students' limited technical skills, and time constraints. However, higher implementing teachers' belief in the value of laptops and resources for students, commitment to classroom technology use, and greater technical skills appeared to help them deal with obstacles encountered.*

Students without Laptops

The most prevalent issue reported as a challenge to implementation during the third year for both higher and lower implementing teachers was students not having a laptop in class. Students without laptops caused problems because there often were not enough desktop computers in a classroom or loaner laptops were unavailable for students.

> I think the other challenge…is just computers breaking down, students not having them, because it's hard sometimes to come up with almost two lesson plans for every class. What do you do for a student who doesn't have their laptop versus those who do? It's not always beneficial to just say, "Team up with somebody who does," because that doesn't work. You have one person doing it and the person without their laptop is kind of sitting there.

Both higher and lower implementing teachers reported that some students did not have laptops because the laptop had mechanical problems requiring repair. In fact, mechanical problems were mentioned as a challenge by almost all the teachers interviewed. Both higher and lower implementing teachers reported that students did not have a laptop in class because they left the laptop at home. Several teachers suggested some students might not be bringing their laptop to class because it was too heavy to carry.

Unreliable Campus Network

Both higher and lower implementing teachers reported network problems that created problems for immersion. Higher implementers were more likely than lower implementers to mention students not having Internet access at home and the need for more technical staff on campus, as additional technical challenges to technology integration.

Monitoring Laptop Use

Both higher and lower implementing teachers reported that the need to constantly monitor students' technology use was a challenge. When instructed to work on a class assignment, students might attempt to access inappropriate sites, play games, download material from the Internet, or get off task in other ways.

Students with Limited Technical Skills

Some teachers reported that having students in class who did not have basic computer literacy skills was a challenge. Often it took time away from teaching a lesson to assist students as they learned the technology they needed for an assignment. Higher implementing teachers were more likely than lower implementers to note this as an issue. One teacher explained:

> Well, I do wish that some of them had better keyboarding skills as far as typing notes. I wish we could offer them a keyboarding class because it's very difficult for them to type notes from the overhead onto their computer; it takes quite a while, so it's another issue with the time.

Time Constraints

Both higher and lower implementing teachers noted that using laptops for instruction frequently took more time than traditional teaching methods. Teachers commented that lessons moved more slowly when students used laptops because students had difficulty locating sites or identifying activities. For some teachers, the slow pace of laptop activities meant that some course content was not covered. One teacher explained:

> Sometimes it takes a little more time to do assignments on the computer than it does to do them by pencil and paper, so time is a big, big challenge…It slows me down quite a bit. I have to now group my chapters and my units and leave out a lot of things that I would not have done. I get all of my objectives in, but there are a lot of things that I leave out because of time and using the technology.

The teacher added that her time problems could be alleviated if the school moved to longer block periods, which would allow for more time for laptop use. Several teachers also said their planning time had increased because they needed to work through all laptop activities prior to assigning them to students. One teacher explained:

> You have to really search and I do everything that I assign a kid. I don't just find the link. You do have to go through it because if you don't you end up with a disaster, something that doesn't work or something inappropriate. So you have to actually do the Connected Tech lessons and it is very time consuming.

However, when planning time ran short, teachers said they relied on previously developed lessons that did not require laptops. "So if I get caught in a crunch," explained one such teacher, "then I don't use this [laptops] because I don't have time to check it out. Then I go back to my textbook because I've memorized that."

Lower implementers' limited technology proficiency appeared to intensify time demands because they were less familiar with technology and needed more time to get familiar with the technology, and to practice lessons that integrated technology before presenting the lessons to their classes. One teacher described the importance of "time for myself to sit and explore and to go through and work it and make sure that it's going to work the way I want it before I present it to the kids." Lower implementing teachers indicated that lack of time was a deterrent to implementing technology in their classrooms.

Effects of Laptops on Students

We asked teachers to explain how laptops had affected their students, either positively or negatively, and whether they saw different outcomes for different groups of students. As Exhibit 3.3 illustrates, analyses of teachers' comments revealed some commonly held opinions and some divergent views.

- *Both higher and lower Classroom Immersion teachers reported that laptops positively affected students' engagement in learning, technology proficiency, ability to arrive at more informed opinions, and behavior. However, some teachers linked laptops to behavioral distractions.*

- *Higher Classroom Immersion teachers were more likely than lower implementers to report positive effects of laptops on students' academic achievement as well as positive impacts on special student populations, including lower and higher achievers, English language learners, and special education students.*

Exhibit 3.3. Teachers' Beliefs about the Effects of Laptops on Students

Teachers' Shared Views
More engaged learners
Increased technology proficiency
Informed opinions through reading and research
More positive behaviors (discipline and responsibility)
…but potential for distraction
Higher Classroom Immersion Teachers
Increased academic achievement
Positive impacts on special students
-Special Education
-Low achievers
-English language learners
-High achievers

Source: Interviews with 19 higher implementing and 18 lower implementing teachers at 21 Technology Immersion schools.

Teachers' Shared Views

More Engaged Learners

Most teachers reported that students were more engaged in learning when using technology as compared to learning without technology. One teacher explained:

> The kids are focused; most of the time, they're focused. They enjoy it, and I'm getting their cooperation. I know that they're learning something because they'll come back and give me feedback …For example, they'll come back and say, "Miss, we didn't know that the Cinderella story came from so many different nationalities. We only thought the basic Cinderella story, and we thought that was it." So after they've done all the research, they were like, "Wow." They didn't understand it, and now that they're creating their own story, they see all the others that they looked at, they can see the possibilities of changing it and adding [something]. It's great to see that in their eyes. It's like wow.

However, a few lower implementing teachers reported that their students were no more likely to be engaged when using laptops compared to not using the technology. One teacher said, "Well, the feedback that I get from the kids is that some like them and some don't. Some want to use them a lot, and some don't even want them."

Increased Technology Proficiency

Most teachers reported that students were gaining proficiency with technology. They indicated that students were better at keyboarding, more computer literate, and better able to use productivity software. One teacher noted how students take their skills and apply them to projects outside their school work.

> They just love it. They love creating stuff. They created their first movie using MovieMaker. And they go home, and sometimes they come and they're like, "Ma'am, we created this presentation."

> And for other things within their community, I know one of them created a presentation of pictures using MovieMaker for their church…And he [explained] "I went into the website where you told us that we use the free music play a lot." And they went in there and they downloaded the background music. They showcased it at their church.…"Oh, and my mom was so proud of me. I did this."

Informed Opinions through Reading and Research

Across higher and lower implementation levels, teachers said that laptops enabled students to research topics and form their own views. "I use the computers to help students form their opinions about what is being taught, and to give them a chance to see different perspectives," explained one teacher. A teacher on another campus noted that research activities challenged students to read at a higher level:

> The thing they [students] don't realize is when you're doing all this research, if you read the research stuff that they're, the articles they're pulling up and stuff, that's more difficult reading than what they're ever reading in a novel, and they're reading it for a purpose that they're trying to search out information, not just because the teacher told them to read it. I've seen that the kids really, to be quite honest, some of them, the majority of them I've noticed that their vocabulary has increased because they've had to in order to read the more difficult materials that they're getting.

More Positive Behaviors but Potential for Distraction

Both higher and lower implementing teachers cited positive and negative effects of student access to technology on classroom behavior. Teachers reported more student engagement when using technology in the classroom, fewer disciplinary referrals, and increased student responsibility. However, they also noted the potential for distraction inherent in giving a student a laptop in class, and in having that laptop connected to the Internet. Higher and lower implementing teachers reported that some students had difficulty remaining on task, accessed inappropriate web sites, communicated with friends, and played games. Interestingly, a few teachers alluded to the opposite phenomenon wherein students had difficulty focusing on their assignments when they were *not* using a laptop.

> I've found is as along as we have those computers, as long as we have them, there is no really major problem, but there have been two or three times that somebody screwed up somewhere or whatever, and they have just taken computers away from them…They don't know what to do. So they sit there and talk and yap, and when they had that computer, they're really quiet and don't bother anybody, just kind of in their own world.

Consistent with this, other teachers noted that some students were frustrated when technical problems prevented them from using their laptops.

Higher Classroom Immersion Teachers

Reasonably, higher implementing teachers had more opportunities to actually observe the effects of technology on their students because laptops were used more often in their classrooms and in more content-integrated ways.

Increased Academic Achievement

Several higher implementing teachers reported that integrating technology into the classroom contributed to the improvement of students' academic skills. In contrast, only one lower implementer reported any student effects related to achievement. Teachers noting improved student academic skills typically described students who had a better vocabulary and were better at spelling and writing.

> I think it's improved their vocabulary…a lot of times, just listening to their conversations in the hall, this and that. You know that it was something they were working on, or something they picked up, or they're like, "Hey, I looked up such and such." You know, just listening to them talk.
>
> The kids are getting a lot more proficient at keyboarding; their reports are getting better. I see some improvements in their grammar and language because of the spell check. Web surfing is getting easier. They feel more comfortable to me this year than they have in the past.

Positive Impacts on Special Students

Higher implementing teachers also were more likely to identify differences for particular groups of students when they used technology compared to when they did not.

Special education and lower achieving students. Higher implementing teachers were much more likely to report differences for special education students as well as low achievers who used technology. Some teachers suggested that technology helped special education students improve their academic skills by allowing for individualization of lessons, use of particular software to strengthen skills such as reading, and access to resources to organize assignments and learning resources on the laptop. With technology, special education students were able to compensate for poor handwriting as well as limiting physical disabilities, and to create better quality products demonstrating their mastery of the lessons. They were more likely to be participants rather than observers in class, and to develop self-confidence as a result of mastering computer skills. Similar to special education students, low achievers gained self-confidence as a result of mastering technology skills, and were more engaged in the classroom. Examples of teacher comments included the following:

> In regards to my Special Ed kids, it is a real benefit. I have got kids that can put out wonderful products, whereas if I were asking them to do paper and pencil, I would not get that quality of work. Yet they can do a lot of other things that show me they understand what is going on in class and they're more motivated; just that usual stuff. In the last two years, I have dealt with two physically challenged students. Without the laptop, they would have been more like observers in the classroom rather than participants.
>
> Most of them can't read, and so, just from an actual, physical simple things like just turning their computer on and knowing how to get to the Internet and knowing how to email somebody and knowing how to get email. I think it gives those students a lot more; it gives them a lot more confidence and belief that they're doing something.
>
> I have one particular [special education] student that I've had several times throughout the year. You could not get him in front of the class to say a word. But he will take that laptop up there, plug it into the projector, and do a PowerPoint in a heartbeat. But don't ask him to just go up there and tell you something.
>
> Students that have a hard time beginning a project, a writing project, that would have a hard time putting something down on paper have a very easy time of getting started on a PowerPoint or a Publisher…I don't know if it's the editing factor, whatever it is, they know they can go back and erase, it's just much, much easier for them to get started. They're much more productive than if I said, "Write this out."

English language learners. Higher implementing teachers were much more likely to report different outcomes for English language learners who used technology. These students improved their language acquisition and writing skills, and gained confidence in writing English with the use of technology.

> They know that if there is a wrong word in there, or sentences, they can go spell check and it'll help them fix it. They're getting a little more confident with their writing.

Higher achieving students. Several teachers noted that high achievers also appeared to do even better with technology. High achievers learned the requisite technology skills more quickly than low achievers, and created products of better quality than previously. A few teachers noted that students with more technology skills tended to exceed the teacher's performance expectations.

In contrast, lower implementing teachers were more likely to discuss the advantages of using technology to reach students who were visual learners. Teachers suggested that technology affords them a variety of methods for presenting lessons so students can visualize concepts in ways that make sense to them.

Classroom Practices

In addition to conducting interviews with teachers, we also analyzed data for a sample of higher and lower Classroom Immersion teachers whose classrooms were observed in spring 2007. Nearly all of the interviewed teachers (32 of 34) were also observed. As Figure 3.1 shows, the observed teachers included 18 higher Classroom Immersion and 16 lower Classroom Immersion teachers. The distribution of subject-area assignments differed across groups. Higher implementing teachers included more science teachers and fewer mathematics teachers. Conversely, lower implementers included fewer science teachers and more mathematics teachers.

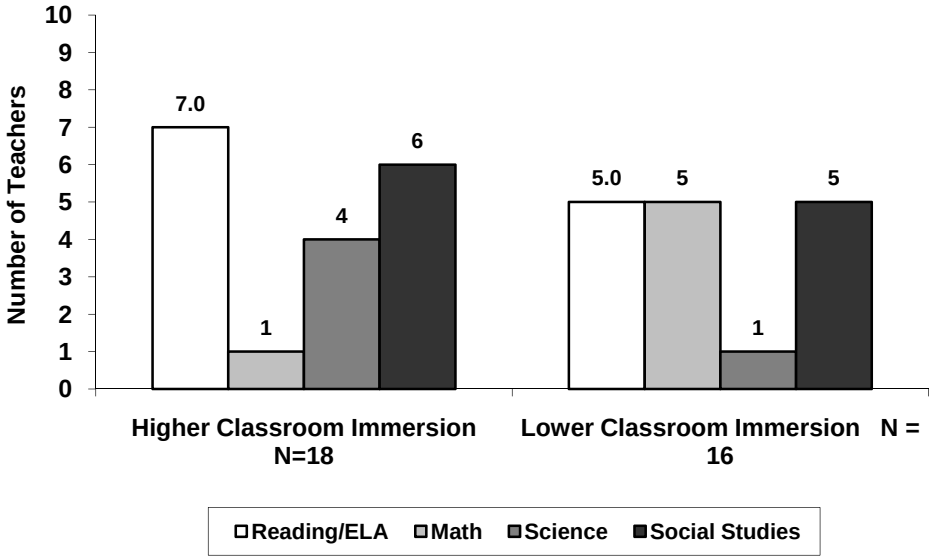

Figure 3.1. Number of observations conducted in higher and lower immersion classrooms (spring 2007).

During observations, data collectors used the Observation of Teaching and Learning (OTL) instrument to record descriptive information about the classroom environment, and to make time-interval ratings for classroom organization, teacher activities and technology use, student activities and technology use, and student engagement. Observers also recorded notes during the observations to capture the lesson's content focus and objectives, teachers' questioning strategies (lower and higher order), and the intellectual rigor of students' learning experiences.

Classroom Environment

- *Higher and lower Classroom Immersion teachers had access to similar types of technology and had comparable student-to-teacher ratios; however, higher implementing teachers arranged their classrooms in a variety of instructional configurations, whereas lower implementing teachers almost always had traditional rows facing the teacher.*

Information in Table 3.3 shows that there were no statistically significant differences in the availability of technology in the classrooms of higher and lower implementers. Student-to-teacher ratios were similar, and teachers and students had access to similar types of technology, such as laptop and desktop computers, LCD projectors, printers, TVs and VCRs.

