eTxTIP

Evaluation of the Texas Technology Immersion Pilot

An Analysis of Second-Year (2005–06) Implementation

October 2007

Prepared for
Texas Education Agency

Prepared by
Texas Center for Educational Research

TCER
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Executive Summary

The Technology Immersion Pilot (TIP), a project sponsored by the Texas Education Agency (TEA), leverages federal Title II, Part D funds to support a wireless learning environment for high-need middle schools. A concurrent research project 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 Texas Center for Educational Research (TCER)—a non-profit research organization in Austin—is the TEA's primary partner in this four-year endeavor that began in the 2004-05 school year and will continue through 2007-08.

Technology immersion encompasses multiple components, including a laptop computer for every middle school student and teacher, wireless access throughout the campus, curricular and assessment resources, professional development and ongoing pedagogical support for curricular integration, and technical support for immersion. The overarching purpose of the study is to scientifically investigate the effectiveness of technology immersion in increasing middle school students' achievement in core academic subjects (English language arts, mathematics, science, and social studies) as measured by the Texas Assessment of Knowledge and Skills (TAKS). The study also examines relationships that exist among contextual conditions, technology immersion, intervening factors, and academic achievement. Accordingly, researchers have annually conducted site visits to treatment and control campuses in order to better understand initial conditions and changes over time.

Visits to campuses in fall 2004 and spring 2005 established the comparability of treatment and control schools and documented first-year implementation. In spring 2006, follow-up site visits to each of the 22 immersion and 22 control schools focused on second-year activities (encompassing the 2005-06 school year). Researchers conducted interviews with principals, technology coordinators, and central administrators and focus groups with a sample of sixth- and seventh-grade teachers and students. In the second year, two middle schools in one district (one immersion and one control) were excluded from analyses due to disruptions of school operations caused by Hurricane Rita on the Texas Gulf coast. Thus, second-year results are for 21 immersion and 21 control schools. Data gathered at control campuses verified that the availability and use of technology had not changed substantially since the project's inception, while data gathered at immersion schools contributed to an in-depth examination of second-year implementation.

This report combines qualitative data (from interviews and focus groups with selected subjects) and quantitative data (from surveys of all teachers and students) to provide a comprehensive description of second-year implementation of technology immersion. We measured implementation using standard-based scores defining four levels of immersion (*minimal*, *partial*, *substantial*, and *full*) and standardized implementation indices (z scores). Both types of scores produced measures for five immersion support components (Leadership, Teacher Support, Parent and Community Support, Technical Support, Professional Development) and two teacher and student immersion components (Classroom Immersion and Student Access and Use). Major findings on second-year implementation are the following.

School Implementation Levels

Most middle schools had difficulty implementing the prescribed components of technology immersion in the second year. The Implementation Index, a composite campus *z* score measuring the overall presence of the seven immersion components, showed that some middle schools had a much stronger presence of the immersion components than others. Mean immersion standard scores (ranging from 2.48 to 3.06 on a 0 to 4 scale) showed that supports for technology immersion from school administrators, teachers, parents and community members, technical staff, and professional development providers typically fell short of full implementation standards (3.50 to 4.00). Given generally low-to-moderate supports for immersion, the levels of Classroom Immersion (2.48) and Student Access and Use (2.17) were below expectations.

Leaders at many schools reported implementation progress in the second year; however, others believed implementation reached a plateau. Some administrators thought the second year went more smoothly because their schools had established laptop management procedures, enacted acceptable-use policies, distributed laptops earlier in the year, stabilized school infrastructures, and/or increased Internet bandwidth. Moreover, leaders said teachers' increased comfort with technology permitted greater attention to classroom integration. Implementation progress was hindered at some schools by financial challenges in providing laptops for every student, parent refusals of laptops, administrator and teacher turnover, competing reform initiatives, Internet safety issues, and loss of teacher buy-in.

Teachers were more comfortable using technology in the second year and made strides toward classroom integration. Many teachers in focus groups indicated that second-year implementation progressed more smoothly. Teachers cited progress relative to increased bandwidth that accommodated classroom Internet access and revised policies that limited students' access to email, games, and music or video downloads. Also, many teachers had received sufficient training in immersion package tools and were able to use them in classrooms.

Schools with a greater proportion of economically disadvantaged students had lower implementation levels. Teachers at economically disadvantaged schools grew in proficiency and created immersed classrooms at significantly slower rates than teachers in more advantaged schools. In general, schools serving mainly disadvantaged and often low-performing student populations faced special challenges in implementing a whole-school initiative that involved profound school and classroom change. These schools needed additional time and external supports to plan for technology immersion.

Supports for Immersion

Many schools needed stronger second-year implementation supports in the areas of leadership, parental support, technical support, professional development, and teacher commitment to innovation.

Administrators at about half of schools provided strong leadership for technology immersion. Surveyed teachers at 48% of schools believed administrators provided the kind of leadership necessary for at least substantial immersion. Although no clear distinctions could be made between higher and lower implementing schools, successful leadership practices emerging from qualitative comments suggested that leadership was more effective if administrators established a clear direction for immersion and helped build the capacities of their staff. Administrator turnover weakened momentum. Some schools had new principals and superintendents who had not been involved in developing and implementing the technology immersion model, and consequently, did not provide the leadership needed for continued progress.

Parent support for immersion was an issue at some schools, but outreach from principals reduced concerns. Administrators at four schools said a small number of parents refused to give permission for their children to have laptops, with reasons for denial centering on concerns about financial responsibility and Internet safety. At two higher implementing campuses, principals assuaged parental fears by telephoning or meeting with parents to discuss their concerns, offering parent training on laptop monitoring strategies, and helping parents to understand the contribution of laptops to students' development as learners and their educational opportunities.

Even though schools expanded staffing for technical and pedagogical support in the second year, additional help was needed to address laptop repairs, Internet safety issues, and in-classroom support for teachers. Campus technology coordinators typically acted as both technical and pedagogical support providers, and several had other assignments that diffused their efforts. As a result, surveyed teachers at most campuses (81%) reported only partial levels of technical support. Likewise, technology coordinators considered technical problems as the most urgent second-year need. As campus technology infrastructure at many schools (wiring, Internet connectivity) stabilized in the second year, laptop maintenance demands and Internet safety monitoring responsibilities increased. Time devoted to technical issues left little time for coordinators to assist classroom teachers with curricular integration.

Professional development received by many teachers in the second year was insufficient to advance classroom immersion. The quality of professional development also varied widely across schools. Survey results showed that core-subject teachers at less than half of campuses received close to the prescribed number of professional development hours (about 80 hours over two years), and across all schools, teachers *rarely* (once or twice a month) or *never* received classroom coaching or mentoring. Core-subject teachers in focus groups said that the bulk of professional development took place during the first year. As a result, new teachers, in particular, had insufficient training opportunities. Professional development also shifted in the second year from whole-group sessions to more individualized training and from vendor-provided training (Dell and Apple trainers) to increased reliance on multiple professional development providers (vendors, local staff, education service center staff, conferences). Thus, the nature and quality of professional development varied across campuses.

Teachers' support for technology immersion was weakened by challenges that often outweighed benefits. While teachers at most schools reported substantial support for learning about and using new technologies, teachers at a third of schools reported only partial support. Core-subject teachers who participated in focus groups appreciated that student laptops eliminated the need to schedule time in the library or in a computer lab, allowed more varied lesson plans and individualized learning, and provided opportunities for in-depth research. On the other hand, teachers were concerned that time absorbed by laptops diminished curricular coverage and TAKS preparation. Teachers also had difficulty finding time to prepare laptop-related lessons, making arrangements for students without laptops, handling technical problems, and monitoring students' appropriate laptop use.

Classroom Immersion

Teachers' progress in creating technology-immersed classrooms was measured by elements gauging their ideological orientation (Technology Integration, Learner-Centered Instruction), Student Activities (with technology), Communication, and Professional Productivity.

Some core-subject teachers were not strongly committed to the instructional and learning practices advocated as part of the technology immersion model. Some teachers believed new technologies were not pertinent to their curriculum and instructional practices and, in some instances, technology integration and learner-centered instruction were inconsistent with teachers' ideological beliefs and values. Consequently, teachers at most schools (81%) reported that students just *sometimes* used various technology resources to support core-content learning (partial implementation). At a fifth of schools, students *rarely* or *never* used technology resources (minimal implementation).

As teachers became more comfortable with technology in the second year, many drew selectively from a wide range of technology resources to enhance their teaching and students' learning experiences. Although the frequency of students' laptop use did not meet full immersion standards, teachers' comments in focus groups revealed progress toward more diverse technology uses. English language arts and reading (ELA) teachers said students used laptops to research information about stories read, keep journals, write original stories, and make presentations. Social studies teachers at all schools believed laptops enhanced their ability to conduct research with their students, and laptops permitted student access to more and better information through resources such as virtual tours or field trips, online newspapers, video clips, and electronic textbooks. Science teachers at many schools had students use laptops to research a wide range of topics, present their research, conduct virtual experiments, take notes, and diagram or illustrate science concepts. Mathematics teachers at all schools found it difficult to integrate laptops in their classes, primarily because they had too few math-related resources and believed pencil-and-paper activities were best for math. Teachers at many schools, however, used laptops for math extension (online activities and games) and diagnostic assessment.

Although many teachers embraced technologies that enhanced their professional productivity, few used communication tools to transform classroom management. Across schools, teachers frequently used new resources to enhance their own professional productivity (e.g., keep records, develop lessons, present content). Conversely, teachers at only a few schools used email regularly to communicate with students about class work or to contact parents. And, although teachers at many schools received web-based communication tools, such as eChalk, as part of immersion packages, few teachers used school or class websites to manage information.

Students believed teachers' tendencies to use laptops reflected the relevance of laptops to the subject area and teachers' personal traits. Some students in focus groups believed laptops were unsuitable for math because problems had to be worked out on paper and inappropriate for writing because the TAKS test requires pencil-and-paper compositions. Conversely, students believed ample learning resources and websites made laptops ideally suited for social studies and science. Students also linked teacher characteristics to laptop use, indicating that teachers who are strict, outdated, lack technology proficiency, do not find laptops useful for schoolwork, or fear that students will behave irresponsibly seldom or never used laptops. In contrast, students thought teachers who know how to use technology and believe laptops provide a different way of learning used them more often.

The strength of professional development and other supports were associated with higher levels of classroom immersion. Analyses of associations between immersion support components and classroom practices revealed that the strength of professional development at a school was significantly correlated with teachers' ideological affiliations with technology integration and learner-centered practices as well as their overall level of Classroom Immersion. In addition, teachers' perception of administrative leadership for technology was significantly associated with their commitment to innovation, views on parent/community and technical support, and the quality of professional development. Thus, school administrators appeared to influence teachers by providing supports for changed practice.

Student Access and Use

In the second year, we measured three elements of Student Access and Use: Laptop Access Days, Core-Content Learning, and Home Learning.

Students' access to laptops varied widely both across and within schools. Students at just a third of campuses had either substantial access to laptops (140 to 178 days per student) or full access (170 to 180 days per student). Thus, students at higher implementing schools had laptops available for use a greater number of days. Students' access to laptops was diminished in some cases because schools did not provide laptops for all students, and some students who received laptops had them for fewer days because of repairs (20% of students) or penalties for misuse/misbehavior (7% of students).

Even though students as a whole used laptops infrequently for learning in core subjects, students in some schools and classrooms used laptops more often. Similar to teachers' reports, students at two-thirds of schools used laptops in core classrooms *sometimes* (once or twice a month) to *often* (once or twice a week). Students at the remaining third of campuses *rarely* (a few times a year) or *never* used technology resources in core classes. Although the frequency of student technology use generally did not meet expectations, sixth and seventh graders participating in focus groups described a variety of laptop uses in their core-subject classes.

Students, similar to their teachers, described a wide range of activities with laptops in core-subject classes. In ELA classes, students used laptops most commonly to write compositions and create presentations, learn and practice skills, read and comprehend texts, use learning programs, and play educational games. In social studies classes, students used laptops most often to research an assigned topic on the Internet and generate a product such as a composition or presentation, to take notes, and to answer content-related questions. In science classes, students used laptops most often to research an assigned topic on the Internet and create a composition or presentation, to define vocabulary words, and to take notes. Students viewed science videos, visited interactive websites, and conducted scientific investigations less often. Students used laptops less often in mathematics classes and the range of activities was less diverse. Students most commonly used laptops for online math-related activities or games, or to take diagnostic tests and prepare for the TAKS math test.

Students at higher implementing campuses used laptops more often outside of school and for more academic purposes. During the second implementation year, similar to the first year, a third of schools (8 of 21) either limited their students to in-school laptop use exclusively, or they allowed laptops to go home for homework or special assignments only. Students at higher implementing schools reported using their laptops more often outside of school and for more academic purposes, such as completing research projects, making PowerPoint presentations, answering chapter questions with an electronic textbook, typing or writing stories, or defining vocabulary terms. When students at lower implementing schools used laptops outside of school, it was more likely to be for playing games, listening to music, watching DVDs, or emailing rather than for academic purposes.

Students' access to and use of technology for learning was significantly related to their teachers' involvement in professional development as well as the strength of the school's supports for immersion. The quality of campus professional development supporting immersion, teachers' support for technology innovation, parent and community support for technology, and the adequacy of technical support were significantly associated with higher levels of Student Access and Use. Similarly, students' laptop use for learning at home (i.e., for homework in core subjects or learning games) was positively associated with the school's emphasis on professional development and parent/community support. All told, supports for immersion at higher implementing schools helped ensure that students' experiences more nearly approximated the immersion goal for core-content learning within and outside of school.

Effects of Immersion on Students

Teachers, technology leaders, and sixth and seventh graders offered their views on technology immersion's effects on students.

Students preferred and believed they benefited more from laptops and electronic resources than from traditional print media. Students across campuses preferred laptops over textbooks, library books, and other forms of print media. Internet search tools and various online resources permitted access to information more quickly and efficiently and allowed students to conduct research on a greater variety of topics. Of some concern, however, were students' general dislike for reading and the potential for obtaining information from Internet resources without reading extensive quantities of text. Thus, students needed explicit guidance from teachers to ensure that assignments required the use of appropriate reading strategies for comprehending electronic texts.

Students believed access to laptops improved their technology proficiency. Similar to survey results showing significantly positive effects of immersion on students' technology proficiency (Shapley et al., 2007), sixth and seventh graders in focus groups at most campuses said their keyboarding skills had improved over the duration of the project, and they were learning, mastering, or being exposed to a wide variety of learning resources and productivity tools such as Internet search tools, Word, PowerPoint, Excel, and Publisher. Teachers at more than half of schools, however, were frustrated by the need to devote class time to teaching sixth graders the basics of computer and program usage. Some schools implemented or planned to implement a sixth-grade orientation covering laptop basics to address the problem.

Students thought laptops positively affected their capacities as learners. Students at many campuses described ways that laptops affected their capacities as learners, including changes related to self-direction (working at their own pace, formulating questions and finding answers, seeking help from and discussing ideas with peers), organization of materials, multi-sensory experiences, creativity, and ownership of learning. In contrast to students' comments, results for the *Style of Learning Inventory* or *SLI* (a quantitative survey of self-directed learning) have shown no significant differences in the self-directed behaviors of immersion and control students (Shapley et al., 2007). The *SLI*, however, does not measure the same types of learning strategies that students described in focus groups.

Students said technology immersion increased their engagement in school and learning. Students representing all campuses said school with laptops is more "fun" than school without laptops. Students linked fun with other terms such as "important," "useful," and "helpful," thus acknowledging laptops as an important learning tool. Students also attributed improved classroom behavior to technology immersion, saying that students are quieter, pay more attention in class, and are more focused on class work. Comments about improved behavior are consistent with quantitative data showing that students in immersion schools have significantly fewer disciplinary actions than control-group students (Shapley et al., 2007).