Table 3.3. Technology Access in Classrooms of Higher and Lower Implementing Teachers: Mean Number

Technology	Higher Classroom Immersion *n* =18	Lower Classroom Immersion *n* =16
Students per class	16.7	15.2
Laptops	12.4	12.3
Desktop computers	1.6	1.1
Overhead projector	0.4	0.6
LCD projector	0.8	0.7
Printer	0.9	1.1
TV/VCR	0.6	0.4

Note. Bold text denotes statistically significant difference between groups ($p < 0.10$).

Figure 3.2 shows, however, that teachers organized their classrooms in different ways. Almost all lower implementing teachers arranged their classroom in traditional rows facing the teacher at the front of the classroom. In contrast, higher implementing teachers arranged their classrooms in a variety of ways, including traditional rows, students at tables and desks, and other arrangements such as clusters of desks or desks arranged so that students faced each other. To some extent, the way that teachers chose to organize their classrooms reflected their instructional views about classroom interactions.

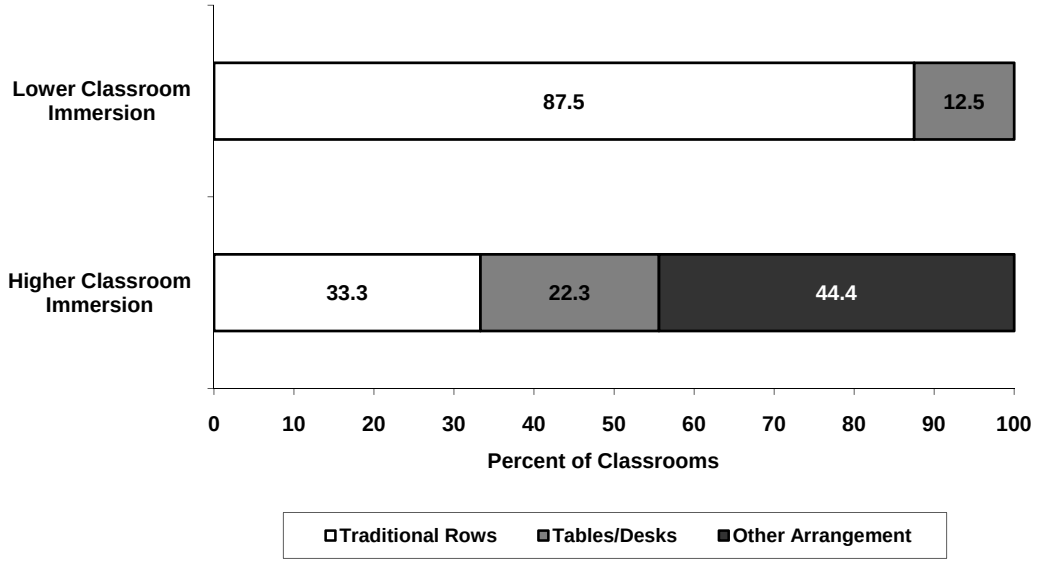

Figure 3.2. Classroom arrangement by higher and lower Classroom Immersion teachers.

Observed Classroom Practices

- *Students in higher implementing teachers' classrooms spent significantly more time working as a whole class, whereas students in lower immersion classrooms spent significantly more time working independently.*

- *Both higher and lower Classroom Immersion teachers mainly directed students as a whole group and monitored students as they worked independently. Higher implementing teachers, however, spent significantly more time facilitating or coaching as students worked on projects.*

- *Students in higher implementing teachers' classrooms spent more time listening to a teacher presentation or discussion, writing responses, constructing knowledge, and engaging in disciplined inquiry. In contrast, students in lower implementing teachers' classrooms spent more time learning facts, definitions, and algorithms, and significantly more time taking tests or doing test-like activities.*

Middle school teachers usually organized their students either for whole-group instruction or their students worked independently on assignments (Table 3.4). Interestingly, students in higher immersion classrooms spent a significantly greater proportion of their time working as a whole class (51.7% of time), whereas students in lower immersion classrooms spent significantly more time working independently (50.9%). Students across groups spent less than a fifth of time working in pairs, small groups, or a combination of arrangements.

Table 3.4. Organization of Classrooms of Higher and Lower Implementing Teachers: Mean Percent of Time

Organization	Higher Classroom Immersion *n* =18	Lower Classroom Immersion *n* =16
Individual students	**26.4**	**50.9**
Student pairs	0.0	3.8
Small groups	8.6	0.0
Whole class	**51.7**	**29.7**
Combination	13.3	15.6

Note. Bold text denotes statistically significant difference between groups ($p < 0.10$).

Higher and lower implementing teachers performed similar roles in the classroom, mainly directing students as a whole group and monitoring students as they worked alone (Table 3.5). One significant difference emerged, with higher implementing teachers spending significantly more time as a facilitator or coach who assisted students as they worked on projects by scaffolding their thinking processes to elicit higher levels of understanding (8.6% of time versus 0.0%).

Table 3.5. Teacher's Role in Classrooms of Higher and Lower Implementing Teachers: Mean Percent of Time

Activity	Higher Classroom Immersion *n*=18	Lower Classroom Immersion *n*=16
Directing whole group	41.1	38.1
Guiding substantive discussion	1.1	0.0
Facilitating/coaching	**8.6**	**0.0**
Monitoring student work	29.4	36.9
One-on-one instruction	2.8	0.0
Giving test	0.0	1.3
Checking/grading student work	0.0	5.0
Managing behavior	0.0	3.8
Managing classroom routines	7.2	12.5
Other	9.7	2.5

Note. Bold text denotes statistically significant difference between groups ($p < 0.10$).

Although the teachers' roles did not differ substantially, there were noteworthy differences in students' classroom roles (Table 3.6). In higher implementing teachers' classrooms, students spent more time listening to a teacher presentation or rote discussion (42.8%), writing communication related to the lesson (20.3%), constructing knowledge (17.8%), and engaging in disciplined inquiry (9.2%). In contrast, students in lower implementing teachers' classrooms spent considerably more time learning facts, definitions, and algorithms (53.8%), and significantly more time taking tests (27.2%). Tests often involved TAKS-preparation activities or assessments of some kind.

Table 3.6. Students' Role in Classrooms of Higher and Lower Implementing Teachers: Mean Percent of Time

Activity	Higher Classroom Immersion *n*=18	Lower Classroom Immersion *n*=16
Listening to teacher presentation/rote discussion	42.8	33.1
Listening to student presentation	5.6	0.0
Engaging in substantive discussion	2.8	0.0
Learning facts, definitions, algorithms	35.6	53.8
Writing communication related to lesson	20.3	7.5
Constructing knowledge	17.8	11.6
Engaging in disciplined inquiry	9.2	0.0
Engaging in individual reading	16.1	15.6
Viewing a video/CD ROM	2.8	0.0
Taking a test	**0.0**	**27.2**
Other academic	12.8	15.6
Other non-academic	8.6	13.8

Note. Bold text denotes statistically significant difference between groups ($p < 0.10$).

Observed Technology Use

- *A larger percentage of higher Classroom Immersion teachers used technology for instructional purposes. These teachers typically used PowerPoint or Keynote programs to present information to their classes or used the Internet as a resource for lessons. In contrast, students used the technology in a significantly larger percentage of lower implementing teachers' classrooms.*

- *Students in higher implementing teachers' classrooms spent significantly more time using laptops to create or make presentations (with PowerPoint or Keynote) and to conduct Internet research on an assigned topic, whereas students in lower implementing teachers' classroom spent significantly more time using laptops to complete an assessment and more time to learn and practice skills.*

Observers recorded the use of technology by teachers and students in classrooms. Unexpectedly, as Table 3.7 shows, students used technology in significantly more classrooms of lower implementing teachers compared to higher implementers (77.8% of classrooms versus 44.4%). On the other hand, higher implementing teachers used technology substantially more often for instruction (77.8% of classrooms versus 56.3%) and for more extensive periods of time (51.9% of time versus 31.3%).

Table 3.7. Technology Use in Classrooms of Higher and Lower Implementing Teachers

Technology use indicator	Higher Classroom Immersion *n*=18	Lower Classroom Immersion *n*=16
Percent of classrooms, teachers used technology	77.8	56.3
Percent of time, teachers used technology	51.9	31.3
Mean number of students using technology	7.0	7.2
Percent of classrooms, students used technology	**44.4**	**75.0**
Percent of time, students used technology	63.3	68.1

Note. Bold text denotes statistically significant difference between treatment and control groups ($p < 0.10$).

As Table 3.8 shows, higher implementing teachers spent more time using presentation software, such as PowerPoint or Keynote, to present information to their classes, and they spent more time using the Internet as a resource for their lessons. These teachers also used other kinds of technology, such as LCD projectors and interactive whiteboards, for a greater proportion of time than lower implementers.

Table 3.8. Technology Use by Higher and Lower Implementing Teachers: Mean Percent of Time

Teacher uses…	Higher Classroom Immersion *n*=18	Lower Classroom Immersion *n*=16
Peripherals (imaging & recording devices)	0.0	0.0
Educational management software (attendance, grades)	0.0	1.3
Word processing software	2.2	1.3
Data management (spreadsheets, graphing, analysis)	0.0	0.0
Database software (e.g., Filemaker, Access)	0.0	0.0
Presentation software (e.g., PowerPoint, Keynote)	17.2	7.5
E-mail	1.4	1.3
Other communication tools (IM, videoconferencing)	0.0	0.0
Desktop publishing software	0.0	0.0
Web publishing software	0.0	0.0
Internet for research	**12.2**	**0.0**
Multimedia reference CDs (e.g., online encyclopedia)	0.0	0.0
Simulations/modeling software	0.0	4.7
Software for video, graphics, and sound editing	1.4	0.0
Online assessment	5.6	0.0
Other	38.1	23.8

Note. Bold text denotes statistically significant difference between treatment and control groups ($p < 0.10$).

Higher and lower Classroom Immersion teachers also had their students use technology in different ways (Table 3.9). Students in higher implementers' classrooms spent significantly more time using laptops to create or make presentations using PowerPoint or Keynote (26.4% of time) and to conduct Internet research on an assigned topic (23.9%). In contrast, students in the classrooms of lower implementing teachers spent significantly more time using laptops to complete an assessment (22.2%) and substantially more time using laptops to learn and practice skills with some kind of learning system (15% of time).

Table 3.9. Students' Technology Use in Classes of Higher and Lower Implementing Teachers: Mean Percent of Time

Students use technology to…	Higher Classroom Immersion *n*=18	Lower Classroom Immersion *n*=16
Express themselves in writing (word processing)	18.1	15.0
Learn/practice skills (drill, learning system, etc.)	3.3	15.0
Analyze data (spreadsheet, graphing, etc.)	0.0	0.0
Manage data (FileMaker Pro, MS Access)	0.0	0.0
Create or make presentations (PowerPoint, etc.)	**26.4**	**3.8**
Communicate by email (peers, experts, etc.)	0.0	0.0
Communicate via discussion boards or videoconferencing	0.0	0.0
Conduct Internet research on assigned topic	**23.9**	**6.3**
Conduct multimedia research (reference CDs, etc.)	3.3	0.0
Enhance conceptual understanding through simulation/modeling software	0.0	3.1
Visually represent or investigate concepts	0.0	7.5
Analyze information (graphing calculator, digital microscope, etc.)	0.0	0.0
Design web sites or web pages	0.0	0.0
Produce print products (desktop publishing)	0.0	0.0
Produce multimedia reports or projects	0.0	0.0
Enhance multimedia products (use peripherals)	0.0	0.0
Access online resources (Cyberkids, etc.)	10.6	10.9
Complete an assessment	**0.0**	**22.2**
Other	15.0	19.1

Notes. Students may be engaged in multiple activities; thus, the sum across all activity categories can equal more than 100 percent. Bold text denotes statistically significant difference between treatment and control groups ($p < 0.10$).

Student Engagement

- *Students in the classrooms of higher implementing teachers were more strongly engaged in their academic tasks than students in the classes of lower implementing teachers.*

Ratings of student engagement in class activities made by observers showed that students in higher implementing teachers' classrooms were more strongly engaged in their assigned tasks than students in lower implementers' classrooms (Figure 3.3). More than half of observed time (53.9% of ratings), students in higher immersion classrooms were moderately to highly engaged, indicating that "most students exhibited a sustained commitment to and involvement in their academic tasks" and were "interested in their assignments." On the contrary, students in the classes of lower implementing teachers were more likely to exhibit low or moderate engagement. Sometimes, a few or several students were "off task" (18.8% of ratings). However, most of the time students in lower immersion classrooms were "obedient" but exhibited "limited or moderate interest in or excitement about the content they were learning" (45.6% of ratings). Students were engaged at a moderate-to-high level about a third of observed time (35.6% of ratings).

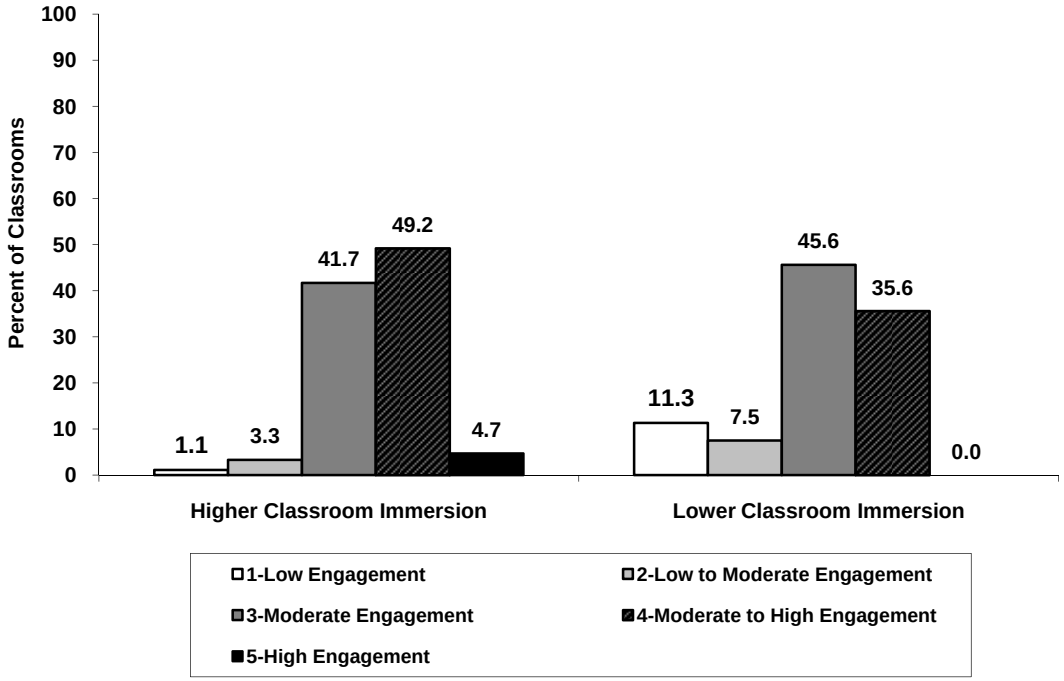

Figure 3.3. Ratings of Student Engagement on a 5-point scale, by higher and lower Classroom Immersion teachers.