Laptops challenged middle school students to assume greater responsibility than had previously been expected. Some students appreciated the sense of responsibility and trust extended to them through individual laptops, while others worried about potential laptop damages and associated costs. Technology coordinators at some campuses noted improved student responsibility for laptops, whereas coordinators and teachers at other campuses, particularly lower implementing schools, cited increased student carelessness and damage. Many students also complained about the responsibility of carrying heavy laptops from class to class, especially when they were not consistently used. Undoubtedly, providing individual laptops presented new challenges for students who had to demonstrate greater self-responsibility than had been expected before immersion.

Although opinions about the effects of technology immersion on academic achievement varied, most believed that immersion had prepared students for the future. Some students at almost all campuses believed access to laptops and learning resources had improved their grades. Teachers, on the other hand, thought laptops had improved student skills (e.g., vocabulary, communication, and reading) but not their academic achievement or TAKS test scores. Second-year quantitative analyses showed no significant effects of immersion on TAKS scores, although immersion schools had more positive achievement trends in reading and mathematics than control schools (Shapley et al., 2007). In contrast to opinions on grades and test scores, students and educators alike thought technology immersion had enabled students to gain valuable skills that prepared them for the future in terms of their college and career readiness.

1. Introduction

The Technology Immersion Pilot (TIP) sets forth a vision for technology immersion in Texas public schools. The Texas Education Agency (TEA) originally directed more than $14.5 million in federal Title II, Part D monies toward funding a wireless learning environment for high-need middle schools through a competitive grant process. A concurrent research project 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 Texas Center for Educational Research (TCER)—a non-profit research organization in Austin—is the TEA's primary partner in this four-year endeavor that began in the 2004-05 school year and will continue through 2007-08.

The overarching purpose of the study is to scientifically investigate the effectiveness of technology immersion in increasing middle school students' achievement in core academic subjects as measured by the Texas Assessment of Knowledge and Skills (TAKS). Technology immersion encompasses multiple components, including a laptop computer for every middle school student and teacher, wireless access throughout the campus, online curricular and assessment resources, professional development and ongoing pedagogical support for curricular integration of technology resources, and technical support to maintain an immersed campus. The evaluation also examines the relationships that exist among contextual conditions, technology immersion, intervening factors (school, teacher, and student), and student achievement. In the first year, there were 22 experimental and 22 control sites in the study. However, in the second year, two middle schools in one school district (one experimental and one control) were removed from the study due to the devastating effects of Hurricane Rita on the Texas Gulf coast. School buildings were damaged, laptops destroyed, and the school year disrupted. Thus, second-year results for the 2005-06 school year are for the remaining 21 experimental and 21 control schools.

Theory of Technology Immersion

In recent years, the vision for educational technology endorsed by many educators, leaders, and policymakers has shifted 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 technology-infused 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 also believe that educational technology can help students develop the competencies needed for the 21st century. Children who are growing up in the Digital Age must have different competencies, including digital literacy, inventive thinking, and effective communication (CEO Forum, 2001; Lempke, Couglin, Thandani, & Martin, 2003). Correspondingly, there is a growing concern that U.S. schools are not preparing students to succeed in the modern world. Today's graduates must be critical thinkers, problem solvers, and effective communicators who are proficient in core subjects as well as in information and media literacy (Partnership for 21st Century Skills, 2006).

Similarly, Texas has long recognized that the state's success is tied to the provision of opportunities for the Digital Age. Preparing for the 21st century means that Texas students must learn different ways to work with tools, information, and people. The Texas *Long-Range Plan for Technology, 2006-2020*, advances the previous state plan's approach for the integration of technology within schools across four major domains: teaching and learning; educator preparation and development; leadership, administration, and instructional support; and infrastructure for technology (TEA, 2006). Texas Senate Bill 396, enacted during the 2003 Texas legislative session, further defines this comprehensive vision as "technology immersion." Technology immersion calls for the provision of a wireless mobile computing device for each student in a school, the use of technology-based learning resources, training teachers to integrate technology into the classroom, and the provision of support for effective technology use. 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).

Technology Immersion Components

While Texas state statutes provide a general description of technology immersion, TEA staff relied on existing research on educational technology as well as practical wisdom gained through numerous pilot studies and statewide technology initiatives to specify critical components of immersion. The technology immersion model assumes that effective technology use in schools and classrooms requires (a) robust technology access, (b) technical and pedagogical support for implementation, (c) professional development for educators in using technology effectively, and (d) readily available curricular and assessment resources that support the state's foundation curriculum, particularly in the core-subject areas of English language arts, mathematics, science, and social studies.

Robust Access to Technology

The targeted level of technology access in Texas is one-to-one access to Internet-connected multimedia computers in classrooms. Similar to national trends, the Texas ratio of students to instructional computers was 3.5 to 1 in 2006, a slight decrease from the ratio of 3.7 to 1 in 2001. Texas schools also have built their infrastructure for technology. Texas had a 3.4 ratio of students per high-speed Internet-connected computers in 2006 (Education Week, 2007). Despite school-level improvements in technology access across years, a statewide survey conducted in 2002 and baseline data collected for this study in 2004 indicate 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., 2006b). Correspondingly, when Texas middle-school students in 2005 were asked how they found out about websites and new technology and how to use them, only 13% reported that they learned from "teachers or classes in school;" students, instead, indicated they learned from "my friends" (32%) or "I explore on my own" (34%) (NetDay, 2006).

Additionally, inequities in technology access continue to pose challenges for economically disadvantaged and minority students both nationally and in Texas. While access to computers and the Internet in higher and lower poverty schools has narrowed in recent years, the income-related gap persists. Nationally, the rate of at-home computer use among children from families earning less than $20,000 a year was 37% percent compared to 80% or higher for children from families earning $50,000 or more (Trotter, 2007). Thus, low-income students had fewer opportunities than their more advantaged peers to develop effective technology skills and to enhance learning at home. Likewise, minority and economically disadvantaged students in Texas are less often exposed to technology outside of school (Shapley et al., 2002).

As a way to counteract prevailing conditions, technology immersion aims for one-to-one student technology access. The Texas project is not unique in its quest for one-to-one computing. As computer technologies have become more affordable and accessible, large-scale projects have begun to appear with each student in a school, grade level, or classroom receiving his or her own computing device (Zucker, 2004; Penuel, 2006). Although the technology immersion pilot is similar to other laptop projects in its provision of one-to-one computing, it is unique in its focus on immersing entire schools in technology and simultaneously providing implementation supports.

Technical and Pedagogical Support

Technology immersion also assumes that increased access to and use of technology in schools requires a healthy technical infrastructure and adequate technical and pedagogical support. Schools must have electronic networks that are robust enough to support wireless laptops and digital content. Campus-based technical support is also vital, as many studies emphasize the importance of on-site access to support personnel who are responsible for assisting teachers in learning to use technology, troubleshooting technical problems, and effectively integrating technology into lessons (e.g., CEO Forum, 2001; Ringstaff & Kelley, 2002; Shapley et al., 2002). Studies have found a strong relationship between the provision of quality technology support and teachers' technology use and their changes in use over time (Ronnkvist, Dexter, & Anderson, 2000; National Center for Education Statistics [NCES], 2000). Disparities in access to technology support also emerge. Teachers at low-socioeconomic schools and at smaller schools and districts report less technical and instructional support (Ronnkvist et al., 2000; Shapley et al., 2002). In addition to technical assistance, ongoing professional development and pedagogical support for teachers' efforts to use technology, as discussed below, is crucial. Considering the importance of support for implementation, technology immersion requires that each school provide technical assistance and ongoing pedagogical support.

Professional Development

Technology immersion assumes that technology's potential impact on student learning depends on teachers' opportunities for effective professional development. Research shows that effective professional development should be of appropriate duration, provide ongoing support, be relevant to individual needs, entail active learning, build content knowledge, and contribute to a professional culture (e.g., Hawley & Valli, 1999; Newmann & Associates, 1996; Garet, Porter, Desimone, Birman, & Yoon, 2001). In particular, research shows that professional development activities of longer duration provide richer learning experiences (Garet et al., 2001). For technology, training should be of an adequate length to comprehensively investigate the topics and provide time for practice and experimentation (American Council on Education, 1999; Lewis, et al., 1999; Smerdon, et al., 2000). Evidence shows that when a particular technology use is mastered by teachers over time or promoted through sustained professional development, it is more likely to be incorporated into instruction (Zhao & Frank, 2003).

Professional development also should include follow-up to support teachers as they acquire and implement new skills in the instructional setting (Garet et al., 2001). While structured professional development provides a start, ongoing, campus-based mentoring and coaching is also necessary to help teachers learn new technology-based instruction and activities in the classroom (Bradburn & Osborne, 2007; Nugent & Fox, 2007; Sulla, 1999). Effective professional development should also focus on subject-specific content or specific teaching methods. For technology, this means that activities should not just build teachers' basic technology skills but should support their understanding of effective curricular integration methods as well (CEO Forum, 2000, 2001; Denton, Davis, & Strader, 2001; Ringstaff & Kelly, 2002; Web-Based Education Commission, 2000).

Additionally, technology professional development should not be isolated but should be part of broader professional growth initiatives in schools (Fullan & Hargreaves, 1996; Mann, Shakeshaft, Becker, & Kottkamp, 1999). 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). Through collective experiences, teachers develop shared norms and values that together reinforce new practices (Newmann & Associates, 1996). A leadership development component is also vital. Research points consistently to the important role of school leaders in successful implementation of technology (Bradburn & Osborne, 2007; Johnston & Cooley, 2001; Pitler, 2005).

Teacher involvement in technology-related professional development also has been associated with positive outcomes. Teachers who participate in professional development more often use technology for instructional purposes (Becker, 1999; Kanaya, Light, & Culp, 2005; Martin & Shulman, 2006; NCES, 2002; Wenglinsky, 1998). Moreover, as training participation increases, teacher reports of feeling well prepared to use technology for instruction increase as well (Smerdon et al., 2000).

Curricular and Assessment Resources

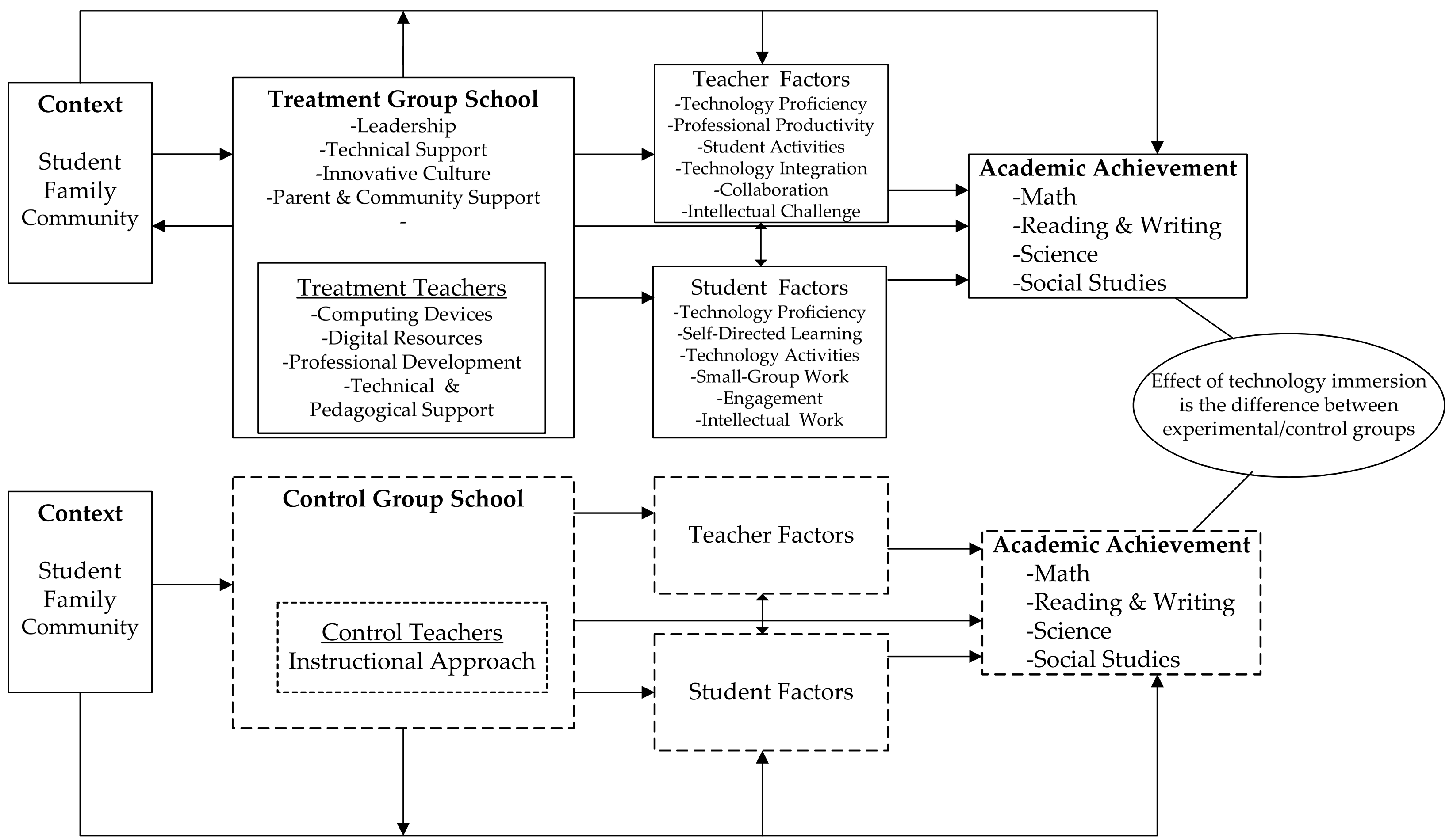
Technology's impact on student academic achievement in an immersed school hinges on the availability of instructional and learning resources that support the state's foundation curriculum. Immersion resources include productivity, communication, and presentation software that allow students and educators to use wireless laptops as a tool for teaching, learning, communication, and productivity. Additionally, digital resources (e.g., online, CD-ROMS, stored on local networks) provide a means to support more engaged, thoughtful, relevant, and personalized learning activities for students. Interactive technologies allow students to build new knowledge by doing, receiving feedback, and refining their understanding. Technologies may also help students to acquire more information, visualize difficult-to-understand concepts, and advance understanding. Immersion resources, thus, provide a means to extend, supplement, or enhance the state's curriculum. In addition to instructional resources, technology immersion provides online formative assessments that allow teachers to diagnose students' strengths and needs and assess progress toward curricular mastery.

Implementing digital resources aligned with the Texas curriculum is expected to modify existing instructional practices. Yet, as others have pointed out, the availability of wireless laptops and digital resources may not improve student learning and achievement if teachers do not use resources or simply provide the same kinds of lessons and assignments electronically instead of using new technologies to transform students' learning experiences (Means, Haertel, & Moses, 2003).

Theoretical Framework for Technology Immersion

The *Theoretical Framework for Technology Immersion* guides the evaluation (see Figure 1.1). The experimental design, as illustrated in the framework, allows an estimate of the effects of the intervention, which is the difference between the experimental and control groups. The framework also postulates a linear sequence of causal relationships. Program implementation comes first. Experimental schools are to be "immersed" in technology through the introduction of technology immersion components. The quality of implementation reflects the robustness of wireless laptop access for teachers and students, the adequacy of technical and pedagogical support services to maintain an immersed campus, the extent to which professional development supports curricular integration of technology, and how well curricular resources and assessments are used. Given quality implementation, we expect school-level improvements in measures of classroom technology integration, technical support, innovative culture (teacher support or buy-in), and parent and community support. Leadership drives progress toward full immersion.