Intellectual Challenge

Following classroom observations, observers used time-interval ratings and descriptive notes to rate the *Intellectual Challenge* of classroom work (rating scales developed by Newmann, Secada, & Wehlage, 1995). One section of the OTL included 5-point rating scales for four standards of the intellectual quality of instruction:

- *Construction of Knowledge: Higher Order Thinking*. Instruction involves students in manipulating information about ideas by synthesizing, generalizing, explaining, hypothesizing, or arriving at conclusions that produce new meaning and understanding.
- *Disciplined Inquiry: Deep Knowledge.* Instruction addresses central ideas of a topic or discipline with enough thoroughness to explore connections and relationships and to produce relatively complex understandings.
- *Disciplined Inquiry: Substantive Conversation*. Students engage in extended conversational exchanges with the teacher or peers about subject matter in a way that builds an improved and shared understanding of ideas or topics.
- *Value Beyond School: Connections to the World beyond the Classroom.* Students make connections between knowledge and either public problems or personal experience (Newmann et al., 1995).

An aggregate score across three of the four standards was used as an overall measure of the Intellectual Challenge of instruction for each teacher. The score for Substantive Conversation was omitted from the composite score because ratings were highly influenced by the organizational structure of lessons. Specifically, lessons involving teacher-directed discussions typically yielded more public conversations, and thus, better opportunities to gather evidence on conversational exchanges than lessons with students working in small groups or individually. We also utilized Many-Facet Rasch Measurement (Linacre,

2004) to adjust the measure of Intellectual Challenge for the relative severity (or leniency) of each observer during analyses.

- *The lessons of higher Classroom Immersion teachers were significantly more intellectually challenging than the instruction of lower implementing teachers. Higher implementing teachers' lessons placed a significantly greater emphasis on higher order thinking, depth of knowledge, substantive conversation, and connections to the real world.*

Table 3.10 reports the adjusted composite Intellectual Challenge scores for higher and lower Classroom Immersion teachers for the spring 2007 observations. Table 3.11 summarizes findings for each of the Intellectual Challenge domains. The lessons of higher implementing teachers received a significantly higher mean Intellectual Challenge score (2.40) than lower implementing teachers' instruction (1.67). The difference between groups represented a large effect size (ES = 1.01).

Table 3.10. Average Adjusted Intellectual Challenge Scores of Higher and Lower Implementing Teachers

Observation Time	Higher Classroom Immersion			Lower Classroom Immersion			*t*-value	*p*	Effect Size
	N	Mean	*SD*	*N*	Mean	*SD*			
Spring 2007	18	2.40	0.80	16	1.67	0.63	-2.91	0.007	1.01

Notes. Observations included 18 higher implementing and 16 lower implementing teachers. Intellectual Challenge of Instruction scores could range from 1 (low challenge) to 5 (high challenge). The rating for Substantive Conversation was deleted from the composite score. Effect size is Cohen's *d*.

Table 3.11. Average Intellectual Challenge Scores of Higher and Lower Implementing Teachers by Dimension

Dimension of Intellectual Challenge	Higher Classroom Immersion		Lower Classroom Immersion		*t*-value	*p*	*Effect Size*
	Mean	*SD*	Mean	*SD*			
Higher Order Thinking	2.50	1.15	1.81	1.05	1.81	0.079	0.63
Depth of Knowledge	2.50	1.04	1.63	0.62	3.01	0.005	1.02
Substantive Conversation	1.78	1.06	1.19	0.54	2.08	0.048	0.70
Connections Beyond the Classroom	2.28	1.07	1.31	0.60	3.28	0.003	1.12

Note. Observations included 18 higher implementing and 16 lower implementing teachers.

Higher Classroom Immersion teachers' lessons, compared to lower implementers, also received statistically significant and higher Intellectual Challenge scores for each of the four standards. Mean scores indicated that higher implementing teachers had a greater instructional emphasis on Higher Order Thinking, Depth of Knowledge, Substantive Conversation, and Connections beyond the Classroom. Effect sizes were moderate to large, with the greatest differences between groups for Discipline Inquiry: Depth of Knowledge (ES = 1.02) and Value Beyond School: Connections to the World Beyond the Classroom (ES = 1.12). Despite positive outcomes for higher immersion teachers, overall results indicated that lessons in middle school core-subject classes generally failed to strongly challenge students, with average ratings mostly below 3 on the 5-point intellectual challenge of instruction scales.

4. Conclusions and Implications

The Technology Immersion Pilot (TIP) called for the Texas Education Agency (TEA) to establish a pilot project to "immerse" schools in technology by providing a wireless mobile computing device for each teacher and student, technology-based learning resources, training for teachers to integrate technology into the classroom, and support for effective technology use. The TEA has used federal Title II, Part D monies to fund Technology Immersion projects for high-need middle schools. Researchers are conducting a four-year investigation of the effects of Technology Immersion on schools, teachers, and students. Given that TIP is a pilot project, an important aspect of the research has centered on studying how the 21 treatment schools implemented the Technology Immersion model. As a way to gauge schools' progress, we developed quantitative measures of implementation fidelity (i.e., the extent to which a school implemented the prescribed components of Technology Immersion). Additionally, researchers have explored the nature of project implementation through site visits conducted at middle schools on four occasions: fall 2004 (project initiation), spring 2005 (first year), spring 2006 (second year), and spring 2007 (third year). During site visits we conducted interviews with district administrators, school principals, and technology leaders; focus groups and interviews with core-subject teachers; and focus groups with students. Structured conversations with educators and students solicited their views on various aspects of project implementation and their opinions about project effects on everyone involved.

Evidence from the first two project years revealed that some schools struggled to implement the Technology Immersion model as designed, while other schools reached far higher levels of implementation. Thus, in the third year we investigated *why* some schools and teachers made notable progress toward Technology Immersion, yet other schools had minimal success. As a way to understand differences between schools and factors that influenced those differences, we used composite measures of school implementation (Implementation Index) to identify four higher and four lower implementing schools for study. Additionally, as a way to understand differences in the extent to which teachers created technology-immersed classrooms and the factors that influenced those differences, we used a composite measure of classroom implementation (Classroom Immersion Index) to identify a sample of higher implementing teachers (19) and lower implementing teachers (18). An overarching purpose of the present study was the identification of traits of higher implementing schools and teachers that would provide information on effective practices for other educators wanting to pursue Technology Immersion.

Our comparative analysis of higher and lower immersion schools and teachers drew from quantitative implementation indices, state Academic Excellence Indicator System (AEIS) reports, transcripts from interviews and discussions with educators and students, and site-visit reflections written by researchers. Major findings on the traits of higher Technology Immersion schools and higher Classroom Immersion teachers are summarized below. In some instances, we highlight disparities between higher and lower implementers to clarify important differences between groups.

Traits of Higher Technology Immersion Schools

Higher Technology Immersion schools grew incrementally toward higher levels of implementation over time, whereas at lower implementing schools, events led to declining levels of implementation (see Figure 4.1). Findings to follow describe the features of Technology Immersion schools, including contextual conditions, project initiation, supports for implementation, and student experiences that help to explain the implementation progress of higher immersion schools.

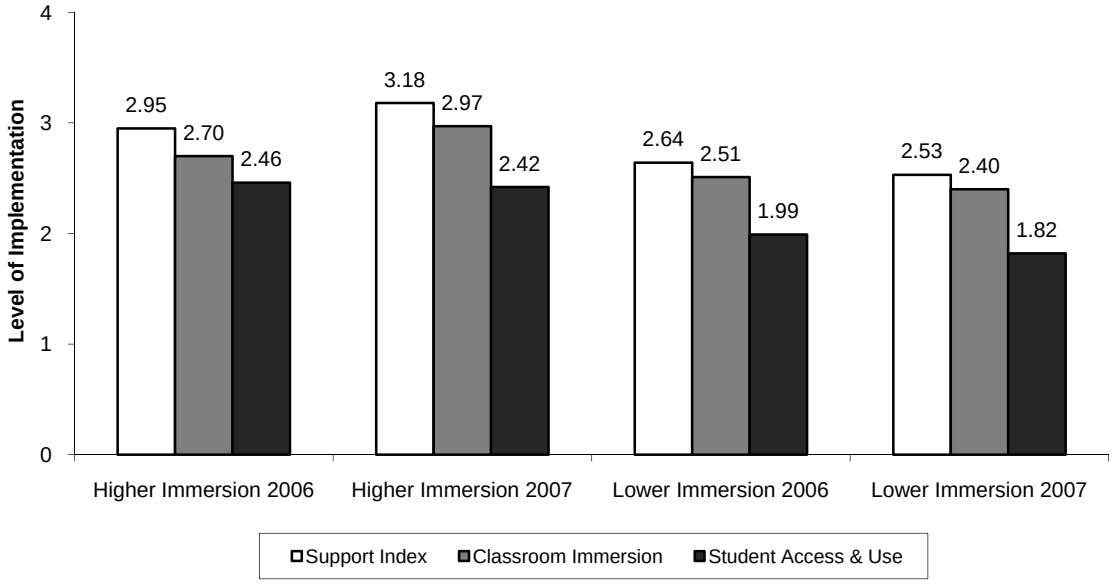

Figure 4.1. Mean level of implementation (measured on a 0 to 4 scale) for higher and lower Technology Immersion schools by component and project year.

Contextual Conditions and Project Initiation

Successful implementation depended on the organizational conditions and actions of people rather than the characteristics of higher and lower immersion schools and their districts. Although contextual conditions differed to some extent at higher and lower immersion schools, overall evidence suggests that the implementation fidelity of Technology Immersion was largely a function of organizational conditions and the actions of people such as district and campus administrators, teachers, and parents. Contextually, higher Technology Immersion schools, similar to lower immersion, were located in districts of varied sizes (about 400 to 15,000 students). TIP districts had less property wealth per pupil than districts statewide. The scarcity of local financial resources for instructional technology was one factor that motivated educators to apply for TIP grants. Like all TIP grantees, higher implementing schools served large proportions of economically disadvantaged (58%) and minority students (49%). Lower immersion schools, compared to higher, had more economically disadvantaged students (76%), minority students (62%), and limited English proficient students (24% versus 5%). Still, all schools qualified for TIP grants because they served highly at-risk students and families. Differences in the demographic characteristics of teachers employed in schools largely reflected regional trends. Higher implementing schools employed mainly White teachers, whereas lower implementing schools had mostly White and Hispanic teachers. Teachers at higher implementing schools had slightly more years teaching experience than lower immersion schools (11.3 versus 8.9 years, on average). Information to follow supports our assumptions about the links among organizational circumstances, personal agency, and the quality of implementation.

Higher Technology Immersion schools had authoritative decision makers involved in the grant application process and had more time to plan for project initiation. The grant applications developed by each of the four higher Technology Immersion schools involved authoritative decisions makers, such as the superintendent, an assistant superintendent, or school board members. In contrast, only one of four lower implementing schools mentioned the direct involvement of a superintendent. Most of the higher Technology Immersion schools (three of four), submitted first-round grant applications and received awards in May 2004. Conversely, only one lower implementing school received an award in May and three schools learned about their awards in August. Thus, higher implementing schools had more time to plan for project initiation. Additional planning time allowed schools to schedule professional

development, prepare the school's infrastructure for wireless technology, and inform teachers about the grant award and its implications. Overall experience with the TIP project underscores the need for a full year of planning for project initiation. The TEA has developed a *TIP Tookit* that provides guidance for the planning process.

Three of four higher implementing schools selected the Apple Technology Immersion package, whereas one selected the Dell package. The criteria schools typically used for TIP package selection was alignment with the district's preferred technology platform. Many factors besides the immersion package influenced implementation, but it is noteworthy that the Apple package included more resources that directly supported student content-area learning (e.g., TeenBiz, Explore Learning, My Access Writing), whereas the Dell package included more resources that supported teaching (e.g., eChalk, Dell Exchange). Additionally, Apple Inc. had substantial educational experience with one-to-one laptop initiatives prior to the TIP project compared to Dell Inc., and this knowledge may have helped Apple schools get off to a better start.

District and School Leadership

Higher Technology Immersion schools had district leaders with authority and clout who were strongly committed to the Technology Immersion concept, maintained a close and ongoing relationship with the middle school, worked as a team with campus leaders, and monitored classroom practices. District leadership was stable at higher immersion schools. Project leaders, including superintendents, assistant superintendents, and district technology directors, demonstrated strong buy-in for the Technology Immersion project. Moreover, leaders initially were often involved on a daily or weekly basis, acting as facilitators or coordinators of project events, and marshalling needed resources and support for implementation. District and campus leaders acted collectively as a team throughout the project. District leaders also visited schools regularly and during those visits often observed classrooms to monitor how well technology was being used for instruction and learning. In contrast, district leaders for lower implementing schools were more likely to be district technology directors rather than higher level administrators. They provided strong initial support for the project but school interactions and direct support diminished over time. Thus, when knowledgeable principals left lower immersion schools, there was no strong district leadership to sustain project momentum.

Principals at higher implementing schools articulated a vision for Technology Immersion, strongly supported teachers' professional development, provided encouragement for changed practice, expressed expectations for classroom technology use, and monitored teachers' classroom practices. Nearly all of the middle schools experienced fluctuations in principal leadership during three project years. Only one of the higher implementing schools had the original principal in the third year, and none of the lower implementing schools had their original principal. Principal changes at higher implementing schools had a less disruptive effect on implementation because other district, vendor, or teacher leaders helped the school weather the principal transition period. As a whole, principals at higher implementing schools were strong advocates for Technology Immersion who educated teachers, students, and the community about the importance of the project and its benefits for students. Principals at these schools recognized that teachers needed intensive professional development centered on integrating technology into the curriculum. They also understood the complexity of change and promoted teachers' changed practices through verbal encouragement, required participation in professional development, attendance at training events themselves, and discussions during faculty meetings. In addition, principals at higher implementing schools established expectations for classroom technology use and monitored classroom practices through methods such as observing classrooms, monitoring lesson plans, and reviewing technology usage reports. Conversely, leadership fluctuations at lower implementing schools reduced the clarity of goals for immersion, weakened lines of communication among project staff, and diminished the quality of professional development.