Figure 1.1. Theoretical Framework for Technology Immersion



An improved school environment for technology should lead to teachers who have greater technology proficiency, use technology more often for their own professional productivity, collaborate more with their peers, have students use technology more and in new ways in their classrooms, and use laptops and digital resources to increase the intellectual challenge of lessons. In turn, improved school and classroom conditions should lead students to greater technology proficiency and personal self-direction, more frequent classroom technology activities and opportunities for peer collaboration, and stronger engagement in school and learning. Student mediating variables presumably contribute to increased academic performance as measured by standardized test scores. In the framework, links also are shown between student achievement and student, family, and school characteristics, which exert their own influence on learning.

The study's theoretical framework has guided the evaluation design as well as the design of data collection procedures and measures. The research literature underpinning the framework is available at the project website (www.etxtip.info).

Study Questions

The evaluation of technology immersion employs a quasi-experimental research design with middle schools assigned to either treatment or control groups. In the second year, researchers answered the following questions:

- How is technology immersion implemented, and what factors are associated with higher implementation levels?
- What is the effect of technology immersion on teachers and teaching?
- What is the effect of technology immersion on students and learning? and
- Does technology immersion affect student achievement?

This report concentrates on information gathered from the participating middle school campuses for the 2005-06 school year. Data collection involved a mix of qualitative and quantitative data sources. Researchers conducted site visits in each of the middle schools in fall 2004 and again in spring of 2005 and 2006. For this report, we focus on data gathered during spring 2006 site visits. Campus visits provided an in-depth look at middle schools through interviews with key personnel, focus groups with teachers and students, and observations in classrooms. We also surveyed teachers and students in spring 2006, and gathered data from the Texas Public Education Information Management System (PEIMS) and the Academic Excellence Indicator System (AEIS).

Organization of the Report

Report sections are organized around findings relative to the study's research questions. An overview of report chapters is provided below.

- *Chapter 1, Introduction*, provides background on the technology immersion project as well as the study's theoretical framework. The section also establishes the purpose for the study and the research questions addressed.
- *Chapter 2, Methodology*, presents information on the evaluation design, characteristics of immersion and control schools, study limitations, data collection methods, and data analysis procedures.

- *Chapter 3, Second-Year Implementation—Supports for Immersion*, describes progress toward implementation in the second year, including the nature of supports provided for the implementation of technology immersion.
- *Chapter 4, Second-Year Implementation—Classroom and Student Immersion,* describes progress toward implementation in the second year, including the nature of teachers' classroom immersion and the robustness of students' laptop access and use.
- *Chapter 5, Effects of Technology Immersion on Students*, offers findings on the perceived effects of immersion on students, including the perspectives of school technology leaders, teachers, and students themselves.
- *Chapter 6, Factors Associated with Implementation*, presents findings on the factors that are associated with higher or lower levels of immersion.
- *Chapter 7, Conclusions and Implications*. The final section presents the major findings from the study and discusses the implications of outcomes.

2. Methodology

Evaluation Design

The evaluation design is quasi-experimental with carefully matched treatment and comparison groups. The design aims to approximate a randomly assigned control group by matching immersion schools with non-immersion schools possessing similar pre-intervention characteristics. For this study, interested districts and associated middle schools responded to a Request for Application (RFA) offered by the Texas Education Agency (TEA) to become technology immersion schools. Applicants to become Technology Immersion Pilot (TIP) sites had to meet eligibility requirements for Title II, Part D funds (i.e., high-need due to children from families with incomes below the poverty line, schools identified for improvement, or schools with substantial need for technology).

Twenty-two technology immersion schools, selected through the competitive grant process, were matched by researchers with 22 control schools on key characteristics, including size, regional location, demographics, and student achievement. The TIP grants targeted high-need schools, thus nearly 70% of students in the study come from economically disadvantaged backgrounds, with many schools in rural or isolated locations. Students are ethnically diverse, roughly 58% Hispanic and 7% African American. As noted in the introduction, two middle schools from one district (one treatment and one control) were removed from the study in the second year due to the damaging effects of Hurricane Rita. Therefore, second-year results are for the remaining 21 treatment and 21 control schools. A re-analysis of baseline data for the new sample revealed that school and student characteristics generally were unchanged and differences between groups remained statistically insignificant. Thus, the study's research design appears sound.

Information in Table 2.1 compares the baseline characteristics of immersion and the control schools. Information for individual campuses is provided in Appendix A. Results for *t*-tests show that the percentages of economically disadvantaged, minority, English as a second language (ESL), and special education students are statistically equivalent across the treatment and control schools. Likewise, results for student enrollment, mobility, and TAKS passing rates show no significant differences. Consequently, the treatment and control schools are sufficiently well matched on key demographic and academic performance measures. Moreover, both treatment and control samples include a range of campus and district enrollments and schools from diverse regions of the state. In these respects, the sample selection process and matching procedures appear to have produced a sample of schools with good internal validity, in that there are no large, statistically significant treatment-control differences. Still, the tendency for immersion schools to enroll greater proportions of minority and economically disadvantaged students may be important considering known links between disadvantaged status and lower achievement.

The primary limitation of the study is external validity—the extent to which the results of an experiment can be generalized from the specific sample to the general population. Schools eligible to become part of the treatment group were limited to those serving children from families living in poverty[1] and middle schools with grades 6 to 8. Only schools that applied for the grant, and submitted applications that met a threshold of quality, were eligible for consideration. Due to these restrictions, the treatment group is not representative of the average middle school in Texas.

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[1] Federal definition used: 27% of population or more than 2,500 people living below poverty line.

Table 2.1. Comparison of Baseline Characteristics: Technology Immersion (*N* = 21) and Control Schools (*N* = 21)

Variable	Condition	Mean	*SD*	95% Confidence Interval for Difference		
				Lower	Upper	*t* (40)
Enrollment	Immersion	374.9	348.4	-284.6	177.5	-0.47
	Control	428.5	391.3			
Economic disadvantage (%)	Immersion	70.8	17.5	-3.4	19.4	1.42
	Control	62.8	19.0			
Minority (%)	Immersion	68.1	28.4	-10.4	24.7	0.83
	Control	60.9	27.8			
ESL (%)	Immersion	13.5	17.2	-1.6	16.0	1.66
	Control	6.3	9.9			
Special education (%)	Immersion	14.7	5.5	-4.0	1.8	-0.76
	Control	15.8	3.7			
Student mobility (%)	Immersion	15.8	4.6	-3.8	2.8	-0.30
	Control	16.3	5.9			
TAKS 2004, Passing All (%)	Immersion	52.4	15.7	-9.2	8.5	-0.08
	Control	52.8	12.5			
TAKS 2003, Passing All (%)	Immersion	65.9	11.4	-9.1	5.5	-0.50
	Control	67.6	12.0			

Source: Texas Education Agency AEIS reports 2004
Note. TAKS = Texas Assessment of Knowledge and Skills. Differences between groups are statistically insignificant. Two campuses (one experimental and one control) were excluded from the groups in the second year.

The majority of students in the sample are economically disadvantaged. The percentage of sample students who qualify for federal free or reduced-price lunch exceeds the state average for middle schools (67% vs. 51%). The sample also is substantially more Hispanic and less white and African American than state middle school students as a whole. Overall, about 58% of sample students are Hispanic compared to about 37% of Texas middle school students. Conversely, the sample includes fewer African American students (7% vs. 14%) and white students (36% vs. 46%) compared to the state averages.

The sample schools also differ structurally from Texas middle schools as a whole. Middle schools in Texas, on average, enroll more students (667 vs. 402 in sample schools) and are concentrated in larger districts (11,575 students enrolled, on average, vs. 3,672 in sample schools). Thus, compared to the state overall, sample schools and the districts they reside in are smaller and serve more economically disadvantaged and Hispanic students. Differences almost certainly reflect funding restrictions (Title II, Part D) and the amount of available funds per grant. The maximum grant amount ($750,000) fell well short of dollars required to support one-to-one technology in larger middle schools.

Data Collection Methods

The data supporting this report came from surveys of teachers and students, combined with qualitative data collected during school site visits. Immersion and control teachers completed an online technology survey in spring 2006 (April to May). The survey included items related to school technology, teachers' technology proficiency and use, and professional development experiences. Students in sixth, seventh, and eighth grade completed paper-and-pencil questionnaires measuring their technology proficiency and use in spring 2006. For this report, the responses of immersion teachers and students were used to calculate measures of the implementation fidelity of technology immersion.

From late February to early May 2006, researchers conducted site visits at each of the participating campuses (22 treatment and 22 control).[2] Campus visits typically involved teams of two to three researchers who collected data for one to two days. During site visits, data collectors conducted interviews with principals, technology coordinators, and central administrators as well as focus groups with a sample of sixth- and seventh-grade core content-area teachers and students (approximately six to eight in each group). (See Appendix B for a comprehensive description of data collection methods.)

Data Analysis

Interviews and Focus Groups

For immersion campuses, verbatim transcriptions for interviews and focus groups were imported into ATLAS.ti for category development and thematic analysis. Coded output was summarized through the use of tables and summaries organized by respondent groups and the content of responses. Across interviews and focus groups, analyses focused on the role of technology in supporting student learning; the challenges of implementing a technology immersion project; the effects of the project on students, teachers, and classroom instruction; the level of support for the project from school administrators, teachers, parents, and community stakeholders; the characteristics and quality of teacher professional development; and student and teacher use of technology resources.

Following spring site visits to control campuses, researchers reviewed notes and audiotapes as a way to determine the extent to which technology conditions and practices had changed at each of the control campuses. Researchers wrote "reflections" on the school environment, administrative leadership, teachers and classrooms, students and learning, and changes in technology and other educational initiatives since spring 2005 visits. Analyses of reflections revealed that little had changed at control campuses since the previous school year (teacher and student survey data also confirmed stable conditions at control campuses). Control campuses in spring had similar access to technology, continued to use technology in similar ways, and continued to pursue their educational missions as articulated during previous site visits.

Implementation Fidelity of Technology Immersion

In the second year, descriptions of the extent to which immersion was implemented as designed provided contextual information for interpreting immersion effects on desired outcomes. To ensure that we had more reliable information, we refined our procedures for measuring the implementation fidelity of technology immersion in the second year. Sections below describe the characteristics of *technology immersion* and the use of *technology immersion packages* as a means to operationally define the treatment and ensure more consistent implementation across sites. Next, we describe our approach to measuring the level and quality of implementation.

Defining Technology Immersion

As a way to ensure consistent interpretation of technology immersion and comparability across sites, the TEA issued a Request for Qualifications (RFQ) that allowed commercial vendors to apply to become providers of technology immersion packages (TEA, 2003). Although state statute gives a general description of technology immersion, the concept and its component parts were defined operationally to foster continuity across treatment campuses. Vendor applicants to the RFQ had to include the following six components in their plan:

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[2] Researchers conducted site visits to two campuses that were excluded from analyses due to the effects of Hurricane Rita; however, findings for these schools are not included in this report.

- A wireless mobile computing device for each educator and student on an immersed campus to ensure on-demand access to technology;
- Productivity, communication, and presentation software for use as learning tools;
- Online instructional resources that support the state curriculum in English language arts, mathematics, science, and social studies;
- Online assessment tools to diagnose students' strengths and weaknesses or to assess their progress in mastery of the core curriculum;
- Professional development for teachers to help them integrate technology into teaching, learning, and the curriculum; and
- Initial and ongoing technical support for all parts of the package.

Through a competitive application and expert review process, the TEA selected three lead vendors as providers of technology immersion packages (Dell Computer Inc., Apple Computer Inc., and Region 1 Education Service Center [ESC]). Prices for technology immersion packages varied according to the numbers of students and teachers, the type of laptop computer, and the vendor provider. Package costs ranged from about $1,100 to $1,600 per student. Of the 21 immersion sites included in analyses, 5 middle schools selected the Apple package, 15 selected the Dell package, and 1 school selected the Region 1 ESC package (Dell computer). Table 2.2 provides an overview of the basic components within each package and the individual vendors that provided various products.

Table 2.2. Technology Immersion Packages

Component	Apple *N*=5 Schools	Dell *N*=15 Schools	Region 1 ESC *N*=1 School
Wireless laptop computer	Apple iBook G4	Dell Inspiron or Latitute	Dell Inspiron
Productivity software	AppleWorks	MS Office eChalk	MS Office eChalk
Online resources	Various	Various	Various
Online assessment	*AssessmentMaster*	*i-Know*	*i-Know*
Professional development	Apple Model	Pearson Achievement	Classroom Connect
Technical and pedagogical support	Apple, Campus/District	Dell, Campus/District	ESC 1, Campus/District

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), *KidBiz3000* 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) that is 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 are 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 must collaborate with vendors to develop their own professional development plans for 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 that leveraged its experience in one-to-one projects. 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 has an online and telephone HelpDesk to answer questions and provide assistance.

In sum, the RFQ process allowed the creation of technology immersion packages with common elements. Still, the complexity 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 Fidelity

Measurement of second-year implementation of technology immersion builds upon research conducted during the first project year. Direction for the refinement of the technology immersion model and its measurement came from first-year reports describing the nature of project implementation and factors that promoted or impeded success,[3] reviews of immersion packages, and discussions with project and vendor staffs. As in the first year, 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 campuses and comparing campus-to-campus variations with the vision for "full" implementation.

In contrast to the first year, we adopted a two-part approach in the second year. First, we used indicators to describe each campus' progress on a 4-step scale toward immersion standards. Rating scales for components and related elements identify four levels of immersion: *minimal* (0 to 1.99),

[3] Shapley et al. (2006a). *Evaluation of the Texas Technology Immersion Pilot: First-Year Results.* Austin, TX: Texas Center for Educational Research. Shapley et al. (2006b). *Evaluation of the Texas Technology Immersion Pilot: An Analysis of Baseline Conditions and First-Year Implementation of Technology Immersion in Middle Schools.* Austin, TX: Texas Center for Educational Research.

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 technology immersion using standardized scores (*z* scores). Both the immersion standard scores and implementation indices are derived from values for seven components. These components include measures for five supports for implementation (Leadership, Teacher Support, Parent and Community Support, Technical Support, and Professional Development) and two measures of the extent of implementation (Classroom Immersion, and Student Access and Use). Scores for components and their elements come from surveys of teachers (*N*=560, including 318 core-subject teachers) and students (*N*=7,022) at 21 treatment schools.

Table 2.3 provides descriptions of the technology immersion indicators that contributed to both the immersion standard scores and implementation indices. Appendix C provides additional technical detail on the measurement of implementation fidelity and scoring rubrics that describe the four levels of immersion for immersion components and their related elements.

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,[4] 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:

- **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 computed 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), and
- an overall implementation score for each school (Implementation Index).[5]

[4] Vernez, G., Karam, R., Mariano, L.T., & DeMartini, C. (2006). *Evaluating Comprehensive School Reform Models at Scale: Focus on Implementation*. Santa Monica, CA: RAND.
[5] Variables were standardized as z scores from their original scale or continuous variable values. The use of *z scores* rather than the *immersion standard scores* was necessary in order to aggregate data across variables that had widely varying standard deviations.

Table 2.3. Description of Implementation Indicators 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.
Parent and Community Support
To what extent do teachers believe that parents and the surrounding community support the school's efforts with technology.
Technical Support
To what extent do teachers indicate that technical problems with computers, Internet access, repairs, and material availability pose barriers to technology immersion.
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 X for a technical description of the measurement of implementation indicators.