Higher Technology Immersion schools typically had adequate levels of campus support for project implementation (at most, a campus staff-to-student laptop ratio of about 1:250). Technology Immersion requires a substantial amount of support to facilitate logistical arrangements, deal with daily technical problems, handle policy issues, interact with parents, and more. The configuration of campus support took many forms, with school and district size having a bearing on the number of support persons available. The services of campus project leaders were augmented by district technology staff. At higher Technology Immersion schools, staffing patterns varied from 3.5 people at a large school (more than 900 students) to zero campus support persons at a very small school (100 students). Overall, higher implementing schools had a campus staff-to-student laptop load (about 1:250) that was about half the ratio at lower implementing schools (about 1:430). Staffs at higher implementing schools were challenged to fulfill their many roles, but staffs at most lower implementing schools were overwhelmed by the enormity of their assigned tasks.

Supportive Policies

Higher Technology Immersion schools implemented policies that reduced parents' financial risks associated with laptop damage, promoted home laptop use, and held students accountable for behavior yet advanced the use of laptops for learning. Leaders at higher Technology Immersion schools enacted policies that helped to advance rather than constrain implementation. First, higher implementing schools were more likely to implement policies that reduced parents' financial risks through laptop insurance policies with reasonable fees and deductibles, along with accommodations for impoverished families who could not afford to pay. Higher immersion schools also enacted policies more often that promoted home laptop use, with students having access to laptops "24/7" (24 hours a day/7 days a week), and policies that held students accountable for having laptops at school each day. Additionally, higher immersion schools had policies that held students accountable for behavior, yet still advanced the use of laptops as a learning tool. Laptop confiscation was a last disciplinary option.

Lower immersion schools, on the other hand, had policies that placed parents at substantial financial risk or did not require parents to assume any financial risks. These schools often restricted students' use of laptops outside of school or failed to enforce home-to-school laptop transport policies. Lower immersion schools also typically used laptop confiscation as a consequence for student conduct infractions. Some schools enacted policies that punished parents for students' misbehavior as much or more than the students themselves.

Parent and Community Support

Higher Technology Immersion schools typically gained parent and community support for the project at the beginning and then continued outreach efforts—informational, educational, and financial—across years. Initially, most of the higher implementing schools held orientation sessions in various formats and settings that helped parents see how children's experiences with laptops would enrich their lives. Maintaining parent support was a continuing goal as schools provided annual orientation sessions, hosted special events, used the media to disseminate information, enhanced school and teacher websites, offered training sessions, and tried to alleviate financial constraints. Lower immersion schools garnered strong parent and community support for the project initially but support waned substantially over time due to factors such as ineffective policies, untenable financial risks, and insufficient efforts to build parents' knowledge about computers and the Internet.

Technical Support

Higher Technology Immersion schools were generally successful at maintaining stable networks, providing ongoing technical support that kept laptops in students' hands, and building a school culture that advanced responsible laptop care. Most of the higher Technology Immersion schools addressed

wireless network and bandwidth problems in the first year. Thus, most schools had healthy networks and sufficient bandwidth to support the number of computers at the school. Higher implementing schools, as noted earlier, also had at least an adequate level of campus support staff to address technical challenges. These schools also were more likely to have sufficient and timely support from district technicians. As laptop repairs began to escalate, schools received additional district assistance to address the volume of repairs. Some schools had loaner laptops or classroom desktops that students used during service periods. Two schools, in particular, promoted a "culture of care" that raised students' awareness of their responsibility for laptop care and reduced damages. Lower immersion schools, in contrast, more often had undependable networks, overloaded technicians, and varied technical problems that discouraged teacher and student laptop use.

Professional Development

Higher Technology Immersion schools had stable and close relationships with vendor professional development providers. Professional development for teachers was a high priority at these schools. Higher Technology Immersion schools typically maintained a continuous relationship with their vendor that allowed consultants to establish exceptionally positive relationships with teachers. Professional development was characterized by dedicated days built into school calendars and at least some opportunities for all teachers to share experiences. Principals were actively involved in planning professional development based on teachers' evolving needs. Accordingly, professional development progressed incrementally from the first-year focus on proficiency with immersion package products to an increased emphasis on technology-integrated lessons, subject-specific lesson development, and the use of more advanced technology applications for projects. In contrast, professional development at lower Technology Immersion schools was characterized by frequent changes in vendor trainers, brief sessions for teacher groups held during or after the school day, and an emphasis on familiarizing teachers with immersion products and Internet resources.

One large higher implementing school provided ongoing, campus-based pedagogical support for classroom technology integration. Campus specialists at one school offered both mandatory and optional sessions on a variety of topics and met with teams of teachers weekly to plan content-related lessons. Specialists provided additional supports such as in-class modeling, co-teaching, working with students, and working with teachers on classroom management. The school also had an eight-member collegial support team. A cadre of core-content teachers received stipends for providing training and support for their subject-area peers and new teachers. Pedagogical support at this school more closely approximated the kind of support envisioned for the Technology Immersion model.

Higher implementing schools held teachers accountable for participation in staff development and for the use of new practices in their classrooms. Teachers also participated in other learning opportunities that advanced classroom integration. Administrators at higher Technology Immersion schools recognized the importance of required teacher participation in technology-related professional development and the need to monitor how teachers applied information from training in their classrooms. Administrators and specialists had observed changes in teachers' classroom practices during walkthroughs and observations. Vendor-provided training was also enhanced by additional learning opportunities for teachers, such as interactions with peers at conferences, sessions with specialized consultants (e.g., Texas mathematics teacher of the year), focused subject-area training in partnership with area districts, and assistance from regional education service center specialists.

Respondents at lower immersion schools believed professional development had increased teachers' comfort with technology and their access to resources. Additional learning opportunities for teachers at lower immersion schools often advanced other district priorities rather than Technology Immersion.

Teacher Support

Teacher turnover was a continuing challenge at Technology Immersion schools. Across all schools, gaining and maintaining teacher support for Technology Immersion was demanding as teachers left schools and new teachers arrived. However, teacher instability was a smaller problem at higher immersion schools (three-year turnover rate of 31%) compared to lower immersion schools (50% turnover rate). The quantity and quality of professional development offered at higher implementing schools helped new teachers make the transition into an "immersed" school.

Teachers at higher immersion schools had positive attitudes and supportive collegial relationships, recognized the high priority administrators gave the project, had high-quality professional development, and grew stronger instructionally over time. Teachers at higher implementing schools generally had a positive attitude about their work, a sense of humor about their new immersion experiences, and a good working relationship with their colleagues. Some veteran teachers had been "rejuvenated" by the project, and teachers who enjoyed the challenge of integrating technology often energized their colleagues. In addition, consistent messages from administrators about the benefits of the project for the school and its students raised teachers' awareness of *why* immersion was important. The extent and quality of staff development provided for teachers advanced changes in attitudes as well as practices. Teachers generally appreciated their professional development opportunities and were excited about what they had learned. Moreover, teachers and administrators often described teachers' incremental growth over time toward greater competency and independence and increased integration of technology into lessons. Increased teacher confidence and improved technical skills freed campus technology specialists for other project duties. On the contrary, teachers at lower implementing schools had uneven leadership for immersion, resisted instructional change, and abandoned instructional efforts when faced with technical barriers.

Teachers at higher immersion schools believed laptops improved student learning. Teachers' support for Technology Immersion at higher implementing schools often arose from the benefits they saw for students. Many teachers believed laptops had expanded students' world view through broad-based access to information, enhanced the relevance of information learned, narrowed the equity gap between advantaged and disadvantaged students, increased student interest and engagement in learning, and improved the quality of students' products. Some teachers believed that laptops had particular benefits for special populations, such as special education and gifted and talented students.

In contrast, extremely high principal and teacher turnover rates hindered progress and diminished teacher support at lower implementing schools. Three of four lower immersion schools had extremely difficult first project years, and schools were never able to reclaim teacher support. Many teachers at these schools were reluctant to change from traditional practices that they viewed as effective, and when faced with serious technical barriers, teachers often abandoned their efforts to use technology resources. Many teachers at these schools believed laptops had negative effects on students' behavior and some linked laptops with lower TAKS scores. Three of the four lower implementing schools experienced drops in their state accountability ratings at the end of the first project year, which seemed to confirm some teachers' fears about the negative influence of laptops on TAKS preparation.

Student Experiences

Laptop Access and Use for Learning

Students at higher Technology Immersion schools typically had one-to-one student access to laptops within and outside of school. Students at three schools had full access to laptops "24/7" whereas students at another school checked laptops out each morning and returned them at the end of the day. Students lost their laptops most often for repairs, but most schools had loaner laptops or desktops in classrooms that

students could use until their laptops were returned. Students were familiar with laptop rules and penalties for infractions, and they seemed aware that technician and administrators were monitoring their actions.

At lower immersion schools, laptop allocations ran counter to TIP provisions. One school distributed laptops as classroom sets, so students did not have individual laptops. Another school used a check-out system with students retrieving laptops from homerooms each morning and returning them in the afternoon. At two schools, access to individual student laptops was limited because many students and parents declined the laptops, schools had an insufficient number of laptops due to increased enrollments, and students who had laptops refused to bring them to school each day.

Students at higher immersion schools used laptops for an array of assignments in their core-content classes, and they used laptops for more complex and challenging projects. Eighth graders described their uses of laptops in science and social studies classes. The frequency of laptop use in science varied across schools from once or twice a week (two schools) to nearly every day (two schools). Students used laptops in science classes for lab experiments, WebQuests, concept maps, charts and graphs, Internet research, videos, Brain Pop, note taking, vocabulary, textbook questions, and Study Island. Eighth graders' laptop use in U.S. History ranged from seldom (one school with a new teacher) to nearly every day (three schools). Students used laptops for WebQuests, educational games, collages with Comic Life, note taking, tests, vocabulary, textbook questions and summaries, and Study Island. Eighth graders at higher immersion schools were *proud* of their work on more complex projects that culminated in the creation of products (e.g., podcasts, presentations, reports, website, video, eight-page story).

At lower implementing schools, eighth graders typically used laptops in mundane ways in their core-subject classes, such as making PowerPoints on various topics, gathering information from the Internet, and completing basic skill or test-preparation activities. Most students used laptops infrequently in their science and social studies classes (a few times per month).

Students at some higher implementing schools used laptops extensively for learning at home. Eighth graders at two schools used laptops extensively for schoolwork at home. Students at one school said they used laptops several times a week and more often when they had an assigned project; eighth graders at another school used laptops at home almost daily. Students had used laptops for U.S. History class (textbook questions, Internet research, and projects), Spanish class (study vocabulary), English class (projects); and for science class (lab assignments, WebQuests, concept mapping, vocabulary, and study guides). Students also used their laptops to do make-up work after school absences. Eighth graders at one higher implementing school rarely used laptops for schoolwork at home because their assignments were usually finished during a special homework class. Students at another school never checked out laptops to do schoolwork at home.

Eighth graders at higher implementing schools also used their laptops at home in other ways. Students used laptops to listen to music, play games or educational games, do research or searches on the Internet, edit music, draw with Photoshop, chat, and visit social networking sites (YouTube and MySpace). Students at lower implementing schools, in contrast, rarely used laptops at home for schoolwork or any other purposes.

Teachers at higher Technology Immersion schools encouraged students' use of laptops outside of school by engaging students in projects or assignments that motivated them to continue working outside of class. Eighth graders' use of laptops for schoolwork outside of school was spurred by teachers who began work during classes that either required or inspired students to continue working on assignments at home. For example, students reported using their laptops extensively for projects or activities in their science classes, and as a result, they commonly continued to work on those assignments or projects at home. Projects that required the creation of products such as presentations, reports, or

podcasts seemed to motivate students the most. Also, access to electronic textbooks on laptops allowed many students to continue working on chapter questions or studying vocabulary terms at home.

Effects of Laptops on Students

Students at higher Technology Immersion schools believed laptops had improved their learning by making schoolwork more interesting and fun, providing immediate access to diverse informational resources, improving their technical skills, and allowing them to get better grades and prepare for the TAKS test. Eighth graders said laptops made their schoolwork more interesting and fun. Students believed they learned more through immediate access to informational resources on the Internet and through access to electronic dictionaries, encyclopedias, and textbooks. Some students also thought visual displays helped them to remember information. Eighth graders also cited improvements in their technical skills, especially their keyboarding proficiency and knowledge of various applications. Some students believed laptops had helped them to get better grades or to be better prepared for TAKS tests.

Students at higher immersion schools believed laptops helped them personally to be more organized and efficient, more responsible, and better prepared for the future. Some students were proud to attend a middle school with laptops. Eighth graders thought keeping work in folders on their laptops helped them to be more organized and less apt to lose their work, and laptops made it easier to retrieve documents for review. Students liked having electronic textbooks so they didn't have to carry heavy books. Some eighth graders thought laptops had made them more responsible because they had to take care of their computers and were held accountable for damages. Several eighth graders believed they were better prepared for future employment because of their technical skills. Students at one school felt proud because they had privileges that made their middle school different from others.

Eighth graders at two lower implementing schools believed laptops had little if any effect on their learning or on them personally because of infrequent use. Students at two other schools cited positive benefits, such as having more information from the Internet, completing work faster, getting better grades, and being prepared for the TAKS test. A few students cited positive effects relative to responsibility, increased self-esteem, and preparation for college.

Students at higher Technology Immersion schools dreaded going to high school without their laptops. Eighth graders at one school, who would have individual laptops in high school, were happy that they would not have to "start using pencil and paper." Students at the other three schools regretted that they would not have laptops in high school and felt it would be difficult to return to old ways of doing schoolwork. Eighth graders at most lower immersion schools (three of four) were glad that they would not take laptops with them to high school; however, students at one school felt it would be difficult to return to using paper and pencil.

Traits of Higher Classroom Immersion Teachers

Findings to follow describe attributes of higher Classroom Immersion teachers, including their characteristics and school context, immersion supports (leadership and professional development), nature of Classroom Immersion, challenges encountered, student effects, and observed practices.

Teacher Characteristics and School Context

Higher Classroom Immersion teachers included a mix of White, Hispanic, and African American teachers, who were often mid-career professionals (6 to 15 years experience). Higher implementing teachers included a blend of White (68%), Hispanic (21%), and African American (11%) teachers, whereas lower immersion teachers were predominantly White (83%). Demographic differences may reflect the greater importance that minority teachers placed on using technology to meet the needs of their

mostly disadvantaged and minority student populations. Higher implementing teachers also had fewer years teaching experience compared to lower implementers (12.3 years versus 16.8). More than a quarter of lower immersion teachers were late in their teaching careers (28% with 26 years or more experience) compared with just 5% of higher implementing teachers. Teachers who are earlier in their professional careers, compared to those who are near retirement, are almost certainly more familiar with technology and more likely to view efforts invested in professional growth as having long-term benefits.

The school's implementation fidelity was the contextual condition that appeared to most influence teachers' instructional practices. Higher Classroom Immersion teachers were concentrated in higher Technology Immersion schools, whereas lower implementing teachers tended to work in lower implementing schools. There were minimal differences between teacher groups in the average size of schools in which they taught (416 versus 343 students), the demographic characteristics of students (more than two-thirds minority and economically disadvantaged), and the achievement context (about half of students passing all TAKS tests).

Supports for Classroom Immersion

Leadership

Higher Classroom Immersion teachers had principals that emphasized technology's positive value for students, allocated time for planning technology-integrated lessons, and monitored classroom technology use. Higher implementing teachers more often reported that their principal supported technology integration through a focus on students, such as giving feedback to students and discussing technology issues with them in classrooms. Higher implementing teachers also reported that their principals allocated time for teachers to plan technology-integrated lessons and monitored teachers' use of technology by conducting periodic classroom visits. These teachers were more likely to believe that accountability was an important component of administrative leadership for technology. Lower Classroom Immersion teachers, in contrast, more often described principals' efforts to model technology use by using email, making electronic presentations at faculty meetings, or posting information on school websites.

Professional Development

Higher Classroom Immersion teachers either participated in more professional development events or they assimilated more information from training. They also took part in a greater variety of locally sponsored professional development opportunities. Higher implementing teachers provided explicit details about the content covered in training sessions. Teachers said third-year training at some schools was a refresher on basics and package resources, while teachers at other schools said training had evolved in the third year to focus on more complex technology-based projects or more advanced topics (e.g., iWeb, iDVD, video camera, video editing). Higher implementing teachers also had participated in a number of additional sessions provided locally on topics such as Inspiration software, Internet safety, website design, podcasting, and Google Earth, or they had attended sessions at technology conferences. Lower immersion teachers, in contrast, strained to recall specific details about any training that had been provided during the past school year, and they seldom participated in locally sponsored professional development events.

Only a third of higher and lower Classroom Immersion teachers had received in-class support from vendor trainers during the third year, although assistance was available upon request. In-class support from campus specialists mainly involved help to resolve technical problems. However, a few schools provided dedicated pedagogical support that appeared to advance classroom technology use for both higher and lower immersion teachers.

Higher immersion teachers said participation in professional development had positively affected their technical proficiency, ability to use technology, self-confidence, creativity, and lesson development. Higher implementing teachers said their training had been useful because it had prepared them to use TIP resources, raised their awareness of other resources, and helped them to develop lessons. Higher implementing teachers also believed their professional development experiences had increased their technical proficiency as well as their ability to troubleshoot problems and monitor students' laptop use electronically. Some teachers also expressed greater confidence in their ability to think creatively about lessons and to design new kinds of lessons (e.g., interdisciplinary units). These teachers appreciated their hands-on experiences, step-by-step directions, ongoing support by email, and opportunities for participation in self-selected classes and conferences.

Generally speaking, lower immersion teachers thought professional development was less worthwhile than higher implementers. Still, they valued in-class support from vendor and campus specialists, access to ongoing support via email, opportunities to learn about new technologies such as interactive whiteboards, and chances to interact with other teachers at conferences. Although lower implementing teachers found training helpful, they usually did not cite ways that it affected them personally.

Nature of Classroom Immersion

Investments in professional development and technology resources are expected to yield classroom change. Accordingly, we assessed five elements of Classroom Immersion: Professional Productivity, Communication, Classroom Activities, Technology Integration, and Learner-Centered Instruction.

Higher Classroom Immersion teachers used technology tools for a wider and more sophisticated range of productivity and communication activities. All teachers used technology for administrative purposes, such as recording attendance, managing grades, and generating lesson plans, and for communication with colleagues by email. Higher implementing teachers, however, were more likely to use email as a tool for communicating with students and parents. Many teachers relied on email as a means to remind students of missed assignments, missed work, upcoming activities, and to distribute and collect class assignments. Teachers also used email to communicate with parents about students' performance and behavior. Higher immersion teachers also were more likely to have a class web page used to communicate with students about assignments, homework, and resources for their assigned tasks.

Higher immersion teachers had their students use laptops more often and in more innovative ways. All teachers said their students used laptops for activities, including research, vocabulary, review activities, essays, journals, presentations, WebQuests, note taking, preparation for exams, creating graphs, and playing games. Even so, higher immersion teachers reported that their students used laptops *four to five days a week*, whereas students in lower implementing teachers' classes used laptops about *once or twice a week*. Higher implementing teachers also described how they used laptops to expand routine aspects of lessons to incorporate online resources and to facilitate student innovation and creativity. These teachers used immersion package resources as an integrated part of their instruction. One science teacher, for example, described a lesson on biomes that required students to gather information from websites to complete a spreadsheet, select a specific biome, and create a podcast (a brochure advertising aspects of the biome). Lower implementing teachers more often used resources for practice, review, TAKS preparation, games, or free-time activities.

Few teachers assigned homework of any kind, although most said work that was not finished during the class period was often completed at home. Middle school teachers rarely assigned homework, with or without laptops. Teachers explained that it was difficult to get many students to complete homework assignments, and so to avoid failing grades, they preferred that students complete work during class time.

Teachers said it would be difficult to assign homework that required Internet use because many students did not have access to the Internet at home.

Higher Classroom Immersion teachers believed laptops facilitated instructional variations, allowed a more student-centered approach, and broadened the curriculum. They also believed an emphasis on the TEKS prepared students for the TAKS, and self-direction and project-based learning promoted student achievement. Higher implementing teachers believed that technology made it easier to plan differentiated lessons and engaging project-based activities. They also said that technology enabled them to change their teaching practices to include more student-centered instruction. Teachers explained that laptops allowed students to have greater self-direction in learning, noting that students were able to choose topics of study as well as the format of their projects. Teachers that adapted their classroom practices to include technology noted that laptops enabled them to broaden their instruction to include new resources and content beyond what was included in textbooks. Higher implementing teachers more often emphasized the link between technology-based lessons, curriculum content, the Texas Essential Knowledge and Skills (TEKS), and the Texas Assessment of Knowledge and Skills (TAKS), noting that these were combined components of instruction. Additionally, higher implementing teachers were more likely to report that self-directed and project-based activities, which enabled students to be creative, had a greater influence on students' achievement. Organizing students for collaborative activities also allowed students to learn a great deal from one another.

Lower Classroom Immersion teachers, in contrast, believed laptops made teaching easier because lessons naturally engaged students, and new peripherals (e.g., LCD projectors, whiteboards, document cameras) were better than overhead projectors. Change from established instructional routines, however, was difficult and teachers' weak technical skills undermined laptop use. Lower implementers also believed laptops were useful for TAKS preparation and free-time activities, but they thought more traditional teaching activities, such as bell-ringers, workbooks, modeling problems on the board, worksheet activities, and answering text questions, promoted student achievement.

Classroom Immersion Challenges

Higher Classroom Immersion teachers' belief in the value of laptops and resources for students, commitment to classroom technology use, and greater technical skills appeared to help them deal with obstacles encountered in integrating technology. Overall, higher and lower implementing teachers faced similar challenges in creating technology-immersed classrooms: students without laptops, unreliable networks, difficulty monitoring students' laptop use, students' limited technical skills, and time constraints. However, higher implementing teachers demonstrated greater resilience than lower implementers when they encountered obstacles. Teachers' fortitude likely stemmed from their belief that the advantages of using laptops and resources outweighed the inconveniences or they may have received stronger technical support for their efforts. Higher implementers' technical competency also may have helped them resolve problems that deterred technology integration.

Effects of Laptops on Students

Higher Classroom Immersion teachers believed laptops had positive effects on students' academic achievement as well as positive impacts on special student populations, including lower and higher achievers, English language learners, and special education students. Higher Classroom Immersion teachers, who arguably had more opportunities to actually observe the effects of technology on their students because laptops were used more often in their classes and in more content-integrated ways, reported positive academic effects more often than lower implementers. Several higher implementing teachers noted effects on student academic skills, including improved vocabulary, spelling, and writing ability. Higher implementing teachers also were more likely to identify positive effects of laptops on particular student groups. Some teachers thought laptops helped special education students improve their

academic skills through individualized lessons, the use of software programs that strengthened skills such as reading, access to resources that helped with organization, the creation of better quality products that demonstrated mastery, active class participation rather than passive observation, and the development of self-confidence through mastery of computer skills. Similarly, lower achievers were more engaged in learning and gained self-confidence through mastery of technology skills. Other teachers said laptops allowed English language learners to improve their language acquisition and confidence in writing English. Several teachers believed higher achieving students did even better with technology than without it because they acquired the requisite technology skills quickly and created products of better quality.

Both higher and lower implementing teachers reported positive effects of laptops on students' engagement in learning, technology proficiency, ability to arrive at more informed opinions, and classroom behavior. On the other hand, teachers also linked laptops to behavioral distractions such as difficulty remaining on task, accessing inappropriate websites, communicating with friends, and playing games.

Observed Classroom Practices

Observations in a sample of higher and lower Classroom Immersion teachers' classrooms captured information on the classroom environment, the activities of teachers and students, student engagement, and the intellectual rigor of instruction.

Classroom Environment

Higher Classroom Immersion teachers arranged their rooms in a variety of instructional configurations, whereas lower immersion teachers almost always had traditional rows of desks. The ways that teachers chose to organize their classrooms provided insight into their pedagogical preferences. Higher implementing teachers arranged their classrooms in a variety of ways, including traditional rows, students at tables, clusters of desks with students facing each other, and desks in circles or semi-circles. In contrast, nearly all of lower implementing teachers arranged their classroom in traditional rows with students typically facing the teacher's projection stand at the front of the room. In other respects, teachers' classrooms had very similar types of technology and comparable student-to-teacher ratios.

Observed Activities

Higher and lower Classroom Immersion teachers performed similar roles in their classrooms. Teachers mainly directed students as a whole group and monitored students as they worked independently. Higher implementing teachers, however, spent significantly more time facilitating or coaching as students worked on projects.

Higher immersion teachers used technology more often for instructional purposes. About three-quarters of higher implementing teachers (78%) compared to half of lower implementers (56%) used technology as part of their instruction, and they used technology for more extensive periods of time (52% of time versus 31%). Higher implementing teachers typically used PowerPoint or Keynote programs to present information to their classes, or they used the Internet as a resource for lessons.

Students in higher implementing teachers' classrooms spent significantly more time listening to a teacher presentation or discussion, writing responses to lessons, constructing knowledge, and engaging in disciplined inquiry. There were noteworthy differences in students' classroom roles. Students in higher implementing teachers' classrooms spent significantly more time working as a whole class. Students spent much of class time listening to a teacher presentation or rote discussion (43% of time); learning facts, definitions, or algorithms (36%); writing responses related to the lesson (20%); constructing knowledge (18% of time spent synthesizing, hypothesizing, generalizing, explaining, etc.); engaging in individual reading (16%); and engaging in disciplined inquiry (9%). In comparison, students in lower

implementing teachers' classroom spent significantly more time working individually. Students spent the bulk of observed time listening to a teacher presentation or discussion (33% of time); learning facts, definitions, and algorithms (54%); and taking tests or doing test-like activities (27%).

Students in higher implementing teachers' classrooms spent significantly more time using laptops to create or make presentations and to conduct Internet research on an assigned topic. Surprisingly, students used technology in less than half of higher implementing teachers' classrooms (44%) compared to three-quarters of lower implementing teachers' classrooms (75%). Teachers also had their students used technology in very different ways. Students in higher immersion classrooms spent significantly more time using laptops to create or make presentations (26%) and conduct Internet research (24%), whereas students in lower immersion classrooms spent significantly more time completing assessments (22%) and substantially more time learning and practicing skills (15% of time using drill and practice, learning systems, or educational games).

Student Engagement and Intellectual Challenge

Students in the classrooms of higher implementing teachers were more strongly engaged in their academic tasks. Ratings of student engagement showed that students in higher immersion classrooms were more engaged in their assigned tasks than students in lower immersion classes. Students in higher immersion classrooms were *moderately* to *highly* engaged more than half of observed time (54% of ratings), which indicated that "most students exhibited a sustained commitment to and involvement in their academic tasks" and students were "interested in their assignments." Students in lower immersion classes were engaged at a *moderate-to-high* level just a third of observed time and they more often exhibited *low* or *low-to-moderate* engagement.

The lessons of higher Classroom Immersion teachers were significantly more intellectually challenging than the instruction of lower immersion teachers. The lessons of higher implementing teachers received a significantly higher mean Intellectual Challenge score (2.40) on the 5-point intellectual challenge scale than lower implementing teachers' instruction (1.67). The difference between groups represented a large effect size (ES = 1.01). Higher implementing teachers' lessons placed a significantly greater emphasis on Higher Order Thinking (ES = 0.63), Depth of Knowledge (ES = 1.02), Substantive Conversation (ES = 0.70), and Connections Beyond the Classroom (ES = 1.12).

Implications for Technology Immersion

The analyses presented in this report provide new insights and advance our understanding of how schools reached higher levels of Technology Immersion, and how teachers created technology-immersed classrooms. Importantly, we find that it is not just the characteristics of schools or teachers that made the greatest difference, but consistent with the immersion model, it was the supportive conditions that advanced project goals. District and school leaders at higher Technology Immersion schools set the direction for school change and provided continuous supports that fostered higher levels of implementation. Foremost, leaders championed the benefits of Technology Immersion for students as the justification for arduous efforts aimed at school and classroom change. Notable also was the importance of continual outreach to parents who had to shoulder responsibility for individual laptops along with their children.

Findings also point to the significance of teacher support for Technology Immersion, as teachers act as gatekeepers to students' experiences with laptops. Teachers, including veterans, who worked in schools with sufficient technical support, extensive opportunities for professional development, encouragement and accountability for changed practices, collegial working environments, and consistent messages from leaders about the importance of immersion for students grew incrementally toward higher levels of

Classroom Immersion over time. Moreover, the quality of school and classroom implementation was vitally important for students. Higher levels of implementation allowed students to use laptops more often for learning both within and outside of school, to use laptops for more varied and complex assignments and projects, and to use laptops for more intellectually rigorous schoolwork. Evidence from multiple sources suggests that these kinds of experiences improved the quality of students learning opportunities as well as their academic achievement, particularly for special populations such as English language learners, higher and lower achievers, and special education students. Many students also benefited personally through greater personal organization and responsibility and preparation for college and future employment.

References

Bradburn, F.B, & Osborne, J.W. (2007, March). Shared leadership makes an IMPACT in North Carolina. *eSchool News,* 60.

Bransford, J.D., Brown, A.L., & Cocking, R.R. (2003). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academy Press.

CEO Forum on Education and Technology (2000). *The power of digital learning: Integrating digital content*. Washington, DC.

CEO Forum on Education and Technology (2001). *Key building blocks for student achievement in the 21st century: Assessment, alignment, accountability, access, analysis*. Washington, DC.

Denton, J., Davis, T. & Strader, A. (2001). *Report of the 2000 Texas public school technology survey*. College Station: Texas A&M University.