3. Second-Year Implementation—Supports for Immersion

This chapter first presents campus-level results for the Implementation Index (*z* score), which provides an overall measure of technology immersion. Next, we use standards-based scores (measured at four levels) to describe the level of implementation for the model's support components (Leadership, Teacher Support, Parent and Community Support, Technical Support, and Professional Development) and implementation outcomes (Classroom Immersion and Student Access and Use). These sections are followed by findings on the extent to which schools provided the implementation supports considered essential to advance technology immersion. Throughout the chapter, we supplement quantitative findings with qualitative descriptions. School administrators, technology coordinators, and teachers offered their views during site visits to schools in spring 2006. Combining quantitative and qualitative data helps to explain the events that occurred during the second project year.

Campus Implementation Levels

Implementation Index

The Implementation Index for technology immersion provides an overall measure of the level of implementation. Campus-level results displayed in Figure 3.1 illustrate the variation in the levels of technology immersion for the 21 middle schools in the second project year. The Implementation Index, which measures the overall presence of the seven components of immersion, is a *z* score with a mean of 0 and a standard deviation of 1.0. The score for each campus, thus, indicates how many standard deviations from the mean a score lies. Campuses with scores above 0 have higher values on the components of technology immersion, whereas campuses with index values below zero show less evidence of the immersion components.

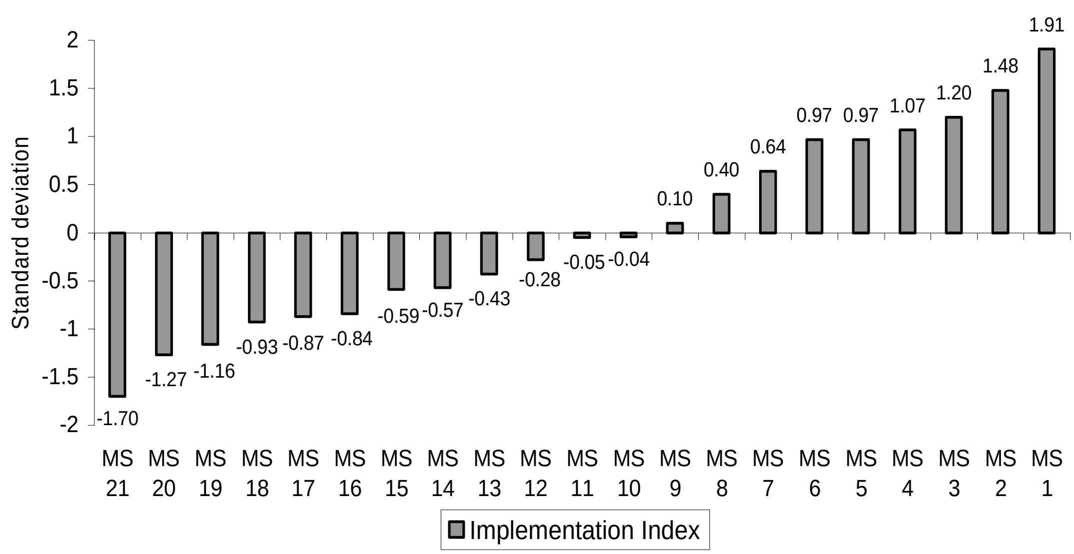

Figure 3.1. Campus means for 21 immersion middle schools (MS) on the Technology Immersion Implementation Index (standardized scores [*z* scores] with a mean of 0 and a standard deviation of 1.0).

Results suggest that about a third of middle schools (six), with Implementation Index scores ranging from 0.97 to 1.91 standard deviations above the mean, had a stronger presence of the technology immersion components compared with the other middle schools, thus a higher level of implementation. The expressed views of district and campus leaders and teachers help to explain campus-to-campus variations. (See Exhibit 3.1 for a summary of respondents' views on second-year implementation.)

Educators' Views on Second-Year Implementation

School-Level Change

About a fourth of interviewed administrators said that the second project year went more smoothly, and was less stressful, than the first. Campus leaders had already developed systems for distributing laptops, training students in appropriate use, obtaining parental permission, and providing technical support. Moreover, teachers had received some training so they were more comfortable using the laptops in instruction. Principals at three campuses reported that this year faculty and staff focused much more on technology integration, compared to the prior year. In the first year, teachers and leaders were more focused on mechanical and technical issues and "working out bugs" with initial implementation.

Exhibit 3.1. Second-Year Implementation Trends
Implementation Progress **+** Established laptop management procedures **+** Distributed laptops earlier, allowing a full year of use **+** Revised technology acceptable-use policies **+** Stabilized infrastructure **+** Increased Internet bandwidth to support lessons **+** Trained teachers became more comfortable with technology **+** Increased teacher focus on integration, less on technical
Implementation Challenges **-** Student population growth requiring more laptops **-** Competing reform initiatives **-** Administrator turnover (district and campus level) **-** Teacher turnover (need to train new teachers) **-** Some parent refusals of student laptops **-** Student Internet safety (accessing inappropriate sites) **-** Limited coordinator time for pedagogical support **-** Loss of teacher "buy-in" at some campuses
Source: Interviews with district and campus administrators and technology coordinators; focus-group discussions with core-subject teachers.

More than a third of technology coordinators felt very positive about their second-year progress toward immersion. Coordinators attributed accelerated progress to distributing laptops to students earlier in the year (allowing more time for technology use), stabilizing the campus infrastructure, and teachers' building on the previous year's experience with the computers. Conversely, nearly a third of coordinators at lower implementing campuses believed their schools had reached a plateau in the second year.

Districts and schools faced a number of challenges that stymied progress in the second year. First, administrators at four campuses said they experienced growth in their student populations. For these campuses, securing laptops for new students was a financial challenge, although additional grant funds provided by the Texas Education Agency (TEA) eased the burden. In at least one case, parents moved into the school's attendance zone so their children would get laptops. The initiation of competing reform initiatives was a challenge for some. One middle school attempted to simultaneously implement the district's new curriculum and online-delivery system along with technology immersion.

Some schools also had new principals and superintendents who had not been involved in developing and implementing the technology immersion model, and consequently, did not provide the leadership needed for continued progress. Moreover, extensive teacher turnover in some schools during the second year resulted in a need to start over again with professional development and integration plans. Technology coordinators also were taking on more administrative roles and had less time to visit classrooms and support teachers' technology integration efforts. Additionally in the second year, some parents chose not to let their children have an assigned laptop, which was due in part to increased insurance or deposit fees for laptop use. Administrators at four schools reported that students were less enthusiastic about the laptops in the second year because the novelty had worn off. Student access to inappropriate websites remained a concern at about a third of schools as they worked to enact effective acceptable use policies and procedures.

Teacher Change

Across half of campuses, teachers in focus groups said they were more comfortable using technology and were incorporating laptops in instruction to a greater extent during the second year. Most teachers indicated that the second year of immersion had progressed more smoothly because many of the frustrations of first-year implementation had been resolved. Teachers at four schools said their campuses had increased bandwidth in order to accommodate classroom Internet access, and several schools had revised their acceptable use policies, limiting students' access to email, games, and music or video downloads. Teachers at nearly a third of schools said they had received sufficient training in package tools and were able to use them in the classroom. Access to the laptops for the full school year also improved teachers' experiences with integration.

On two campuses, however, teachers said that the second year of implementation was more difficult than the first. On one campus, teachers attributed the difficulty to a loss of teacher buy-in caused by a wide variety of school changes, including a curricular reform initiative and drop in TAKS scores. On the second, teachers said that new sixth graders "had a lot less knowledge than the kids we've had in previous years" and that the students' poor academic skills created obstacles to immersion.

Technology coordinators' views generally mirrored teachers' opinions. About half of interviewed coordinators believed teachers were more comfortable with technology in the second year and were relying on technology more than they previously had. While some teachers appeared to be using the technology to do what they had always done—for example, projecting a lecture outline on the wall or a screen—other teachers used technology for more challenging classroom activities and assignments. Coordinators believed at least part of teachers' increased comfort level was due to their realization that technology is a tool, and one they can control like all the other tools used in their classrooms. Teachers at some campuses, according to coordinators, also may have recognized the degree to which technology makes their jobs easier, and this may have encouraged further exploration of classroom technology use.

Progress Relative to Implementation Standards

The Implementation Index (shown in Figure 3.1) is helpful in comparing the relative implementation level across immersion campuses. Educators' general comments also provide insight into second-year progress. However, it is also important to examine the degree to which individual middle schools are attaining the standards that represent what a substantially or fully immersed campus should achieve. Thus, as another way to gauge successful implementation, we used standards-based scores that described the extent to which immersion schools received various supports for implementation and the degree to which schools implemented the instructional and learning components of immersion as designed. Comments from administrators, technology coordinators, teachers, and students provided insights into quantitative results.

Progress toward technology immersion standards is measured at four levels (*minimal*, 0-1.99; *partial*, 2.00-2.99; *substantial*, 3.00-3.49; and *full immersion*, 3.50-4.00) across five supports for immersion (Leadership, Teacher Support, Parent and Community Support, Technical Support, and Professional Development) as well as measures of Classroom Immersion and Student Access and Use. Figure 3.2 displays the mean implementation scores by immersion components. In general, mean implementation scores ranging from 2.48 to 3.06 suggest that supports for technology immersion from school principals, teachers, the community, technical staff, and professional development providers fell short of expected full implementation standards (mean score of 3.50 to 4.00).

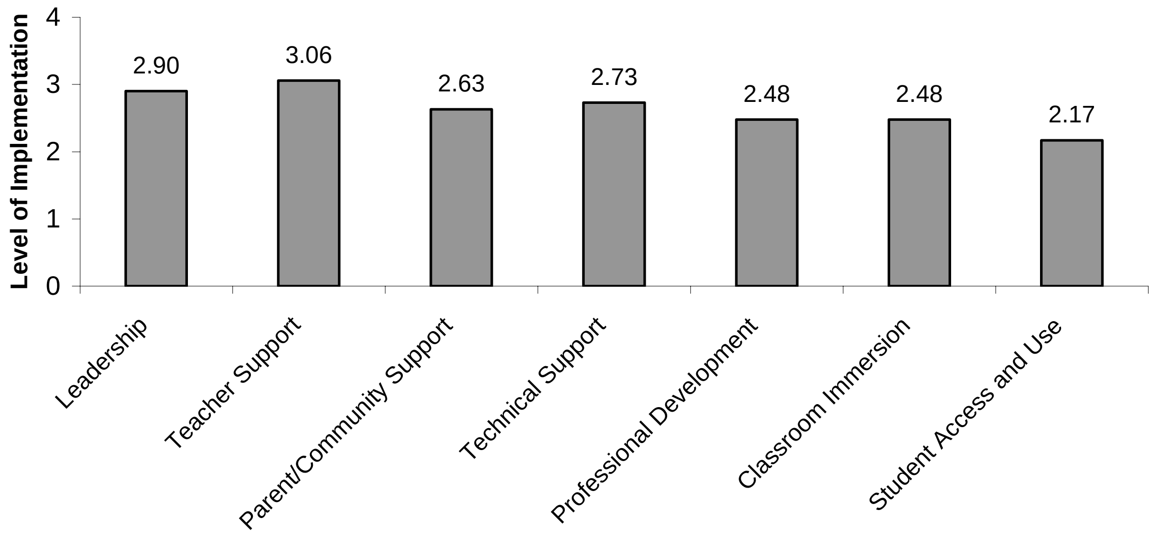

Figure 3.2. Mean level of implementation (measured on a 0 to 4 scale) for seven Technology Immersion components (N=21 middle schools).[6]

Given insufficient levels of support, classroom- and student-related immersion components had been implemented to only a modest extent. Teachers, on average, reported only *partial* levels of Classroom Immersion (M = 2.48) and students, as a whole, reported *partial* levels of technology access and use (M = 2.17). Results for the individual support components are discussed in detail below. Findings relative to Classroom Immersion and Student Access and Use are provided in Chapter 4.

Principal, Teacher, and Parent and Community Support

Momentum for the implementation of technology immersion depends upon the backing and support of school personnel, establishment of institutional norms, and assistance from the surrounding community. Figure 3.3 shows the implementation strength for immersion relative to school Leadership, Teacher Support, and Parent and Community support. Sections to follow portray the views of school leaders and core-subject teachers.

[6] Standards-based scores for Professional Development, Classroom Immersion, and Student Access and Use are averages across elements of these components. These scores serve descriptive purposes. Composite *z* scores are used in statistical analyses.

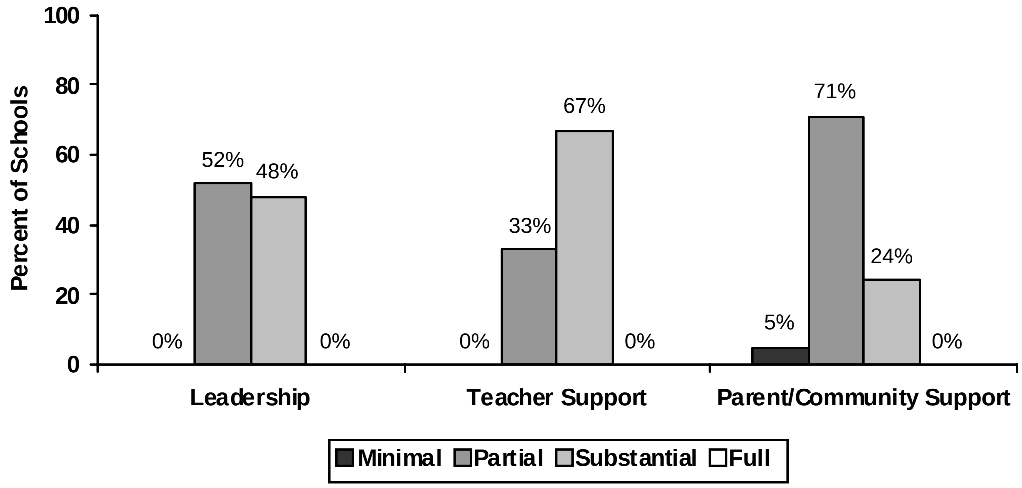

Figure 3.3. Percentage of schools at each implementation level for Technology Support (Leadership, Teacher Support, and Parent and Community Support).

Leadership for Immersion

School administrators play a key role as the champions for school innovation and change, managers of reform efforts, and providers of necessary resources. Accordingly, teachers at each school were asked to rate the extent to which their administrators, especially their school principal, provided leadership for technology immersion. Administrators demonstrated leadership through behaviors such as involving staff in decisions, setting clear expectations for technology use, encouraging and participating in professional development events, and providing resources and support. Results in Figure 3.3 show that teachers in half of schools (48%) reported substantial levels of support, indicating that they either *agreed* or *strongly agreed* that administrators provided technology-related leadership. An additional half of schools (52%) reported only partial levels of administrative support for technology.

Exhibit 3.2. Features of Successful Leadership for Technology Immersion
Set the Direction • Communicated expectations clearly • Developed, communicated, and enforced policies • Coordinated district and campus efforts • Garnered support from parents and school board members
Developed Staff • Acted as a technology coach or mentor to teachers • Supported professional development geared towards technology integration
Strengthened the Organization • Maintained leadership continuity for immersion
Source: Interviews with district and campus administrators and technology coordinators; focus-group discussions with core-subject teachers.

Successful leadership practices emerging from a qualitative analysis help to explain teachers' survey ratings (see Exhibit 3.2). Although no clear distinctions could be made between leadership practices at campuses rated as having either partial or substantial levels of administrative support, overall findings suggest that leadership for immersion was more effective if administrators established a clear sense of direction for technology immersion and helped build the capacities of staff. Successful leadership also addressed organizational conditions that advanced immersion, such as leadership continuity.

Set the Direction

Communicated expectations clearly. Supportive principals communicated their expectations by implementing formal measures that encouraged teachers to integrate technology into classroom practices. At some campuses, principals prescribed a particular frequency of technology use (e.g., using technology in instruction three times a week), although this approach reportedly met with limited success, and in some instances, amplified teacher resistance. Other principals focused on lesson planning and classroom observations. For example, a new principal realized in the middle of the school year that many teachers were not integrating technology into their instruction, so she asked teachers to submit lesson plans using technology, increased the frequency of classroom walkthroughs, and provided feedback to teachers on lessons observed.

In another district, central administrators conducted unannounced "curriculum sweeps" (i.e., visited middle-school classes). In another district, teachers were expected to work together in instructional clusters to create interdisciplinary units incorporating project-based learning and WebQuests. Some principals made technology integration part of their hiring practices. One principal said new teacher applicants had to describe their classroom technology use, and teachers' responses influenced hiring decisions.

Several technology coordinators favored higher administrator expectations. Coordinators at four lower implementing schools believed superintendents and principals should provide stronger leadership for classroom technology integration, such as requiring planning meetings for working on technology lessons plans or doing more classroom walkthroughs to monitor teachers' technology use.

Developed, communicated, and enforced technology policies. School principals played a key role in the development and implementation of policies underpinning technology immersion (acceptable use, laptop rollout and distribution, insurance, etc.) Moreover, supportive principals showed that they stood fully behind these policies and enforced the disciplinary consequences. One principal, for example, called students who violated the appropriate use rules into his office to discuss why student behavior violated policies. He also explained the school's laptop monitoring procedures, and as a result, he said very few students violated the rules more than once. In contrast, at some lower implementing schools, personnel were unclear about their policies. At one school, the principal and technology coordinator disagreed on what the disciplinary policies should be, and at two campuses, school leaders changed the policies regarding website access and email at midyear, resulting in student and parent frustration.

Coordinated district and campus efforts. Good communication and collaboration between district and campus leaders helped to facilitate technology immersion. One district, for example, scheduled weekly conference calls with principals, grant coordinators, and technicians during the first year, and in the second year, calls occurred monthly. During conference calls, participants shared information about technical problems, professional development plans, and other issues. Technology immersion schools, additionally, often were faced with costs that grant dollars did not cover. So, some district and campus leaders worked collaboratively to ensure the availability of adequate resources to cover costs. Without shared district and campus goals, implementation could be difficult. For example, in one district, the superintendent was disengaged from the project. He opposed giving students their own laptops, even as the principal and grant coordinator tried to convince parents and students about the value of technology immersion.

Garnered support from parents and school board members. Gaining parental support for immersion is crucial since parents must share personal and financial responsibility for laptops along with their children. In the second year, several schools reported problems associated with parental concerns about issuing student laptops. Still, proactive intervention by school leaders alleviated parents' fears. Principals at two schools reportedly telephoned, met with, or offered training for skeptical parents that addressed their concerns and helped them to understand the benefits of students having laptops. Principals and district leaders also needed to keep school board members informed about the merits of technology immersion. The technology coordinator at one district believed his district needed more vocal support and advocacy from school board members. Administrators in two districts said board members' support for immersion was contingent upon TAKS score increases. This pressure to show large test-score increases worried campus and district leaders. Some districts and campuses also wanted to continue or expand technology immersion with local funds after the grant expires, and school board buy-in was essential to accomplishing long-term goals.

Developed Staff

Acted as a technology coach or mentor for teachers. Support for teacher development was also important. Principals helped teachers by acting as a technology coach or mentor. One new principal, for example, planned in the third year to meet with each teacher individually to help them develop their own goals for technology immersion. Another principal said that he constantly worked to support teachers and remind them that "technology integration is the school's biggest goal." Several principals reported that they tried to model technology use by using email to communicate with teachers, using technology-based management systems for school record keeping, or using PowerPoint to make presentations.

Supported professional development geared towards technology integration. Supportive campus and district leaders designed and implemented professional development plans for technology immersion. At these campuses, principals found ways to schedule professional development events within the constraints of busy school schedules. In one district, the superintendent allowed almost all of staff professional development days to be allocated to technology immersion. In another district, teachers could purchase their laptops if they attended a specified number of professional development hours. In yet another district, teachers met district professional development requirements through summer participation in technology-related events. At one campus, professional development was scheduled for teachers during common, subject-specific planning periods. The same school switched to a block schedule in order to give teachers additional planning time for immersion.

Strengthened the Organization

Maintained leadership continuity for immersion. In the second year, about a third of campuses had new principals. New principals at these mainly lower implementing schools reported that they needed several months to get "up to speed" with the technology immersion project. Principal turnover was an even greater problem when new principals came to campuses with unenthusiastic teacher commitment to or limited understanding of technology immersion. Given that principal turnover is common in Texas public schools, some districts and campuses established leadership teams so that the loss of the principal did not derail technology immersion efforts. In one large district, for example, a district leadership team included the superintendent, assistant superintendent and executive director for curriculum and instruction, district curriculum content coordinators, executive director of technology, director of instructional technology, campus technology coordinators, campus professional specialists, campus principals, and campus technology specialists. This team approach promoted continuity and helped to ensure that a principal change at the middle school did not stall implementation progress.

Level of Teacher Support

Ample evidence demonstrates that teachers are central to the implementation of any initiative aimed at fundamental school change. Specifically, teachers' commitment to the reform is affected by their beliefs about the need for school reform and changes in classroom practice (Desimone, 2002;

Hargreaves, 1994; Fullan & Hargreaves, 1996). Teacher buy-in is critically important for technology immersion because teachers are to a large extent the mediators of students' technology experiences. Thus, it is noteworthy that teachers at immersion schools expressed moderate levels of support. Teachers at a third of campuses (33%) reported a partial level of support. That is, teachers at these schools were *unsure* that they shared an understanding about technology use for student learning, were continually learning and seeking new ideas, were not afraid to learn about and use new technologies, and were supportive of integration efforts. Although teachers at two-thirds of schools (67%) reported substantial support for innovative practices, their mean score (3.20) indicated reserved rather than strong support for technology immersion (Figure 3.3).

The responses of sixth- and seventh-grade teachers during focus-group discussions help to explain some teachers' reticent support for immersion. (See perceived benefits and challenges in Exhibit 3.3.) While teachers' comments tended to focus on the challenges of teaching with laptops, they were generally enthusiastic about the role of laptops in instruction and had difficulty imagining a return to their pre-immersion methods of teaching. Teachers appreciated that student laptops eliminated the need to schedule time in the library or in a computer lab. They said that their lesson plans were more varied, that students were more able to review and revise their work and work at their own pace, and that laptops provided opportunities for in-depth research, which sparked students' interest in topics that otherwise may not have interested them. Teachers on several campuses noted that as they became more comfortable using laptops, they adopted a more collaborative approach to planning lessons.

Exhibit 3.3. Factors Affecting Teacher Support for Technology Immersion
Perceived Benefits
+ Eliminates scheduling computer use in library or lab
+ Allows more varied lesson plans
+ Allows individualized student learning
+ Sparks student interest through In-depth research
+ Increases collaborative lesson planning
Perceived Challenges
- Reducing time for curricular coverage and TAKS preparation because of laptops
- Time-consuming preparation of laptop-related lessons
- Monitoring students' appropriate use of laptops
- Making arrangements for students without laptops
- Dealing with technical problems
Source: Focus-group discussions with sixth- and seventh-grade core subject area teachers.

On the contrary, many teachers noted obstacles to using laptops and technology resources in their classrooms that seemed to outweigh benefits. Teachers described five major challenges in using laptops in their classrooms. These included balancing laptops and curricular priorities, finding time for immersion, monitoring students' laptop use, dealing with students without laptops, and handling technical problems.

Laptops versus the curriculum. In spite of the instructional benefits of laptops, teachers were concerned with the amount of time absorbed by laptop instruction and were wary of falling behind in terms of curricular requirements and TAKS preparation. "…really quality work [using the laptop] takes more time…" explained one teacher, "So that is the biggest problem right now is trying to cover the curriculum." Teachers on another campus agreed, "…to get the same lesson, to get the same thing taught via the computer just simply takes more time than teaching it à la conventional methods," said one teacher.

Many teachers said that they strove to balance the demands of laptop integration with TAKS preparation. "I wish we had more time…" said a teacher in one focus group, "it's like with our [TAKS] objectives being such a focus, it's a lot easier to teach your objectives from your book and what you know and paper resources and then try to use the laptop to enhance it. We don't have that kind of time within a classroom period.” Teachers on two campuses attributed a drop in students’ TAKS scores to the amount of time spent on “technology-type stuff.”

Time demands. Teachers on many campuses said that they had limited time to devote to the demands of immersion and restricted their planning to resources that they felt comfortable using. “You focus on usually one or two things that work really well for you, and you stick with it,” explained one teacher, “It’s not that you wouldn’t want to use something else; you’re just limited with your time.” For some teachers, the summer months provided an opportunity to absorb the lessons of first-year implementation and plan for the second, and others said that an additional planning period was needed in order to fully achieve the goals of immersion.

Monitoring laptop use. Across campuses, teachers said that monitoring students’ classroom use of technology was a central challenge of integration. Students quickly became adept at hiding task bars and using the maximize/minimize functions of their computers to mask games, chatting, and Web searches unrelated to class activities. In response, teachers became skilled at recognizing the traces of duplicity in students’ expressions and reorganized their classrooms such that students’ laptop screens were visible. One campus installed software enabling teachers to track students’ Internet histories, and another purchased a sophisticated system that allowed technical staff to actively monitor students’ laptop use and shut down or freeze the computers of students engaged in off-task or impermissible activities.

Students without laptops. The high number of students without laptops also challenged teachers seeking to use laptops in class activities. Students’ reasons for not having laptops varied. Students were often without laptops during periods of service or repair. In addition, students were without laptops due to disciplinary confiscations, some students forgot their laptops or did not want to carry them to class, and on one campus, parent resistance to immersion resulted in a some students not receiving laptops.

Teachers said that it was difficult to find satisfactory remedies to the problem of students without laptops. Most campuses did not have sufficient loaner laptops, and most classrooms had only one or two desktops, which frequently were not loaded with the same software as student laptops. Pairing students reduced productivity and increased off-task behavior, and generating parallel lessons for students without laptops was burdensome for teachers and difficult to do when lessons focused on research-based activities.

Technical problems. Teachers on many campuses complained of technical problems that limited the classroom use of laptops. “Anything that can go wrong may go wrong” said one such teacher, “It’s kind of like the Marine Corps: You adapt, overcome, and endure.” Teachers reported a variety of technical problems, including inability to access the Internet, logjams and slow Internet connections resulting from insufficient bandwidth, laptop batteries that ran down over the course of the school day, as well as the associated problems of students without laptops because of repairs.

Level of Parent and Community Support

As explained earlier, parents must share responsibility for an expensive laptop computer with their child or children, so their understanding of and support for technology immersion is a key part of implementation. Additionally, the enthusiastic support of community members, including elected members of the local school board and business people, may influence the level of implementation through mechanisms such as the adoption of supportive policies, provision of resources, or promotion of positive public relations. More important, a lack of parent and community support has been associated with the failure of other school reforms (Desimone, 2002). Unfortunately, at most of the 21 middle schools, the level of parent and community support fell short of expected standards in the second year (see Figure 3.3). Teachers at three-fourths of campuses reported minimal (5%) or partial (71%) levels of parent and community support. On the other hand, teachers at a quarter of campuses reported a substantial level of support (24%), with teachers generally agreeing that parents and the surrounding community supported their efforts with technology.

During interviews in spring, a number of principals and district administrators discussed parental attitudes toward technology immersion that clarify teachers' ratings. At four campuses, some parents refused to give the school permission to issue a laptop to their child, and a few parents at one school did not want their children taking their laptops home because they worried about access to inappropriate websites. Parents at three of the lowest implementing schools did not want to assume responsibility for lost or damaged laptops. Students who were denied parental permission used laptops at school, but could not take them home.

Principals at two of the higher implementing campuses reportedly spent considerable time dealing with skeptical parents at the beginning of the second year. Both schools eventually convinced nearly all parents to let students take the laptops home. One principal estimated that a quarter of parents at first refused to let their children take the laptops home because they worried about inappropriate websites. However, the school addressed the problem by offering parents computer training, so that they could monitor their child's laptop use. The principal also telephoned each parent several times to discuss their concerns and convinced them that the laptop would help students develop skills as "self-learners." At both schools, principals helped parents understand that the laptops offered students skills and opportunities they would usually not receive in their rural community.

Technical and Pedagogical Support

Technical and pedagogical supports are critical aspects of the technology immersion model. As schools build their network infrastructures and acquire computer hardware and technology resources, ongoing technical support for all components of immersion and ongoing professional development in integrating technology into teaching and learning are essential for successful implementation. Accordingly, the TIP grant required that technology vendors and recipient districts provide comprehensive technical and pedagogical support services for immersion campuses. Sections below describe the nature of technical and pedagogical support provided during the second year.

Configuration of Support

More than three-quarters of technology coordinators said that staffing resources for both technical and pedagogical support were expanded in the second year to address hardware, software, infrastructure, and instructional integration issues experienced in the first implementation year. During the second year, immersion campuses had the following support configurations:

- The campus technology coordinator acted as coordinator of both technical and pedagogical support for immersion (about 80% of schools),
- the campus technology coordinator handled only technical issues (about 15% of schools), or
- the campus technology coordinator headed pedagogical support activities, and technical support was handled by a campus specialist and help desk, and by district specialists (one school or 5%).

In the second year, campus technology coordinators spent considerable time addressing technical issues, and the majority of coordinators relied on district technicians for assistance. Two of the larger campuses staffed a help desk to deal with laptop maintenance issues. Vendors, including Dell, Apple, the online software vendors, and local education service centers provided additional technical support for the campuses, or they served as a resource for problem solving.

Technology coordinators at many campuses had multiple assignments that diffused their efforts. For example, in addition to coordinating both technical and pedagogical support for immersion, six of the campus coordinators served as district technology directors or as other district administrators. Three of the campus coordinators also taught one or more classes at the middle school or high school level. These additional duties interfered with the coordinator's technical support role, and left little time for assisting teachers with classroom integration. About half of immersion campuses had a designated trainer or professional development specialist, in addition to the technology coordinator, who assisted with support for instructional integration of technology. At the remaining campuses, teachers received little or no pedagogical support from local staff. The nature of pedagogical support offered by campuses is discussed in the professional development section that follows.

Level of Technical Support

Technical support for immersion is expected to assist teachers with implementation and offer timely support when technical problems arise. Similar to other support mechanisms described previously, the level of technical support typically fell short of expectations (see Figure 3.4). Teachers at most campuses (81%) reported only a partial level of technical support for implementation. These teachers were generally *unsure* that school computers are kept in working order, requests for assistance are addressed in a timely way, Internet connections work adequately, and classroom materials are readily available. Teachers at a few campuses reported a substantial level of technical support (14%), and teachers at one campus reported a full level of support. Findings as a whole, consistent with teachers' comments in focus groups, suggest that inadequate levels of technical support for technology immersion challenged many middle school teachers.

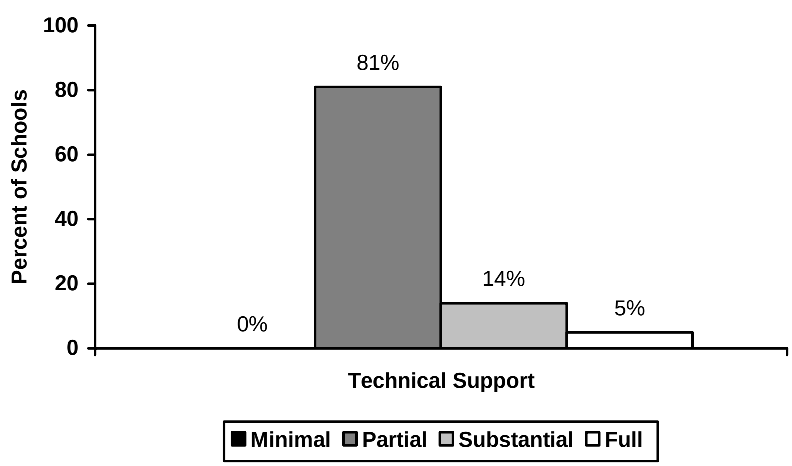

Figure 3.4. Percentage of schools at each implementation level for Technical Support.