Education Week (2007, March 29). Technology counts 2007: A digital decade. *Education Week, 26(30).* A Special State-Focused Supplement. Retrieved May 4, 2007, from www.edweek.org/rc.

Fullan, M., & Hargreaves, A. (1996). *What's worth fighting for in your school* (2nd ed.). New York: Teachers College Press.

Garet, M.S., Porter, A.C., Desimone, L., Birman, B.F., & Yoon, K.S. (2001). What makes professional development effective? *American Educational Research Journal, 38*(4), 915-945.

Johnston, M., & Cooley, N. (2001). *Supporting new models of teaching and learning through technology*. Arlington, VA: Educational Research Service.

Lawless, K.A., & Pellegrino, J.W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research, 77(4),* 575-614.

Lempke, C., Coughlin, E., Thadini, V., & Martin, C. (2003). *enGauge 21st century skills—Literacy in the digital age*. Los Angeles, CA: Author.

Mann, D., Shakeshaft, C., Becker, J., & Kottkamp (1999). *West Virginia Story: Achievement gains from a statewide comprehensive instructional technology program.*

National Center for Education Statistics (2000). Internet access in U.S. public schools and classrooms: 1994-99. *Stats in Brief*. U.S. Department of Education. Washington, DC.

Neugent, L., & Fox, C. (2007, January). Peer coaches' spark technology integration. *eSchool News,* 32.

Newmann, F., & Associates (1996). *Authentic achievement: Restructuring schools for intellectual quality*. San Francisco: Jossey-Bass Publishers.

Newmann, F., Bryk, A., & Nagoaka, J. (2001). *Authentic and intellectual work and standardized tests: Conflict or coexistence?* Chicago: Consortium on Chicago School Research.

Partnership for 21st Century Skills (2006, March). *Results that matter: 21st century skills and high school reform.* Retrieved January 8, 2007 from http://www.21stcenturyskills.org/index.php?option=com_content&task=view&id=204&Itemid=114

Penuel, W.R., Fishman, B.J., Yamaguchi, R., & Gallagher, L.P. (2007). What makes professional development effective? Strategies that foster curriculum implementation. *American Educational Research Journal, 44(4),* 921-958.

Pitler, H. (2005). *McREL technology initiative: The development of a technology intervention program: Final report.* (Report No. 2005-09). Denver, CO: Mid-continent Research for Education and Learning. (ERIC Document Reproduction Service No. ED486685).

Ringstaff, C. & Kelley, L. (2002). *The learning return on our educational technology investment.* WestEd. Retrieved from www.wested.org/cs/wes/view/rs/619.

Ronnkvist, A., Dexter, S., & Anderson, R. (2000). *Technology support: Its depth, breadth and impact in America's schools.* Retrieved from http://www.crito.uci.edu/tlc/findings.html.

Shapley, K., Vicknair, K., Sheehan, D., Pieper, A., Jepson, D., & Sturges, K. (2004, October). *Texas Study of Students at Risk: Case Studies of Initiatives Supporting Ninth Graders' Success.* Austin, TX: Texas Center for Educational Research.

Shapley, K.S, Benner, A.D., Heikes, E.J., & Pieper, A.M. (2002). *Technology Integration in Education (TIE) initiative: Statewide survey report, Executive Summary.* Austin, TX: Texas Center for Educational Research.

Shapley, K., Sheehan, D., Sturges, K., Caranikas-Walker, F., Huntsberger, B., & Maloney, C. (2006, December). *Evaluation of the Texas Technology Immersion Pilot: An analysis of the baseline conditions and first-year implementation of technology immersion in middle schools.* Austin, TX: Texas Center for Educational Research.

Smerdon, B., Cronen, S., Lanahan, L., Anderson, J., Iannotti, N., Angeles, J. (2000). *Teachers' tools for the 21st Century: A report on teachers' use of technology* (NCES 2000-102). U.S. Department of Education. Washington, DC: National Center for Education Statistics.

Texas Education Agency (2006*). Long-range plan for technology, 2006-2020: A report to the 80th Texas Legislature from the Texas Education Agency*. Austin, TX: Texas Education Agency.

Vernez, G., Karam, R., Mariano, L.T., & DeMartini, C. (2006). *Evaluating Comprehensive School Reform Models at Scale: Focus on Implementation.* Santa Monica, CA: RAND.

Web-Based Education Commission (2000). *The power of the Internet for learning: Moving from promise to practice*. Washington, DC.

Zhao, Y. & Frank, K.A. (2003). Factors affecting technology uses in schools: An ecological perspective. *American Educational Research Journal, 40*(4), 807-840.

Appendix A

Measurement of Implementation Fidelity

Defining Technology Immersion

The Texas Education Agency selected three lead vendors as providers of technology immersion packages (Dell Computer, Inc., Apple Computer Inc., and Region 1 Education Service Center [ESC]). Sections to follow provide descriptions of the components of technology immersion packages.

Wireless Laptops and Productivity Software

All vendors offered a wireless laptop as the mobile computing device. Campuses could select either Apple laptops (iBook and MAC OSX) or Dell laptops (Inspiron or Latitude with Windows OS). For Apple laptops, *AppleWorks* provides a suite of productivity tools, including Keynote presentation software, Internet Explorer, Apple Mail, iCal calendars, iChat instant messaging, and iLife Digital Media Suite (iMovie, iPhoto, iTunes, GarageBand, and iDVD). For Dell laptops, *Microsoft Office* includes Word, Excel, Outlook, PowerPoint, and Access. In addition, *eChalk* serves as a "portal" to other web-based applications and resources included in the immersion package and a student-safe email solution. Region 1 ESC provided Dell products.

Online Instructional and Assessment Resources

Immersion packages included a variety of digital resources. Apple included the following online resources: *netTrekker* (an academic Internet search engine), *Beyond Books* from Apex Learning (reading, science, and social studies online), *ClassTools Math* from Apex Learning (complete math instruction), *ExploreLearning Math and Science* (supplemental math/science curriculum), *TeenBiz3000* from Achieve 3000 (differentiated reading instruction), and *My Access Writing* from Vantage Learning (support for writing proficiency). Dell, Inc. selected *netTrekker* (an academic Internet search engine) and *Connected Tech* from Classroom Connect (technology-based lessons and projects). Region 1 ESC selected *Connected Tech* but also added a variety of teaching and learning resources including *Unitedstreaming* (digital videos), *Encyclopedia Britannica*, *EBSCO* (databases), *NewsBank*, and *K12 Teaching and Learning Center*. For the Apple package, *AssessmentMaster* (Renaissance Learning) provides a formative assessment in all four core subject areas. Both the Dell and Region 1 ESC packages provide *i-Know* (CTB McGraw Hill) for core-subject assessment. In addition, all campuses have access to the online Texas Mathematics Diagnostic System (TMDS) and Texas Science Diagnostic System (TMDS) that are provided free of charge by the state.

Professional Development

Each immersion package includes a different professional development provider. Apple uses its own professional development model, whereas the Dell package relies on *Pearson Achievement Solutions*, a commercial provider (formerly *Co-nect*), to support professional development. Region 1 ESC uses a combination of service center support plus other services offered through *Connected Coaching and Connected University*. Although the professional development models and providers differ, they all were expected to include some common required elements, such as support for immersion package components, the design of technology-enhanced learning environments and experiences, lesson development in the core-subject areas, sustained learning opportunities, and ongoing coaching and support. Individual districts and campuses collaborated with vendors to develop specific professional development plans for their teachers and other staff.

Technical and Pedagogical Support

Each technology immersion package provider also is required to provide campus-based technical support to advance the effective use of technology for teaching and learning. Apple designed a Master Service and Support Program. Dell established a Call Center dedicated to technical support for TIP grantees as well as an 800 telephone number for hardware and software support. Region 1 ESC had an online and telephone HelpDesk to answer questions and provide assistance.

In sum, the RFQ process created technology immersion packages with common elements. Still, the complexity and variability of the treatment makes it critically important for researchers to document not only how and how well technology immersion is implemented but also to identify factors that contribute to implementation variations.

Measuring Implementation

In the third year, we employed a two-part approach to the measurement of implementation fidelity. First, we used indicators to describe each campus' progress on a 4-step scale toward immersion standards. Rating scales for components and related elements identified four levels of immersion: *minimal* (0 to 1.99), *partial* (2.00 to 2.99), *substantial* (3.00 to 3.49), and *full* (3.50 to 4.00). Second, we used quantitative implementation indices that gauged the level of technology immersion using standardized scores (*z* scores). Both the immersion standard scores and implementation indices were derived from values for seven components: (a) Leadership, (b) Teacher Support, (c) Parent and Community Support, (d) Technical Support, (e) Professional Development, (f) Classroom Immersion, and (g) Student Access and Use. The following sections describe the seven components of technology immersion and related measurement procedures. Table D.1 shows the scoring rubrics for immersion indicators, and Table D.2 describes the data sources used to generate scores.

Supports for Implementation

Leadership. Our measure of administrative leadership comes from teacher survey items (12) that yield a Leadership scale score. Items assess the extent to which administrators involved staff in decisions, set clear expectations for technology use, encourage and participate in professional development, have a well-developed technology plan, promote teacher innovation, and provide necessary resources and administrative support. Teachers rated the extent of their agreement on a 5-point scale ranging from 0 (*strongly disagree*) to 4 (*strongly agree*). To achieve substantial to full immersion, teachers had to *agree* or *strongly agree* that administrators provided technology leadership. A Leadership Index was generated by transforming the scale score to a *z* score.

Teacher Support. Although implementation may be affected by the characteristics of individual teachers, it also may reflect the collective disposition of teachers toward the adoption of new and innovative practices. Our measure of teacher commitment to technology immersion comes from teacher survey items (4) measuring a Teacher Support scale (i.e., Innovative Culture). Items gauged the extent to which teachers in the school share an understanding about technology use for student learning, are continually learning and seeking new ideas, are not afraid to learn about and use new technologies, and are generally supportive of technology integration efforts. Teachers rated the extent of their agreement on a 5-point scale ranging from 0 (*strongly disagree*) to 4 (*strongly agree*), with substantial to full immersion tied to the strength of teacher *agreement.* A Teacher Support Index was generated by transforming the scale score to a *z* score.

Parent and Community Support. Support from parents and community members is also a key part of implementation because they must understand the goals of technology immersion, assume responsibility along with their children, and assist in enacting effective policies. Our measure of Parent and Community

Support is a scale score composed of teacher survey items (2). These items indicate the extent to which parents support the school's emphasis on technology and the community actively supports instructional efforts with technology. Teachers rated the extent of their agreement on a 5-point scale ranging from 0 (*strongly disagree*) to 4 (*strongly agree*). Substantial to full immersion reflected the strength of teacher agreement. A Parent/Community Support Index was generated by transforming the scale score to a *z* score.

Technical Support. On a fully immersed campus, sufficient technical support and a healthy infrastructure are expected to alleviate technical problems that might interfere with the use of technology in the classroom, school, and beyond. Our measure for technical support comes from teacher survey items (5) contributing to a Technical Support scale score. Teachers indicated the extent of their agreement on a 5-point scale ranging from 0 (*strongly disagree*) to 4 (*strongly agree*) that computers are kept in good working order, requests for assistance are addressed in a timely way, Internet connections work adequately, and classroom materials are readily available. A Technical Support Index was generated by transforming the scale score to a *z* score.

Professional Development. In constructing measures of professional development, we drew from research conducted on the effectiveness of the Eisenhower Professional Development Program (e.g., Garet, Porter, Desimone, Birman, & Yoon, 2001). Key features of quality professional development provided a framework for examining dimensions of schools' and vendors' professional development models. Data for measures come from core-subject teachers' responses to survey items.

First, we measured the total number of Contact Hours that core-subject teachers spent in technology-related professional development during the past school year. In addition, professional development models for technology immersion were required to include a classroom support component, so we measured Classroom Support as the extent to which core teachers indicated that they received modeling, coaching or mentoring from an internal source (such as another teacher or technology coordinator), or an external source (such a professional curriculum developer). Teachers rated the frequency of support on a 4-point scale linked to standards: 0 (*never)*, 1.33 (*rarely—a few times a year)*, 2.67 (*sometimes—once or twice a month*), and 4 (*often—once or twice a week* or *almost daily)*.

To examine the Content Focus of teachers' activities, we asked each teacher who participated in technology-related professional development to indicate the degree of emphasis the activity placed on curriculum, instructional methods, and lesson development in their core-subject area. Teachers' responses were coded on a 5-point scale with 0 = *no emphasis*, 2 = *minor emphasis*, and 4 =*major emphasis*. As a measure of professional development Coherence, each core teacher who attended technology-related events indicated the extent to which the activity was consistent with the their goals for professional development, was based explicitly on what the teacher had learned in earlier professional development experiences, was followed up with activities that built on what the teacher learned in the professional development activity, was aligned with state or district standards and curriculum frameworks and with state and district assessments. To measure this indicator, teachers used a 5-point scale ranging from 0 (*not at all*) to 4 (*to a great extent*). A Professional Development Index was generated by averaging *z* scores for each of the four professional development elements.

Extent of Implementation

Classroom Immersion. The technology immersion packages included a variety of instructional and assessment resources designed to extend, supplement, or enhance core-subject teaching and learning. Wireless laptops, for example, were loaded with productivity software (i.e., either *Appleworks* or *Microsoft Office*) for students to use as a learning tool. Teachers and students also received a variety of digital resources and formative assessments to support content-area instruction and learning activities.

Indicators for Classroom Immersion, accordingly, assessed the extent to which core-subject teachers at immersion campuses utilized resources and embraced practices consistent with the technology immersion model. Classroom Immersion is measured by five elements: Technology Integration, Learner-Centered Instruction, Student Classroom Activities, Communication, and Professional Productivity. Measures of Technology Integration (10 items) and Learner-Centered Instruction (4 items) are scale scores adapted from the Levels of Technology Implementation (LoTi) Questionnaire. Core teachers indicated the extent to which statements related to Technology Integration (e.g., I alter my instructional practices to support higher order thinking through technology) and Learner-Centered Instruction (e.g., I have students use information and inquiry skills) are true on a 5-point scale, including 0 (*not true of me now),* 1 to 3 (*somewhat true of me now*), and 4 (*very true of me now*).

Because teachers influence students' classroom opportunities to use technology for learning academic content, we also used items from teacher surveys as a way to assess the extent to which teachers had students use various technology applications in core-subject classrooms (Student Classroom Activities). For example, survey items gauged how often students' used a word processor to write a story or used software to learn and practice skills. Teachers' responses were converted to a 5-point scale tied to immersion standards. Responses indicated how often students' in a typical class used technology in particular ways: 0 (*never),* 1.33 (*rarely—a few times a year),* 2.67 (*sometimes—once or twice a month*), 4.00 (*often—once or twice a week—* or *almost daily)*.