Campus technology coordinators, like teachers, considered technical problems encountered in the second year as the most urgent support need and technical issues dominated the campus technology coordinator's role. Coordinators said they spent most of their time addressing hardware, software, and infrastructure issues. Many expressed an interest in working more with teachers in the classroom to integrate technology into the curriculum, but they typically said this would require additional staff to provide technical support, thereby allowing the coordinator to reallocate time for pedagogical support.

Technical support services. Teachers' limited proficiency contributed to technical work loads at immersion campuses. About half of coordinators said teachers most often requested technical support to assist with printer and peripheral issues, including adding printers and projectors, and printing documents. Teachers also requested assistance with network issues and Internet access problems, as well as using various software packages, resources, and utilities. While problems using the laptops and managing student accounts were less pervasive, technology coordinators reported dealing with these issues routinely. Similarly, across immersion campuses, teachers in focus groups reported a variety of technical support needs, including problems with printers, slow or faulty Internet connections, software difficulties, as well as problems arising from aging computers and student misuse. However, the most prevalent technical issue teachers reported arose from forgotten logins and passwords. Teachers suggested that the use of resources could be improved if passwords could be streamlined such that a single password was needed to access all programs.

Teachers were generally positive about the campus- and district-level staff that provided technical support services. Teachers in only one focus group said that technical support staff lacked the necessary skills to complete repairs and was frequently unavailable, but teachers on several campuses said that repairs took too long because technical support staff were "flooded with work." Teachers on some Dell campuses said they relied on Co-nect trainers for assistance with technical problems, and teachers on two campuses reported receiving technical support from an education service center or other support vendor.

Technical support improvement. Despite expanded levels of technical support in the second year, coordinators at seven campuses said they needed more technicians to assist with repair work. Two coordinators suggested that they be released from their teaching duties in order to devote more time to technical support. Likewise, teachers in about half of focus groups suggested adding more dedicated campus-level technical support staff. Teachers on three campuses said that technical support could be improved by relieving campus-level support staff of their teaching and administrative responsibilities.

Technological Environment

Technology coordinators also discussed specific aspects of schools' technological environments that influenced second-year implementation, including infrastructure, hardware maintenance, and Internet monitoring issues.

Infrastructure for immersion. At more than half of schools, the technology coordinators reported that the campus technology infrastructure (e.g., wiring, Internet connectivity) was more stable during the second year. One technology coordinator believed the campus infrastructure was immensely more reliable than the previous year, although the school continued to have wiring problems that stemmed from building construction errors.

Hardware maintenance. On both Dell and Apple campuses, technology coordinators reported that laptops required considerable repair in the second year. For the most part, laptop repairs were due to normal wear and tear, and manufacturing defects rather than student mishandling. Nearly all of technology coordinators at Dell campuses (13 out of 14 interviewed) reported laptop problems. Some A/C adapter plugs and motherboards had to be repaired, numerous chargers and power cords had to be replaced, and many batteries would not hold a charge after the one-year warranty period ended. At Apple campuses, nearly all of coordinators (3 of 4) reported laptop problems. One key problem was the replacement of motherboards due to some type of defect. Since repairs for Apple computers must be completed at the factory, schools had to purchase extra loaner laptops, which was a financial burden. A fourth of technology coordinators reported repairs or loss due to student carelessness. One campus had extraordinary hardware damage, which reportedly stemmed from disciplinary actions that caused some students to be deliberately carelessness with laptops.

Internet problems. About two-thirds of technology coordinators voiced concerns with students' accessing inappropriate websites or downloading music and software. Coordinators developed Internet monitoring approaches that reduced student access to inappropriate sites. As one technology coordinator explained, "We're just looking at a way to kind of lock down the computer a little bit more." Concerns about student Internet safety also raised coordinators' awareness of the need to educate parents regarding their role in monitoring children's Internet use. Additionally, as schools acquired more online learning resources, some coordinators saw a need for greater home Internet access. Many students at immersion schools did not have Internet access at home, and those who did, often were using inefficient dial-up services.

All told, even though campuses improved their infrastructure for technology immersion and expanded staffing levels to provide better support services, ongoing technical problems undermined progress towards full immersion in the second year. Aging laptops and unresolved Internet access and use issues created barriers to implementation.

Professional Development

Each of the technology immersion packages also was required to include a professional development component designed to support all educators on an implementing campus. The technology immersion model calls for professional development that instructs educators in effective classroom integration and is delivered through proven methods (i.e., learning through a variety of delivery systems, collaboration, sustained learning opportunities, and ongoing coaching and support). Findings for elements of professional development displayed in Figure 3.5 show that school staffs typically were not exposed to either the prescribed amount or type of professional development.

Although professional development providers were obligated to support all teachers, we concentrated on core-subject teachers because of their close association with measurable student outcomes. Teacher survey results show that core teachers at the majority of campuses received less than the prescribed hours of technology-related professional development over the first two implementation years (estimated to be about 80 hours). Teachers in about half of schools (52%) reported 35 or less hours of professional development (minimal level of implementation). In contrast, teachers in 43% of schools received nearly the requisite number of hours (substantial to full implementation).

Core teachers also reported that they typically received only minimal or partial levels of classroom support for technology immersion (33% and 67% of schools, respectively). This meant that teachers as a whole *rarely* (once or twice a month) or *never* received classroom coaching or mentoring from an internal source (such as another teacher or technology coordinator) or external source (such as a vendor-provided professional trainer). Core teachers who participated in technology-related professional development also expressed varying views on the extent to which activities supported the curricular and instructional goals of the technology immersion model. Teachers at nearly half of schools (43%) reported that the content of professional development placed a *minor* emphasis on curriculum, instructional methods, and lesson development in core areas (partial implementation). On the other hand, teachers at more than half of schools (57%) indicated there was at least a *moderate* to *major* emphasis on the prescribed content.

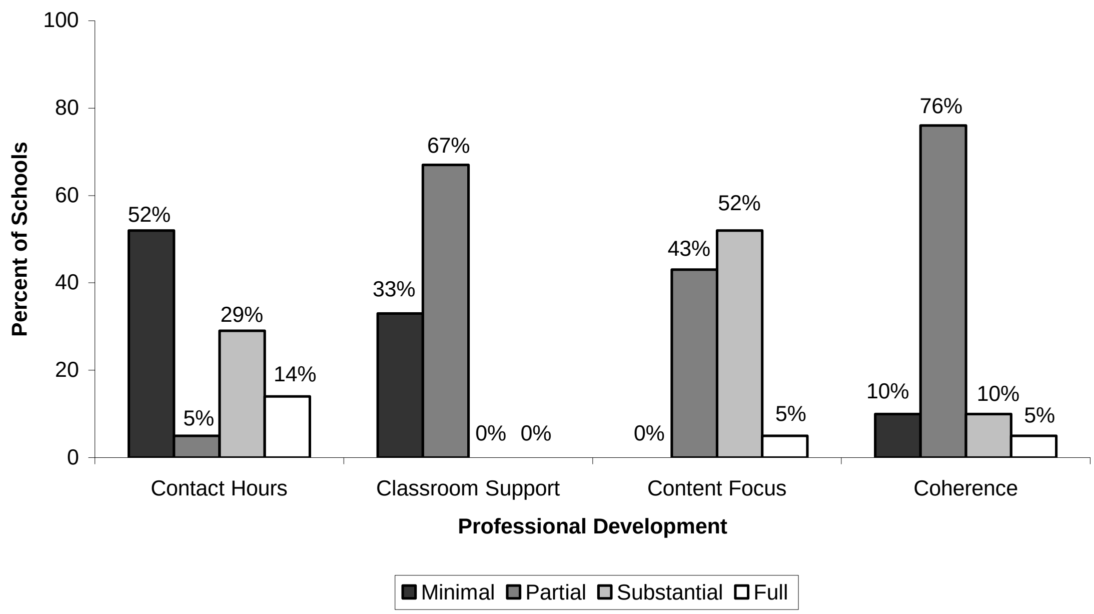

Figure 3.5. Percentage of schools at each implementation level for Professional Development (Contact Hours, Classroom Support, Content Focus, and Coherence).

Teachers also did not see the relevance of the technology-related professional development to their personal goals, earlier learning experiences, and state/district curriculum standards and assessments. Teachers at almost all schools reported that professional development was either *not at all* coherent (minimal implementation) or coherent *to a minimal extent* (partial implementation). Teachers at only a few campuses believed professional development was coherent to a *moderate extent* (substantial implementation) or *great extent* (full implementation).

In general, many core-content teachers did not receive the kind of professional development intended to advance technology immersion, and the nature of professional development varied widely across schools. Sections to follow summarize the views of school leaders and sixth- and seventh-grade teachers of core subjects on the nature and quality of professional development. Exhibit 3.4 provides an overview of respondents' views.

Nature of Events and Services

Decreased quantity and increased focus on teacher needs. Teachers on about a third of campuses said that the bulk of TIP professional development took place during the first year of implementation, and some teachers strained to recall that they had received any technology-related professional development during the second year. For teachers at a fourth of schools, second-year professional development was more focused on individual teacher needs and classroom support. One teacher explained:

> Last year, [the trainer] was pretty much teaching us what we needed to know. This year we are telling him where we have problems, and he's working with us on fixing our problems. Or if we come up with ideas and we don't quite know how to get from Point A to Point B, then he helps us to get where we need to be (teacher at an Apple campus).

Administrators offered few specifics about the quantity of second-year professional development, but, similar to teachers, almost all agreed that the amount of professional development seemed to have decreased in the second year.

Exhibit 3.4. Features of Professional Development Provided in the Second Year

Nature of Professional Development

- Decreased quantity at many schools
- Little training for teachers new to schools
- Shift from whole-group to individual teacher needs
- Content focused on use of online resources
- Increased diversity in training delivery modes (summer, after school, Saturday, conference periods)
- Increased diversity of professional development providers and venues (vendors, local staff, ESC staff, conferences)
- Minimal in-class support for individual teachers

Effectiveness of Professional development

- Difficult for teachers to retain content after training events
- Mainly increased teachers' technology knowledge and skills

Teachers' Professional Development Needs

- Subject-specific training
- Classroom modeling and support
- Assistance with lesson development

Source: Interviews with administrators and technology coordinators; focus-group discussions with core-subject teachers.

Minimal opportunities for new teachers. Teachers who were new to campuses in the fall of the second year reported receiving very little professional development. New teachers on one campus said they received professional development on package tools at the start of the year, but no follow-up training. On three other campuses, new teachers reported that the training they received was insufficient to meet the demands of immersion, and on another campus, new teachers said they received no training. The only new teacher reporting sufficient training taught at a middle school in which the district had extended technology immersion to the high school. This teacher attended the introductory trainings offered at the high school as well as trainings at the middle school and was satisfied with his ability to incorporate laptops in instruction.

Content focused on identifying online resources. Similar to the first year, teachers at about a third of schools said that professional development activities focused on the identification of online resources and lesson plans. The identification of online sites was so pervasive that some teachers felt this was the service schools were purchasing from professional development vendors: "[The trainer's] job is to try to find us some sites that are really interactive, that the kids can get to," explained one such teacher, "[The trainer will]… put them on to eChalk, the web page, where we can go directly to them."

For other teachers, the identification of online resources was the most useful aspect of professional development. "...all those ideas I've gotten from professional development that gives insight of where we can go to get lesson plans and do the games and everything like that," explained one teacher, "That's where I get most of my information." A teacher on another campus valued sites that provided TEKS-aligned materials, saying, "I know one site [the trainer] gave us was awesome. I mean, it's broken down by the TEKS and everything…It's wonderful."

Diverse schedules for professional development activities. Generally speaking, teachers said that second year activities were scheduled to reduce the amount of class time lost to professional development. Teachers said that professional development was offered in the summer months, after school, on Saturdays, and during conference periods. Teachers said these schedules reduced the need for substitutes, but that some activities, such as those offered during conference periods, were too rushed to be of much use. Teachers on another campus were frustrated with conference period trainings that reduced their planning time. About a fourth of administrators reported moving away from large-group sessions ("sit-and-get") and towards one-on-one work and/or in-class support from professional development providers.

Increased reliance on other professional development providers. As vendor-provided professional development diminished over the course of the second year, immersion campuses increased their reliance on other sources of professional development. Teachers on about half of campuses said they relied on district- or campus-level pedagogical and technical support staff for assistance that they previously received from vendors. Teachers said that local staff provided follow-up instruction in package tools and helped with Microsoft Office applications, modeled lessons and provided in-class support, and helped in locating useful resources. Teachers on one campus explained that their campus-level trainer had always intended to provide this assistance, but that the demands of implementation taxed her time during the first year:

> She wants to come into the classroom and teach, and last year there were so many fires to put out that a lot of times, she was taken away from what she wanted to do, which was get in the room and do stuff with you, and this year, she's been more able to do that.

In addition to campus- and district-level support for professional development, teachers at nearly a third of schools said they attended technology conferences. Teachers who attended conferences frequently said that conference activities were their most valuable professional development activity, noting that they were able to attend subject-specific trainings and that conferences covered a broad range of immersion topics. On three campuses, teachers said that they received a substantial portion of their professional development from educational service centers (ESCs), and on another campus, teachers instructed one another in immersion topics.

Pedagogical Support in Classrooms

Vendor-provided in-class support (modeling, mentoring, and coaching). All of the campus technology coordinators reported that their Dell or Apple vendors, ESC staff, software representatives, or other vendor contacts provided support for classroom immersion. The coordinators described vendors working with teachers to plan lessons integrating technology, modeling technology use in the classroom, visiting classrooms to support teachers, co-teaching lessons involving technology, providing information on online resources to incorporate into lessons, and providing training on the online resources that could be used with students.

In contrast to optimistic reports provided by technology coordinators, the number of teachers reporting having received in-class professional development from vendor trainers varied across campuses, and in some cases, the in-class activities they described occurred during the first year of implementation. Teachers on five campuses reported receiving no in-class training. Teachers on seven other campuses reported receiving in-class support, but the characteristics of the support they described tended to vary widely.

Some teachers said that they observed as trainers modeled lessons. Other teachers described brief visits in which the trainer would "sit-in, like a visit" and provide feedback. "[The trainer] will ask us if we're using whatever program he trained us in. And then he'll say, if you have any questions, let me know," explained a teacher in one focus group. On another campus, teachers described in-class professional development activities that are better defined as technical support. The trainer repaired a computer in one classroom and assisted the teacher in loading software in another.

Campus/district-provided in-class support (modeling, mentoring, and coaching). Almost all of the campus technology coordinators said they were responsible for supporting teachers in integrating technology into the curriculum. However, as noted earlier, campus technology coordinators felt they had little time to devote to pedagogical support, so this support most often was obtained from others. At about half of campuses, district personnel assisted in providing instructional support and professional development for teachers. Also, at a third of campuses, technology coordinators relied on teachers to present or share information on technology integration with their colleagues, as well as to mentor or serve as a resource for teachers new to technology.

Despite the varied ways of providing in-class professional development, many teachers were aware that in-class modeling and coaching were available to them if they should request it, but few said that they asked for such assistance. Teachers' comments on the frequency of classroom support generally mirror survey findings suggesting that teachers, on average, *rarely* or *never* received classroom coaching or mentoring. Teachers also commented on the effectiveness of professional development and their present needs.

Effectiveness of Professional Development

Difficulty retaining content. Many teachers said they had difficulty retaining the content of professional development activities. Some said that the pace of trainings was too fast and they could not remember all that was taught. Others said that they lacked sufficient opportunities to practice what they had learned.

> If you don't go to a workshop and then use it within the next week, chances are, you're not going to use it, because you forget, and then you go back and you look at it later saying, 'I don't even remember how to get into that.'

Increased technology knowledge and skills. Teachers described few notable effects of professional development beyond their increased comfort using technology and immersion package tools. Those that described effects tended to cite nominal changes, such as using PowerPoint to present lessons, using LCD projectors, and using online resources. One teacher described how she had changed her instructional approach as a result of professional development:

> I'm getting to the point to where I'm not going to be using those old-fashioned transparencies anymore. It's really neat, and the thing is it catches the students' attention because, you know, you add the colors and they remember and things like that.

A teacher on another campus was frank about the lack of change in his classroom: "I'm really no different than I was before, except it's on laptops. You know, it's pretty much the lecture and do the worksheet, do the quiz, and then go play games."

Professional Development Needs

Content and classroom support. Teachers on two campuses noted a need for more training in math; however, teachers on four other campuses said that vendors focused their attention on math teachers during second-year implementation. A teacher on one campus expressed a need for more classroom modeling and support, explaining:

> Actually being able to go back into my classroom and integrating it, I've not been real good at that. You know, I need more practice with it, maybe somebody coming in and helping me modeling it with my kids so that I can see how they're wanting us to use it.

Assistance with lesson development. On another campus, teachers felt that attention to lesson planning would be more instructive than classroom modeling:

> Instead of having someone come in and demonstrate to my classroom, I would personally like someone to do a hands-on thing with me and maybe guide me in helping to create more lessons that are technology-based. If you show me, "Eh." But if you walk me through it and let me do it, I'm going to get a lot more out of that and use it more often.

As a whole, findings on professional development raise concerns about the extent to which the developmental support provided for teachers at immersion campuses in the second year was sufficient to advance the goals for curricular integration of technology.

Conclusions

In the second year, we measured implementation using standards defining four levels of immersion (*minimal, partial, substantial,* and *full*). These standards produced measures for immersion support components and components for teachers' classroom immersion and students' technology access and use. Major findings on implementation and supports for immersion include the following.

- The majority of middle schools did not fully implement the prescribed components of technology immersion in the second year. Mean implementation scores ranging from 2.48 to 3.06 suggest that supports for technology fell short of full implementation standards (mean score of 3.50 to 4.00).
- Although most campuses did not reach the highest levels of implementation, school leaders and teachers cited noteworthy improvements relative to laptop management procedures, earlier distribution of student laptops, stabilization of school infrastructures, and implementation of acceptable-use policies. Moreover, teachers who had received training in the first year were more comfortable with technology and this permitted greater focus on classroom integration.
- Implementation progress was hampered by obstacles such as supplying laptops for larger student populations, competing reform initiatives, administrator and teacher turnover, insufficient pedagogical support for teachers, some parent refusals of student laptops, student Internet safety, and loss of teacher buy-in at some campuses.
- Many immersion schools needed stronger supports in the areas of school leadership, teachers' commitment to innovative technology practices, parental support for students' technology use, and technical support to deal with repairs associated with aging laptops and Internet access and use issues.
- In general, many core-content teachers did not receive the kind of professional development intended to advance technology immersion, and the nature of professional development varied widely across schools.
- The quantity of professional development supporting immersion decreased in the second year, and new teachers, in particular, did not receive adequate training to prepare for classroom immersion. The nature of professional development shifted in the second year from whole-group sessions to more individualized training delivered through various scheduling configurations and by multiple training providers. In-class support for teachers occurred infrequently, and when offered, teachers seldom took advantage of opportunities.

4. Second-Year Implementation—Classroom and Student Immersion

This chapter describes teachers' progress in creating technology immersed classrooms and the nature of their students' technology access and use. We first present implementation findings on five elements of Classroom Immersion for core-subject teachers (English language arts/reading, mathematics, science, and social studies). Next, we describe three aspects of Student Access and Use. Throughout the chapter, we supplement quantitative measures with qualitative descriptions. Teachers and students expressed their views during focus groups conducted at each immersion school in spring 2006. The blend of qualitative and quantitative information provides a more complete picture of the second-year experiences of teachers and students.

Level of Classroom Immersion

Given needed equipment and digital resources and support for technology immersion, teachers are expected to design technology-enhanced learning environments and integrate technology into teaching, learning, and the curriculum. Ideally, a technology immersed classroom provides a means for more engaged, relevant, meaningful, and personalized student learning. Table 4.1 illustrates teachers' level of implementation relative to five elements of Classroom Immersion: Technology Integration, Learner-Centered Instruction, Student Activities (with technology), Communication, and Professional Productivity. Overall, teachers at schools typically reported only minimal to partial levels of implementation for the elements of Classroom Immersion.

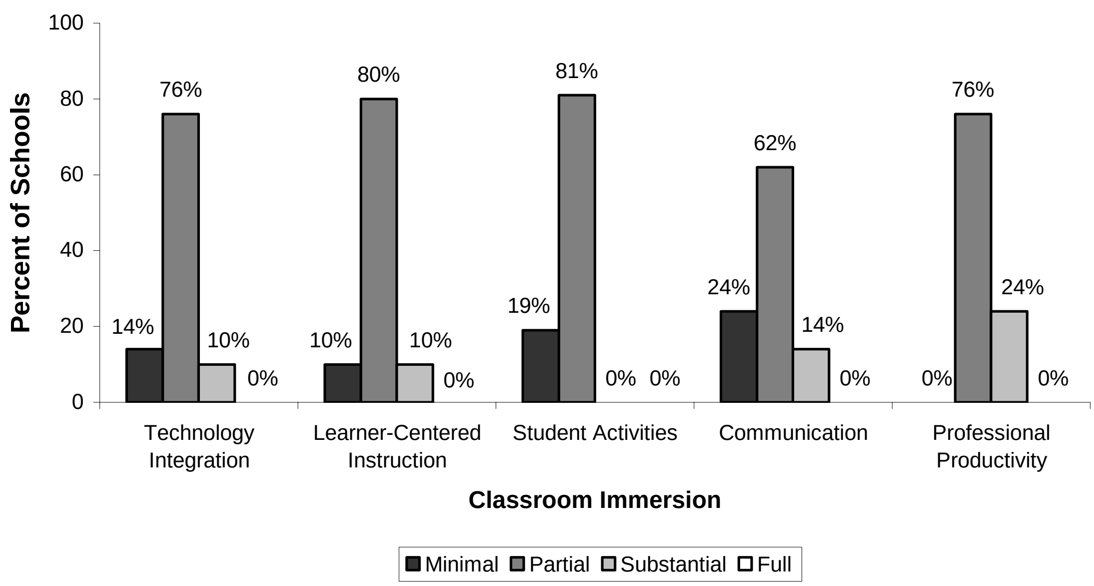

Figure 4.1. Percentage of schools at each implementation level for the elements of Classroom Immersion (Technology Integration, Learner-Centered Instruction, Student Activities, Communication, and Professional Productivity).

Technology Integration and Learner-Centered Instruction

Just as a school's teachers as a whole must buy-in to the concept of technology immersion, individual core-subject teachers also must believe that new technologies are relevant to their particular curriculum and instructional practices and that new methods have the potential to positively influence student outcomes. Researchers have found that teachers embrace change more strongly when the pedagogical design of reform models is compatible with their own ideology (Datnow & Castellano, 2000). For the technology immersion model, teachers reported the strength of their affiliation with technology integration and learner-centered instruction. Notably, teachers at nearly all of campuses reported only minimal (14%) or partial (76%) levels of affinity for Technology Integration. Teachers at these schools reported it was either *not true* or just *somewhat true* that they now modify their instructional practices in significant ways through technology. In contrast, teachers at a mere 10% of schools indicated that it is *somewhat* to *very true now* that they alter their instructional practices, allocate time, integrate current research on teaching and learning, improve basic skills, and support higher-order thinking through technology (substantial immersion).

Teachers' responses relative to Learner-Centered instruction mirror their beliefs about technology integration. Teachers at almost all of schools reported only minimal (10%) or partial (80%) levels of implementation relative to the adoption of learner-centered practices. Core teachers at these campuses indicated that it was either *not true* or just *somewhat true* that their students establish learning goals, use information and inquiry skills, complete alternative assessments, and have active and relevant learning experiences. Teachers at just 10% of campuses reported a substantial level of implementation, saying that it was *somewhat* to *very true* that they now use learner-centered methods. Overall results suggest that core-subject teachers at many schools are not strongly committed to the instructional and learning practices advocated as part of technology immersion. The challenges teachers described in implementing immersion reported earlier (i.e., curricular conflicts, time demands, classroom management issues, students without laptops, and technical problems) may at least partially explain teachers' beliefs.

Student Activities

Teachers in immersed classrooms also are expected to have their students use technology resources to support core-content learning on an almost daily basis, but at the majority of schools (81%), teachers reported that their students just *sometimes* (once or twice a month) use various technology resources to support core-content learning (partial implementation). For example, students sometimes use a word processor to write a story, use software to learn and practice skills, create a presentation, or conduct Internet research. On average, teachers at none of the campuses reported substantial to full implementation, with students using technology resources *often* (once or twice a week) to *almost daily*. At a fifth of schools (19%), students *rarely* (a few times a year) or *never* use technology resources (minimal implementation). Sections below summarize teachers' focus-group comments about the use of laptops in each of the core subjects: English language arts and reading (ELA), social studies, science, and mathematics. Exhibit 4.1 provides an overview of student activities. Although the overall frequency of teachers' technology use did not reach established standards for either substantial or full implementation, teachers who participated in focus groups described a variety of ways that they used laptops in their ELA, social studies, science, and mathematics classrooms during the third year.

English Language Arts and Reading

Across immersed campuses, ELA teachers said students used laptops to research information about the stories they read and authors they studied, to keep journals (often in the form of blogs), and to write original stories. Teachers at three campuses used computers to play recorded versions of class readings aloud for students. ELA teachers at more than half of campuses required students to present their work using presentation software such as PowerPoint or Keynote, although one teacher noted that the heavy use of presentations across subject areas was diminishing students' interest in such activities. Students at some schools used graphic organizers to outline stories and create diagrams representing characters, settings, and the elements of plot, or online dictionaries to complete vocabulary activities.

While most ELA teachers were pleased that students were more interested in writing when they used laptops, teachers at three campuses raised concerns that the spelling and grammar functions of word processing programs had "created a crutch" because students no longer looked up misspelled words or paid attention to errors in syntax or grammar. Seventh grade teachers on six campuses (mainly lower implementing) said that they avoided using laptops in preparation for the TAKS writing test because the exam required students to use pencil and paper. One 7th grade teacher explained, "I have not used them [laptops] as much this year because we're so focused on the TAKS test… since the test is paper and pencil, that's how they [students] practice, and, unfortunately, that's our focus, the test."

Exhibit 4.1. Student Activities in Core-Content Classrooms (Teacher Views)

ELA	Social Studies	Science	Mathematics
Research information on stories/authors, keep journals, write stories	Conduct research on assigned topics	Conduct research on assigned topics	Play math games after completing traditional paper-pencil work
Present work (PowerPoint or Keynote software)	Present work (PowerPoint or Keynote software)	Present work (PowerPoint or Keynote software)	Complete assessments (TMDS, textbook, Study Island, etc.)
Use resources (My Access Writing, Study Island, KidBiz, etc.)	Use electronic textbooks	Use electronic textbooks	Use spreadsheets for skills, graphing
Use graphic organizers for stories or literary elements	Conduct WebQuests to gather information	Conduct virtual experiments	Use resources (Gizmos, Unitedstreaming, math websites, etc.)
Define vocabulary words	Take virtual tours or trips	Use word processors for notes, Excel for charts	
	Use resources (Inspiration, online newspapers, Unitedstreaming, etc.)	Use resources (Study Island, Inspiration, online dictionary, etc.)	

Source: Teachers' reports of technology use in core-content classes, with activities generally ordered high to low by the frequency with which teachers mentioned activities at the 21 immersion campuses.

Teachers on two campuses, however, noted that My Access Writing was a useful tool in preparing students for the TAKS writing test. They explained that the program provided immediate feedback in the form of a TAKS-like score. "They [students] do pre-writing" one teacher explained "…We make revisions, and then we go on My Access Writing and type their final copy. And it sends it to the company, and they get a 1, 2, 3, or 4 score, just like on the TAKS." A teacher on another campus felt that the scoring function of My Access Writing was not calibrated properly, and this engendered doubts about the validity of grades. Sixth grade teachers at four schools, conversely, appreciated My Access Writing, noting the program provided immediate feedback and took the grade out of teachers' hands, eliminating perceptions of teacher bias. Sixth grade teachers on another campus felt that My Access Writing was "way too advanced" for their students.

In terms of other technology-based resources, ELA teachers at a third of campuses said they used Study Island to prepare students for TAKS tests. Teachers on four campuses said they used netTrekker to conduct online research, and teachers at three campuses said they used Connected Tech and Unitedstreaming with their classes. ELA teachers across five Apple campuses said they frequently used KidBiz, noting that the program adjusted for students' reading levels and provided rapid feedback to student work. Teachers on two Apple campuses said they liked using Beyond Books for reading activities; however, teachers on another campus were dismissive of the program because it did not have activities for the texts they taught.

Social Studies

Social studies teachers on all immersed campuses said that laptops enhanced their ability to conduct research with their students. Teachers said social studies “came alive” as students accessed “more exciting, more interesting, [and] more varied” information using laptops, and that laptops provided access to more up-to-date information than textbooks. At a fourth of campuses, teachers said laptops enabled students to take virtual tours or field trips of far away places and to use online newspapers to study current events. Students at a fourth of campuses conducted WebQuests to gather information, and social studies teachers at about half of campuses had students present their findings using PowerPoint. Several teachers said they used Unitedstreaming video clips to animate portions of their social studies lessons and Google Earth to enliven geography activities. Social studies teachers at three schools used graphic organizers, such as Inspiration, and teachers at six schools used online versions of their textbooks. Seventh grade teachers on five campuses noted a need for more technology-based resources for Texas History.

Science

Science teachers in focus groups at a third of campuses said they made frequent use of laptops in their classrooms, noting that it was “easier to fit technology in” science than in other subject areas because of the prevalence of technology-based science resources. Using online resources, students in more than half of immersion science classrooms conducted virtual experiments, such as frog dissections, heart transplants, and rocket launches, and researched a wide range of science topics. And, similar to other subject areas, science teachers frequently asked students to use Keynote or PowerPoint to present their research.

Science teachers at a few campuses said they used graphic organizers, such as Inspiration to create diagrams and that students used Paint to illustrate science concepts. Science teachers at several schools had students take notes using word processing programs, create charts using Excel, and find vocabulary words using online dictionaries. Teachers on five campuses said they used TAKS-aligned resources, such as Study Island and SAILOn (Subject Area Interactive Lessons On-line), to prepare students for the TAKS science test. Teachers at more than a third of campuses used online or CD versions of their science textbooks. Teachers said that students preferred using computer texts: “They don’t like to open up their book and look for questions and read. So having it on the computer made it so much easier. They were willing to look it up and see the text there and see the pictures. It’s interactive, so that was easier,” explained one teacher.

Mathematics

While teachers on three campuses reported that technology use in math classes had improved during the second year of implementation, math teachers in about half of schools felt that it was difficult to integrate laptops in their classes. Math teachers in a fourth of schools said they had difficulty using laptops because there were too few technology-based math resources. And teachers in a third of schools felt that students needed to learn math concepts and prepare for the TAKS test by working problems out using pencil and paper. One teacher explained:

> Honestly, I think it’s really hard to use this stuff for math, especially with the TAKS test having so much pressure on it. I think that, in my opinion, the best way for kids to learn math is pencil and paper and actually working it out themselves.