Teachers at immersion schools also are expected to use technology as a communication tool. Communication that advances student learning involves sending email to students, parents, or colleagues, or posting information and assignments on a class or school website. Technology also provides a way to improve teachers' Professional Productivity, including the use of technology for purposes such as keeping records, analyzing data, developing lessons, or delivering information. Scale scores for Communication (4 items) and Professional Productivity (11 items) are comprised of teacher responses on a 5-point scale indicating the frequency of activities: 0 (*never*) to 4.00 (*almost daily*). The Classroom Immersion Index was generated by averaging z scores for each of the five elements described above.

Student Access and Use. This indicator gauged the extent of student access to laptop computers as well as the frequency of students' laptop use for learning in core-content classrooms and at home. Three elements—Laptop Access Days, Core-Content Learning, and Home Learning—contribute to the component score. First, in an immersion school, students are expected to have access to wireless laptops for the entire school year. Our measure of Laptop Access was calculated as the number of days out of the 180-day school year that students actually had laptops available for use. Information for the indicator comes from an analysis of student survey items in which students indicated whether the school provided a laptop for student use, and if provided, how many days the laptop had been taken away (e.g., for misuse, misbehavior, failure to complete assignments, bad grades, or repairs). Student access scores, which could range from 0 days (no laptop) to 180 days (laptop available the full school year), were converted to the 0-4.00 continuous scale to measure progress toward the immersion standard. A Laptop Access Index was generated by transforming the continuous score to a *z* score.

The potential for laptops to affect achievement depends largely on students' opportunities to use technology for learning core academic content. Consequently, we used items from student surveys (4) to assess the frequency with which students used technology resources in their English/language arts, mathematics, science, and social studies classrooms (Core-Content Learning). Students' responses were converted to a 4-point frequency scale tied to standards: 0 (*never or rarely—a few times a year),* 1.33 (*sometimes—once or twice a month*), 2.67 (*often—once or twice a week),* and 4 (*almost daily)*. A Core-Content Learning Index was generated by transforming the scale score to a z score.

Additionally, on a fully immersed campus, students should have access to their wireless laptops for learning both within and outside of school. Information for the measure of Home Learning comes from student survey items in which students indicated whether the school provided a laptop for student use, how often the student could take a laptop home, and if a laptop could be taken home, how often it was used for homework in core subjects or for learning games. A student's use of the laptop for home learning was rated on a 6-point scale: 0 (*no access to laptop outside of school*), 1 (*restricted or full access to laptop outside of school)*, plus up to 5 additional points if a student used their *laptop for homework in ELA, math, science*, or *social studies*, or for *learning games*. Students' scores were converted to the 0-4.00 scale as a measure of progress toward immersion standards, and a *z* score was generated. We generated the Student Access and Use Index by averaging z scores for each of the three elements described above.

Table A.1. Scoring Rubrics for Measuring the Implementation Fidelity of Technology Immersion—Year 3

Component/Element	Minimal Immersion 0-1.99	Partial Immersion 2.00-2.99	Substantial Immersion 3.00-3.49	Full Immersion 3.50-4.00	Implementation Index
Leadership					
Campus Scores 2.31 to 3.49 M=2.96 SD=0.33	Teachers *disagree or strongly disagree* that administrators establish clear vision and expectations, encourage integration, provide supports, and involve staff in decisions.	Teachers are *unsure* that administrators establish clear vision and expectations, encourage integration, provide supports, and involve staff in decisions.	Teachers *agree* that administrators establish clear vision and expectations, encourage integration, provide supports, and involve staff in decisions.	Teachers *agree or strongly agree* that administrators establish clear vision and expectations, encourage integration, provide supports, and involve staff in decisions.	Campus *z* Scores -1.93 to 1.59
Teacher Support (Innovative Culture)					
Campus Scores 2.76 to 3.70 M=3.14 SD=0.27	Teachers *disagree or strongly disagree* that they share an understanding of technology, continually learn, are unafraid, and support integration.	Teachers are *unsure* that they share an understanding of technology, continually learn, are unafraid, and support integration.	Teachers *agree* that they share an understanding of technology, continually learn, are unafraid, and support integration.	Teachers *agree or strongly agree* that they share an understanding of technology, continually learn, are unafraid, and support integration.	Campus *z* Scores -1.41 to 2.09
Parent and Community Support					
Campus Scores 2.13 to 3.42 M=2.81 SD=0.41	Teachers *disagree or strongly disagree* that parents and the surrounding community support the school's efforts with technology.	Teachers are *unsure* that parents and the surrounding community support the school's efforts with technology.	Teachers *agree* that parents and the surrounding community support the school's efforts with technology.	Teachers *agree or strongly agree* that parents and the surrounding community support the school's efforts with technology.	Campus *z* Scores -1.68 to 1.48
Technical Support					
Campus Scores 2.31 to 3.37 M=2.82 SD=0.31	Teachers *disagree or strongly disagree* that computers are in good condition, Internet connections are adequate, responses to requests are timely, and materials are available.	Teachers are *unsure* that computers are in good condition, Internet connections are adequate, responses to requests are timely, and materials are available.	Teachers *agree* that computers are in good condition, Internet connections are adequate, responses to requests are timely, and materials are available.	Teachers *agree or strongly* that computers are in good condition, Internet connections are adequate, responses to requests are timely, and materials are available.	Campus *z* Scores -1.66 to 1.78

Table A.1. Scoring Rubrics for Measuring the Implementation Fidelity of Technology Immersion—Year 3 (*Continued)*

Component/Element	Minimal Immersion 0-1.99	Partial Immersion 2.00-2.99	Substantial Immersion 3.00-3.49	Full Immersion 3.50-4.00	Implementation Index
Professional Development					Campus *z* Scores
Contact Hours Campus Hours 1.13 (14 hrs) to 4.0 (70 hrs) M=2.52 (33 hrs) SD=1.06	Core-subject teachers, on average, participated in 25 or less hours of PD during the past school year.	Core-subject teachers, on average, participated in 26 to 37 hours of PD during the past school year.	Core-subject teachers, on average, participated in 38 to 49 hours of PD during the past school year.	Core-subject teachers, on average, participated in 50 or more hours of PD during the past school year.	-1.80 to 1.79
Classroom Support Campus Scores 1.37 to 2.93 M=2.14 SD=0.36	Core teachers indicate that they *rarely* or *never* receive classroom coaching or mentoring from an internal or external source.	Core teachers indicate that they *rarely* (a few times a year) receive classroom coaching or mentoring from an internal or external source.	Core teachers indicate that they *sometimes* (once or twice a month) receive classroom coaching or mentoring from an internal or external source.	Core teachers indicate that they *often* (once or twice a week) *or almost daily* receive classroom coaching or mentoring from an internal or external source.	
Content Focus Campus Scores 2.00 to 3.73 M=2.89 SD=0.42	Core teachers indicate there is *no or almost no PD emphasis* on curriculum, instructional methods, and lesson development in core areas.	Core teachers indicate there is *a minor PD emphasis* on curriculum, instructional methods, and lesson development in core areas.	Core teachers indicate there is a *minor* to *major PD emphasis* on curriculum, instructional methods, and lesson development in core areas.	Core teachers indicate there is a *major PD emphasis* on curriculum, instructional methods, and lesson development in core areas.	
Coherence Campus Scores 1.83 to 3.07 M=2.49 SD=0.33	Core teachers indicate that PD is *not at all* consistent with personal and school goals, prior learning, and state standards and assessment.	Core teachers indicate that PD is consistent with personal and school goals, builds on prior learning, and supports state standards and assessment to a *minimal extent.*	Core teachers indicate that PD is consistent with personal and school goals, builds on prior learning, and supports state standards and assessment to a *moderate extent*.	Core teachers indicate that PD is consistent with personal and school goals, builds on prior learning, and supports state standards and assessment to a *great extent*.	
Student Access and Use					Campus *z* Scores
Laptop Access Days Campus Scores 1.80 (81 days) to 3.54 (160 days) M=2.50 (115 days) SD=0.51	Students' laptop access days vary to an *extremely large extent* at a campus, with laptops available from about 80 to 168 days per student.	Students' laptop access days vary to a *large extent* at a campus, with laptops available from about 95 to 175 days per student.	Students' laptop access days vary do a *moderate* extent at a campus, with laptops available from about 140 to 175 days per student.	Students' laptop access days vary to a *small extent* at a campus, with laptops available from about 160 to 180 days per student.	-1.71 to 1.38
Core-Content Learning Campus Scores 1.42 to 2.98 M=2.12 SD=0.48	Students *rarely* (a few times a year) *or never* use technology resources in core-subject classes	Students *sometimes* (once or twice a month) or *often* (once or twice a week) use technology resources in core-subject classes	Students *often* (once or twice a week) or *almost daily* use technology resources in core subjects.	Students use technology resources in core subjects *almost daily.*	
Home Learning Campus Scores 0.40 to 2.58 M=1.84 SD=0.49	Students, on average, use their laptops outside of school for homework or learning either *not at all* or to a *trivial extent.*	Students, on average use their laptops outside of school for homework and learning to a *small extent.*	Students, on average, use their laptops outside of school for homework and learning to a *moderate extent.*	Students, on average, use their laptops outside of school for homework and learning to a *large extent.*	

Table A.1. Scoring Rubrics for Measuring the Implementation Fidelity of Technology Immersion –Year 3 (*Continued)*

Component/Element	Minimal Immersion 0-1.99	Partial Immersion 2.00-2.99	Substantial Immersion 3.00-3.49	Full Immersion 3.50-4.00	Implementation Index
Classroom Immersion					Campus *z* Scores -2.40 to 1.92
Technology Integration Campus Scores 1.72 to 3.65 M=2.64 SD=0.42	Core teachers indicate it is *not true now* that I alter instructional practices, allocate time, integrate research on teaching and learning, improve basic skills, and support higher order thinking through technology.	Core teachers indicate it is *somewhat true now* that I alter instructional practices, allocate time, integrate research on teaching and learning, improve basic skills, and support higher order thinking through technology.	Core teachers indicate it is *somewhat* or *very true now* that I alter instructional practices, allocate time, integrate research on teaching and learning, improve basic skills, and support higher order thinking through technology.	Core teachers indicate it is *very true now* that I alter instructional practices, allocate time, integrate research on teaching and learning, improve basic skills, and support higher order thinking through technology.	
Learner-Centered Instruction Campus Scores 1.58 to 3.55 M=2.62 SD=0.45	Core teachers indicate it is *not true now* that my students establish learning goals, use information and inquiry skills, complete alternative assessments, and have active and relevant experiences.	Core teachers indicate it is *somewhat true now* that my students establish learning goals, use information and inquiry skills, complete alternative assessments, and have active and relevant experiences.	Core teachers indicate it is *somewhat* or *very true now* that my students establish learning goals, use information and inquiry skills, complete alternative assessments, and have active and relevant experiences.	Core teachers indicate it is *very true now* that my students establish learning goals, use information and inquiry skills, complete alternative assessments, and have active and relevant experiences.	
Student Activities Campus Scores 1.79 to 2.97 M=2.39 SD=0.32	Core teachers *rarely or never* have students use technology resources to support core-content learning.	Core teachers *sometimes* have students use technology resources to support core-content learning.	Core teachers *sometimes* to *often* have students use technology resources to support core-content learning.	Core teachers *often* to *almost daily* have students use technology resources to support core-content learning.	
Communication Campus Scores 1.29 to 3.33 M=2.50 SD=0.54	Core teachers *rarely* or *never* use technology to communicate with students, parents, and colleagues or to post information on a class website.	Core teachers *sometimes* use technology to communicate with students, parents, and colleagues or to post information on a class website.	Core teachers *often* use technology to communicate with students, parents, and colleagues or to post information on a class website.	Core teachers *often* to *almost daily* use technology to communicate with students, parents, and colleagues or to post information on a class website.	
Professional Productivity Campus Scores 2.45 to 3.33 M=2.86 SD=0.24	Core teachers *rarely* or *never* use technology to enhance their professional productivity (e.g., keep records, analyze data, develop lessons, deliver information).	Core teachers *sometimes* use technology to enhance their professional productivity (e.g., keep records, analyze data, develop lessons, deliver information).	Core teachers *often* use technology to enhance their professional productivity (e.g., keep records, analyze data, develop lessons, deliver information).	Core teachers *often* to *almost daily* use technology to enhance their professional productivity (e.g., keep records, analyze data, develop lessons, deliver information).	
Implementation Index					Campus *z* Scores -1.55 to 1.89

Table A.2. Data Sources for Technology Immersion Implementation Indicators

Indicator	Source	Item Description	Index Score	Standards-Based Score
Leadership (all teachers)				
	Teacher survey	Q11: Please indicate the extent of your agreement with each of the following statements. c) The principal consults with staff before making decisions about instructional technology that affect us. d) In this school there are clear expectations that technology will be used to enhance student learning. j) The principal in my school actively encourages teachers to pursue professional development geared towards curricular integration of technology. o) Our school has a well-developed technology plan that guides all technology integration efforts. p) The principal is an effective leader for instructional technology in this school. q) Overall, considering the uses of technology in my school today, I am confident that this use is leading to increased student achievement. r) The principal encourages teachers to be innovative and try new methods. t) The principal is willing to support—through funding or manpower—teachers' efforts at technology integration. v) Administrators in this school help teachers to use technology to access, analyze, and interpret student performance data w) Teachers receive adequate administrative support to integrate technology into classroom practice. x) Teachers and administrators rely on research-proven teaching and learning principles in making decisions about technology use. y) When our school has professional development focused on technology, the principal often participates.	5-point scale *z* score	0 = Strongly Disagree 1 = Disagree 2 = Unsure 3 = Agree 4 = Strongly Agree
Teacher Support (Innovative Culture) (all teachers)				
	Teacher survey	Q11: Please indicate the extent of your agreement with each of the following statements. b) Teachers in this school share an understanding about how technology will be used to enhance learning. i) Teachers in this school are continually learning and seeking new ideas. k) Teachers are not afraid to learn about new technologies and use them with their class(es). aa) Teachers in this school are generally supportive of technology integration efforts.	5-point scale *z* score	0 = Strongly Disagree 1 = Disagree 2 = Unsure 3 = Agree 4 = Strongly Agree
Parent & Community Support (all teachers)				
	Teacher survey	Q11: Please indicate the extent of your agreement with each of the following statements. f) Parents support our school's emphasis on technology. h) The surrounding community actively supports our instructional efforts with technology.	5-point scale *z* score	0 = Strongly Disagree 1 = Disagree 2 = Unsure 3 = Agree 4 = Strongly Agree
Technical Support (all teachers)				
	Teacher survey	Q11: Please indicate the extent of your agreement with each of the following statements. a) Most of our school computers are kept in good working condition. b) Internet connections in my class are often too slow or not working. c) My requests for technical assistance are addressed in a timely manner. d) Materials (e.g., software, printer supplies) for classroom use of computers are readily available in my school. e) Problems such as computers freezing or an inability to access the Internet make it difficult for me to use technology.	5-point scale *z* score	0 = Strongly Disagree 1 = Disagree 2 = Unsure 3 = Agree 4 = Strongly Agree

Table A.2. Data Sources for Technology Immersion Implementation Indicators (*Continued)*

Indicator	Source	Item Description	Index Score	Standards-Based Score
Professional Development (core-subject teachers)				
Contact Hours	Teacher survey	Q20: Indicate the number of hours spent in technology-related professional development (PD) over the past school year (i.e., since August 1, 2006).	Continuous variable 0 to *x** *z* score	Continuous variable 0 to *x* * >= 3 *SD* from mean excluded
Classroom Support	Teacher survey	Q12: About how often do you interact with colleagues in each of the following ways. j) receive coaching or mentoring from an external (non-school) source such as a professional curriculum developer k) receive coaching or mentoring from an internal source, such as another teacher or technology coordinator	5-point scale *z* score	0 = Never 1 = Rarely (a few times a year) 2 = Sometimes (once or twice a month) 3 = Often (once or twice a week) 4 = Almost Daily
Content Focus	Teacher survey	If core-subject teacher participated in technology-related PD, Q24: How much emphasis did the "most time" technology-related professional development activity give to each of the following areas? a) Curriculum (e.g., units, texts, standards) b) Instructional methods d) Lesson development in English language arts, mathematics, science, or social studies [mean of teachers' responses pertinent to their subject-area assignments (e.g., math teachers rate math)]	3-point scale *z* score	0 = No Emphasis 2 = Minor Emphasis 4 = Major Emphasis
Coherence	Teacher survey	If core-subject teacher participated in technology-related PD, Q27: To what extent was the "most time" technology-related professional development activity: a) Consistent with your own goals for professional development b) Consistent with your school's or department's plan to change practice c) Based explicitly on what you had learned in earlier professional development experiences d) Followed up with activities that built upon what you learned in this professional development activity e) Designed to support state or district standards/curriculum frameworks f) Designed to support state or district assessment	5-point scale *z* score	0 = Not at All 1 2 3 4 = Great Extent
Classroom Immersion (core-subject teachers)				
Technology Integration	Teacher survey	Q12: Please indicate your present level of classroom technology implementation. c) I alter my instructional use of the classroom computer(s) based upon the newest software applications and research on teaching, learning, and standards-based curriculum. d) My students discover innovative ways to use classroom computers to make a difference in their lives. e) I allocate time for students to practice their computer skills on the classroom computer(s). g) I integrate the most current research on teaching and learning when using the classroom computer(s). h) In my classroom, students use technology-based computer and Internet resources beyond the school (NASA, other government agencies, private sector) to solve authentic problems. i) My students' authentic problem solving is supported by continuous access to a vast array of computer-based tools and technology. k) I plan computer-related activities in my classroom that will improve my students' basic skills (e.g., reading, writing, math computation). l) It is easy for me to design student-centered, integrated curriculum units that use the classroom computer(s) in a seamless fashion. n) I seek out activities that promote increased problem-solving and critical thinking using the classroom computer(s). o) Using cutting edge technology and computers, I have stretched the instructional computing in my classroom.	7-point scale *z* score	0 = Not true of me now 1 = Somewhat true of me now 2 = Somewhat true of me now 3 = Somewhat true of me now 4 = Very true of me now

Table A.2. Data Sources for Technology Immersion Implementation Indicators (*Continued)*

Indicator	Source	Item Description	Index Score	Standards-Based Score
Classroom Immersion (*Continued)*				
Learner-Centered Instruction	Teacher survey	Q12: Please indicate your present level of classroom technology implementation. b) Students authentic use of information and inquiry skills guides the type of instructional materials used in my classroom. j) My students are involved in establishing indivual goals within the classroom curriculum. m) In additional to traditional assessments, I consistently provide alternative assessment opportunities that encourage students to "showcase" their content understanding in nontraditional ways. q) My instructional approach emphasizes experiential learning, student involvement, and students solving "real-world" issues.	7-point scale *z* score	0 = Not true of me now 1 = Somewhat true of me now 2 = Somewhat true of me now 3 = Somewhat true of me now 4 = Very true of me now
Student Classroom Activities	Teacher survey	Q16: About how often do students in your typical class use technology in the following ways during class time. Students in my class use technology to… a) express themselves in writing (e.g., word processing). b) learn and practice skills (e.g., instructional software or educational games). c) enter, calculate, and graph information (e.g., Excel spreadsheet). d) create a database of information for a class project (e.g., Filemaker Pro, Access). e) create and make presentations (e.g., PowerPoint). f) communicate by email with peers, experts, or others on topics they are studying. h) conduct Internet research on an assigned topic. i) conduct multimedia research (reference CDs, online encyclopedias). j) enhance or express conceptual understanding through simulation/modeling software. k) visually represent or investigate concepts (e.g., through concept mapping, graphing, reading charts). l) produce print products (e.g., desktop publishing). m) produce multimedia reports/projects (e.g., with video, graphics, and sound editing). n) analyze information using tools such as graphing calculators or digital microscopes. p) complete a test or quiz (e.g., online assessments, Texas Math Diagnostic System).	5-point scale *z* score	0 = Never 1.333 = Rarely (a few times a year) 2.667 = Sometimes (once or twice a month) 4 = Often (once or twice a week) or Almost Daily
Communication	Teacher survey	Q13: About how often do you use technology in each of the following ways? As a teacher I… e) communicate with students. f) communicate with parents. g) communicate with colleagues/other professionals. m) post homework, class requirements, or project information on a website.	5-point scale *z* score	0 = Never 1 = Rarely (a few times a year) 2 = Sometimes (once or twice a month) 3 = Often (once or twice a week) 4 = Almost Daily
Professional Productivity	Teacher survey	Q13: About how often do you use technology in each of the following ways? As a teacher I… a) keep administrative records (e.g., attendance). b) manage student assessment data (e.g., electronic gradebooks). c) use technology to analyze and interpret student data to guide my instruction. d) create electronic lesson plans. h) create instructional materials (e.g., tests, handouts). i) gather information from the Internet to create a lesson (e.g., text, video, clipart). j) access model lesson plans integrating technology. k) deliver information using presentation software (e.g., PowerPoint). l) deliver information using multimedia presentations (text, audio, video, graphics). p) use the Internet at home for instructional purposes. q) use a computer to do schoolwork at home.	5-point scale *z* score	0 = Never 1 = Rarely (a few times a year) 2 = Sometimes (once or twice a month) 3 = Often (once or twice a week) 4 = Almost Daily

Table A.2. Data Sources for Technology Immersion Implementation Indicators (*Continued)*

Indicator	Source	Item Description	Index Score	Standards-Based Score
Student Access and Use				
Laptop Access Days	Student survey	Q3.a: Does your school provide a laptop that you can use? [Yes = 180 days, No = 0 days] Q3.b: Have you had a laptop taken away from you for more than a class period? [No = 180 - 0 days; Yes = 180 – Q3.d. no laptop days] Q3.d: How many days was the laptop taken away? [1 to 180]	Continuous variable 0 to 180 *z* score	Continuous variable 0 to 180 4 = Meet or exceed expectations 0-3.99 = proportional fraction of requirement [campus mean adjusted for variance (-2 SDs)]
Core-Content Learning	Student survey	Q6: About how often do you use technology in each of the following classes? a) Reading/English language arts b) Math c) Science d) Social studies	5-point scale *z* score	0 = Never or Rarely (a few times a year) 1.333 = Sometimes (once or twice a month) 2.667 = Often (once or twice a week) 4 = Almost Daily
Home Learning	Student survey	Q4.a: How often can you take a laptop home? [0 = Never (no access); 1 = Only when I have a project or assignment or Other (restricted access) or As often as I want (full access)] Q4.b: When you take a laptop home, how do you use it? Homework for language arts (reading/writing) [+1] Homework for social studies [+1] Homework for science [+1] Homework for math [+1] Play games to learn [+1]	Continuous variable 0 to 6 *z* score	Continuous variable 0 to 6 0 = No access to laptop outside school 1 = Restricted or full access to laptop outside school + Laptop used for homework and/or learning outside of school (up to 5 points) 4 = Meet or exceed expectations 0-3.99 = proportional fraction of requirement
Implementation Index			Composite *z* score	

Appendix B

Observation of Teaching and Learning

Researchers have conducted classroom observations for teachers who instructed cohorts of students. In fall 2004 and spring 2005, we observed in a sample of sixth-grade, core-subject classrooms (reading/English language arts, mathematics, science, and social studies). In spring 2006, we observed a sample of classrooms including sixth-grade teachers and seventh-grade teachers. In spring 2007, we observed a sample of classrooms including sixth-grade teachers, seventh-grade teachers, and eighth-grade teachers. For this study, we report findings for a sub-sample of teachers observed in spring 2007. We used treatment teachers' spring 2006 Classroom Immersion Index to identify core-subject teachers that had indices in the highest quartile (*z* score of 0.63 or higher) and those with indices in the lowest quartile (*z* score of -0.50 or less. Thus, we analyzed data for a sub-sample of higher and lower Classroom Immersion teachers who were observed in spring 2007.

The Observation of Teaching and Learning (OTL) form documents basic descriptive information (e.g., number of students, content area), technology access and use (i.e., technology available and used by the teacher and students), and classroom environment (i.e., organization and management). In addition, researchers used time-interval ratings to record information in six areas: class organization (e.g., individual students, pairs, small groups, whole group), teacher activities (e.g., directing, guiding substantive discussion), teacher's technology use (e.g., peripherals, presentation software), student activities (e.g., listening, learning facts, definitions, algorithms), students' technology use (e.g., express themselves in writing, learn/practice skills), and student engagement (rated on a 5-point scale from low engagement to high engagement).

Observers made the first rating after observing for 5 minutes, then made a rating every 10 minutes. During the observation, observers also recorded descriptive notes on the lesson objectives, teachers' questioning strategies (lower or higher order), and class activities. Observations lasted about 45 minutes. After the observation, and based on time-interval ratings and descriptive notes, observers rated the intellectual challenge of classroom work. Relying on rubrics developed by Newmann, Secada, and Wehlage (1995), observers rated four standards measuring the intellectual quality of classroom instruction on a 5-point scale: Higher Order Thinking, Disciplined Inquiry, Substantive Conversation, and Value Beyond School. An aggregate score across three of the standards was used as an overall measure of the Intellectual Challenge of instruction. We excluded the Substantive Conversation standard because ratings were biased by teachers' classroom organization. Classes with teacher-directed instruction typically provided more public conversations, and thus, better opportunities to document the nature of conversational exchanges.

Number of observations. Our analysis included 18 higher Classroom Immersion and 16 lower Classroom Immersion teachers. The distribution of subject-area assignments differed across groups. Higher implementing teachers included 7 reading/English language arts, 1 mathematics, 4 science, and 6 social studies teachers. Lower implementers teachers included 5 reading/English language arts, 5 mathematics, 1 science, and 5 social studies teachers.

Training procedures. Prior to site visits in fall 2004 and spring of 2005, 2006, and 2007, researchers participated in one- or two-day training events. Training activities informed data collectors about the research design, aspects of technology immersion, data collection protocols, effective interview and focus group techniques, and classroom observation procedures. Approximately half of each training event was devoted to the establishment of inter-rater agreement on the OTL form. During observation training,

raters first reviewed background information and individual item and code definitions in the OTL manual. Raters next viewed a video in which a classroom teacher used technology as part of a lesson. The trainer stopped raters at 10-minute intervals to record ratings, discuss the extent of agreement or disagreement, and resolve misunderstandings. This process was repeated for an additional classroom video.

To further enhance inter-rater agreement, raters were paired for observations in classrooms during visits to a middle school selected for training purposes. Following paired classroom observations in these schools, raters again discussed assigned ratings and resolved disagreements. Subsequently, for site visits to treatment and control middle schools, observers were paired for about 25% of classroom observations. Overlapping observations allowed the calculation of the consistency of observers' scores (i.e., the percentage of agreement on ratings from paired observations). Additionally, paired observations supported the use of Many-Facet Rasch Measurement (MFRM) to adjust scores on the Intellectual Challenge factor for differences across raters.

Inter-rater agreement. Inter-rater agreement on the rating scales for the Intellectual Challenge standards (Higher-Order Thinking, Disciplined Inquiry, Substantive Conversation, and Value Beyond School) was established by calculating the percentage of time observers agreed on ratings from paired observations. Analyses of observations from fall 2004 indicated 78% inter-rater agreement. Agreement reached 98% when scale categories were allowed to vary by one scale point (on the 5-point scale). Inter-rater agreement declined somewhat in spring of 2005, 2006, and 2007. Exact agreement was 63%, 62%, and 62%, respectively, and 89%, 93%, and 96% when ratings varied by one scale point.

Reliability of scores. Statistics for inter-rater agreement indicated that raters may have had somewhat different standards for assigning scores, so we needed to adjust statistically for the differences in the severity of raters. An overall measure of Intellectual Challenge for each teacher was constructed using MFRM. The quality of instruction measure is an aggregate score across three standards (Higher Order Thinking, Disciplined Inquiry, and Value Beyond School). The measure is adjusted for the relative difficulty of each standard and the relative severity (or leniency) of each observer. MFRM analysis produces several fit statistics that can be used to measure each observer's intrarater reliability or internal consistency. One of these, observer infit, weights each standardized residual by its variance and is more sensitive to unexpected patterns of small residuals. A second statistic, observer outfit, is an unweighted mean-square residual sensitive to outlying residuals (Linacre, 2004).

There is no fixed rule for setting upper and lower limits for theses fit statistics. "Misfitting" raters have been defined as having either a mean-square infit or outfit statistic greater than 1.5 (Lunz, Wright, & Linacre, 1990), or the range has been from 0.5 to 3.0 (Myford & Wolfe, 2000). We define a "misfitting" observer as one with either a mean-square infit or outfit statistic less than 0.5 or greater than 1.5. This defines "misfit" as less than 50% of the variance in ratings than is modeled (a muted pattern) and more than 50% of the variance than is modeled (a noisy pattern). Observation data in fall 2004, spring 2005, spring 2006, and spring 2007, respectively, resulted in observer infit values from 0.61 to 1.34, 0.61 to 1.34, 0.43 to 1.59, and 0.58 to 1.14, and observer outfit values from 0.62 to 1.20, 0.62 to 1.20, 0.40 to 1.67, and 0.66 to 1.17. While the spring 2006 fit statistics extended slightly beyond the 0.5 to 1.5 range, mean infit and outfit values were in the 0.90 to 1.00 range. No unusual rating patterns appeared to be present in the spring 2006 classroom observation data, with only slightly unpredicted or overly predictable ratings (Linacre, 1995).