A teacher on another campus agreed:

> To me in math, it's a little more difficult to get there because everything we do is basically paper/pencil. The TAKS test is going to come down to paper/pencil, being able to do it. Where with the computers, they're able to easily get to the calculator, and they're always using the calculators and things like that. Well, on the TAKS test, they're not going to have that advantage.

Teachers at about half of schools said they taught math concepts using traditional methods and materials, such as the chalkboard, textbook, and worksheets, and used laptops to extend and enrich the concepts presented in the lesson. In most instances, the extension activities involved math games that students were permitted to play once they completed paper and pencil activities.

Teachers said that immersion package resources for math were focused on assessment. "In math, they gave us several assessment tools, but not necessarily teaching tools," noted one math teacher, "You know, assessment is part of it, but it's not the majority of what I do; the majority is teaching." Not surprisingly, at nearly half of schools, the use of assessment tools was widespread among immersion teachers, and the Texas Mathematics Diagnostic System (TMDS) was the most widely used. However, campuses implemented TMDS in different ways. On some campuses, TMDS was reserved for enrichment activities such as tutorials or "enrichment days," while on other campuses, a supervisor provided math teachers with handouts of problems drawn from the TMDS test bank. Teachers on some campuses said they had difficulty using TMDS because the program was not set up properly for their classes or because the bank of test questions was too small. In addition to TMDS, math teachers at about half of schools said they used assessment tools included as part of the online or CD versions of their textbooks or included as part of a math website, such as AAA Math or Study Island.

Beyond the use of assessments, teachers at a third of schools said they used spreadsheet programs to teach math skills, particularly those that related to graphing. Teachers at a few schools found Unitedstreaming video clips to be a useful tool in illustrating math concepts; others used presentation software, such as PowerPoint, to present math lessons. Teachers on several Apple campuses said that Gizmos was a useful program for teaching math, and teachers at a fourth of campuses said they relied on math websites, including SAILOn, AAA Math, and the International Library of Virtual Manipulatives to teach concepts.

A few math teachers said they used laptops for research projects, such as planning and budgeting for a vacation or developing a dictionary of geometry terms, and others said they simply replaced overhead-based activities, such as worksheets, with computerized versions of the same materials.

Communication and Professional Productivity

The wireless computing devices and supporting software provided through technology immersion packages also supported communication and productivity (see Figure 4.1). Appleworks provided a suite of communication tools at the Apple campuses, and at Dell campuses, Microsoft Office and eChalk provided software and a web-based portal for resources and email. Despite the availability of these communication tools, teachers at a quarter of campuses (24%) reported they *rarely* (a few times a year) or *never* used technology to communicate with students, parents, or their colleagues, or to post information for students on a class website (minimal implementation). Teachers at an additional two-thirds of schools (62%) just *sometimes* (once or twice a month) used technology for communication. On the other hand, teachers at a few campuses (14%) reported a substantial level of implementation, with email and web-based communication tools used *often* (once or twice a week).

In contrast to other elements of Classroom Immersion, teachers used technology more often to enhance their professional productivity. Teachers at three-quarters of campuses (76%) reported they *sometimes* used technology for activities such as keeping records, analyzing data, developing lessons, and delivering information using presentations, and teachers at another quarter of campuses (24%) reported a substantial level of implementation, with technology used *often* (once or twice a week) for professional productivity purposes.

Overall, findings indicate that teachers generally did not take full advantage of the instructional and learning resources provided as part of the technology immersion packages. Teachers' reported levels and kinds of technology use are generally consistent with other research on teachers' adoption of technology-based practices. In the early stages of implementation, teachers discover the potential of technology use for increased productivity and begin to use it as an instructional tool on a limited basis (Sanholdtz, Ringstaff, & Dwyer, 1997). The sections below provide information on technology immersion from the student perspective.

Level of Student Technology Access and Use

The transformation of instructional practices is a critically important part of technology immersion, but the model also assumes that students must have access to a personal laptop both within and outside of school to support their development as independent and self-determined learners. Thus, in a fully immersed school, (a) *all* students should have access to wireless laptops and resources nearly the entire school year (about 170 to 180 days), (b) they should use technology resources for core-content learning almost daily, and (c) they should use their laptops extensively outside of school for homework and other learning activities.

Figure 4.2 and sections to follow explain second-year progress relative to three elements of Student Access and Use: Laptop Access Days, Core-Content Learning, and Home Learning. Information on students' technology use comes from surveys of sixth, seventh, and eighth graders and focus-group discussions with randomly selected sixth and seventh graders.

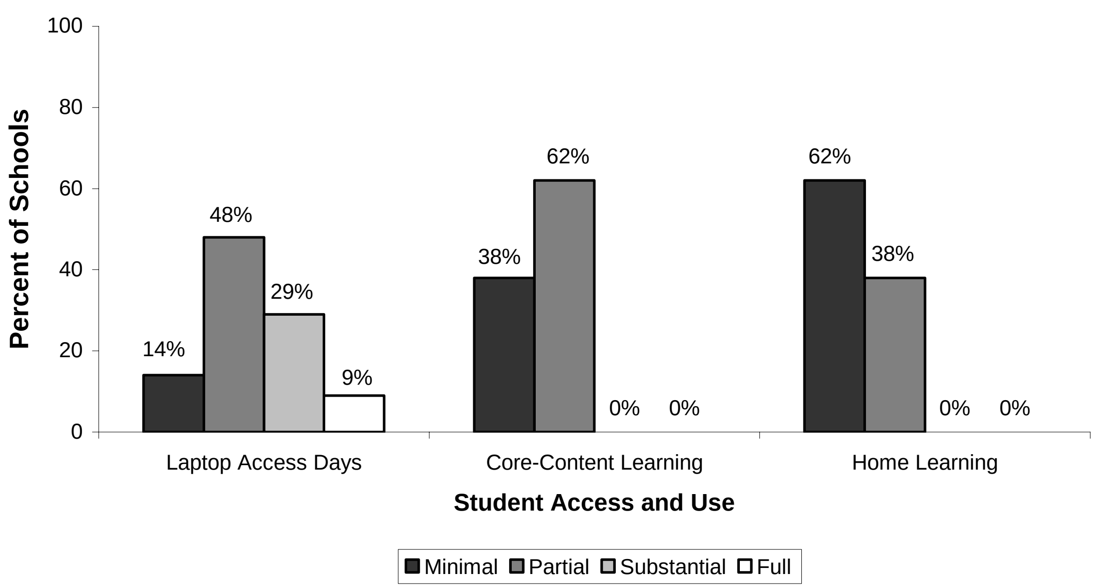

Figure 4.2. Percentage of schools at each implementation level for elements of Student Access and Use (Laptop Access Days, Core-Content Learning, and Home Learning).

Laptop Access Days

Information reported by surveyed students showed that the number of days that students had laptops available for use out of the 180-day school year varied widely both across and within schools (Figure 4.2). At 14% of campuses, students had a minimal level of access, indicating that their laptop access days varied to an *extremely large extent* (from 42 to 169 days per student). Students at about half of campuses (48%) had only a partial level of access, with student access days varying to a *large extent* (from 100 to 176 days per student). At a third of campuses (29%), students reported a substantial level of access, signifying that access to laptops varied from about 140 to 178 days per student. Students at 9% of campuses had full access, with laptops available the targeted 170 to 180 days per student. (See Appendix C for measurement details.)

Students' laptop access was affected by a number of factors—mainly the failure of a few campuses to provide all students with laptops, and for students who received laptops, the loss of laptops throughout the school year for repairs, disciplinary infractions, and for other reasons. Additional analyses of survey responses showed that about 3% of students (213) did not receive a laptop due to causes such as parental concerns about Internet safety and their responsibility for damage, or insufficient numbers of laptops to accommodate newly enrolled students. Students without laptops were concentrated mostly in four, lower implementing schools.

Students' laptop access also changed throughout the school year. As a whole, survey responses indicated that about a third of students (2,135 or 32%) had their laptop taken away for more than a class period for some reason during the 2005-06 school year. For students who had laptops taken away, it was most commonly because of a need for repairs (62%), or students lost their laptop due to misuse or misbehavior of some kind (23%). Students rarely lost their laptops for academic reasons, such as not completing assignments or receiving bad grades (less than 3%). When considering *all* students who had laptops at technology immersion schools, about 20% lost their laptops for more than a class period due to repairs and about 7% lost laptops due to misuse or misbehavior.

Additional campus-level analyses revealed large differences in students' loss of laptops across schools. As might be expected, students at schools that allowed complete access to laptops outside of school usually had higher overall student laptop losses for repairs (from 10% to 43% of students) compared to schools that restricted students' laptop access outside of school (from 10% to 15% of students). The overall rates at which students lost laptops for misbehavior varied widely across campuses (from about 1% of students who lost laptops due to misbehavior to 30% of students). Generally, there were no consistent associations between the reasons "why" students lost laptops for more than a class period and the implementation level of technology immersion. Additional school-level analyses are needed to understand the dynamics associated with factors such as the behavior and discipline policies at schools, technical supports for monitoring student use, and the duration of students' laptop loss.

Core-Content Learning

Sections to follow describe students' reports of the frequency of their laptop use in core-subject classes, their perceptions of teachers who frequently or infrequently use laptops, and their reports of the ways that laptops are used in ELA, social studies, science, and mathematics classes. Noteworthy differences between higher and lower implementing campuses are cited, as warranted.

Frequency of Technology Use in Core Subjects

Surveyed students estimated how often they used laptops in their ELA, social studies, science, and mathematics classes (Figure 4.2). Similar to teachers, students at two-thirds of schools (62%) reported a partial level of implementation, with laptops used in core classrooms *sometimes* (once or twice a month) to *often* (once or twice a week). Students at the remaining third of campuses (38%) reported a minimal level of implementation, indicating that they *rarely* (a few times a year) or *never* used technology-resources in core-subject classes. Students' comments during focus-group discussions confirmed that their laptop use, indeed, varied by school. Furthermore, students reported differences in laptop use across core subjects and for individual teachers within subject areas. Students' comments revealed minimal differences in the frequency of laptop use by grade level (sixth versus seventh).

Across all immersion schools, students regarded social studies teachers as the most consistent users of laptops for classroom activities. In some cases, students taking advanced social studies classes reported that they used laptops more often than their classmates in regular classes. Students with higher implementing social studies teachers used laptops on an almost daily basis, whereas students who had lower implementing teachers used laptops at weekly or monthly intervals. For ELA classes, students who attended the highest implementing schools reported that they used laptops several times a week in ELA classes, although this trend varied for individual teachers within some larger schools. In contrast, students enrolled in the lowest implementing schools typically reported weekly, bi-weekly, or monthly technology use in ELA classes.

Although students in most higher implementing schools reported that science teachers used laptops for lessons quite often (on a nearly daily basis), students in a few lower implementing schools also had science teachers who used laptops as a daily or almost daily part of classroom activities. Students in other lower implementing schools, however, reported that their science teachers seldom used laptops in class (on a bi-weekly, monthly, or less-frequent basis). Across all schools, students reported using laptops least often in mathematics classes, with the frequency of laptop use usually attributed to teachers' individual instructional preferences. Higher implementing teachers reportedly had students use laptops in mathematics classes at least once a week. In contrast, the majority of math teachers used laptops in their classes on a bi-weekly, monthly, or less-frequent basis.

Students in the lowest implementing schools, where laptops were seldom used in many classes, expressed a discernable degree of frustration. One student believed teachers should "come up with more ways to use laptops because we just have them and we just carry them around and that's all we do with them." Similarly, another student explained: "The first time I came, they told us that we could use computers. I was really excited because I never used one, but then since days passed, we don't use them." At this school, inconsistent laptop use in classrooms caused many students, especially seventh and eighth graders, to stop bringing their laptops to school, and there appeared to be no procedures in place to hold students accountable for having their laptops each day.

Teachers Who Frequently or Infrequently Use Laptops

During discussions, students described teachers who had them use laptops either "a lot" or "seldom or never." Consistent with findings described above, students most often cited social studies, ELA, and science teachers as facilitators of frequent classroom laptop use. Conversely, students regarded mathematics teachers and teachers of elective courses, such as art, music, theatre arts, physical education, and sports, as infrequent- or non-laptop users. Students' explanations for teachers' behaviors generally centered on two themes: (a) the relevance of laptops to particular subject areas and (b) teachers' personal traits.

Subject-area relevance. A number of students believed laptops were more appropriate for some subjects than for others. One student explained:

> I think it's more that we use it in science because…there's more science things on the computers than math. You have to, like, work out the problem on paper, so that's probably why we use it less in math, because you can't write on the computer.

A student at another school agreed with the limitation of laptop use for math saying, "In math, we have to work out the problems on paper…I mean, if we do math on the Internet, we still have to get paper and work it out, so it doesn't really make it any easier."

Other students described the influence of content-related websites. One student explained: "The class with more websites for that subject is the one that we get more time on our laptops. There are a lot of sites for Texas History." Another student said that the TAKS test affected laptop use: "The English teacher says that since we're not going to get to type it on the real test, we shouldn't be able to use the laptop, so we don't use it in her class." Many students also explained that laptops had limited utility for band, choir, art, theatre, or physical education classes.

Teachers' personal traits. Students also described particular characteristics of teachers that explained whether or not they opted to use laptops. Teachers who seldom or never used laptops were described by some students as "strict" or "old-fashioned." One student said, "I think that if the teacher's like, more strict than the other teachers, then you don't use them as much, because they like the old-fashioned way." Similarly, other students portrayed some teachers as out of date: "She's stuck in the old age. She wants to stay in the 1800s," and "He's more of an old-fashioned guy."

Students also thought a lack of technology proficiency limited teachers' laptop use. "I think it's because some teachers…maybe they don't know a lot of technology or they're like scared of the laptops…so they don't want us to get on them," said one student. Other students believed it was harder for "older" teachers who didn't have computers when they grew up. Conversely, teachers who were perceived as being more knowledgeable about computers were regarded as more frequent users. One student explained:

> The teachers that use the laptops more, they usually know more about the computers because they know what to tell us to do. We usually do a lot more projects.

Considering the importance of teachers' proficiency, one student declared, "I think that it should be like a requirement for a teacher [who] wants to be hired for campuses that have laptops. They have to know about technology."

Students also thought some teachers did not find the laptops very useful for schoolwork or feared that students would behave irresponsibly. One student said, "He thinks it's easier to do it on the paper than the laptop," while another student said, "the only time we use it is for free time." Others students believed they seldom used laptops in some classes because teachers thought they were going to play "around on the computer," "talk too much," or "get into different websites that we're not supposed to." Conversely, students believed other teachers used laptops a lot because they provided a different way of learning. One student said, "He doesn't like us to be just on the book." Students at a different school said a teacher liked to use laptops "because it's a lot faster…to take notes instead of writing them down." Other students thought some teachers used laptops because they provided better explanations, more information, or particular resources, such as KidBiz.

Ways Students Used Laptops in Core Subjects

Students also described the ways they used laptops in their core-content classes. Students' technology use trends are summarized in Exhibit 4.2 and described in sections below. Similar to teachers' reports, although the overall frequency of students' technology use did not reach either substantial or full immersion standards, students who participated in focus groups described a wide variety of ways that they used laptops in their core classes.

Exhibit 4.2. Student Technology Use in Core-Content Classrooms

ELA	Social Studies	Science	Mathematics
Write compositions and create presentations	Research assigned topics on the Internet and…	Research assigned topics on the Internet and…	Engage in online math activities or play games
Learn and practice skills	Generate products (composition or presentation)	Generate products (report, essay, or presentation)	Take or prepare for tests
Read and comprehend texts	Take notes and answer questions	Define vocabulary terms and take notes	Use productivity tools for concept acquisition
Use resources (KidBiz, My Access Writing, Study Island, etc.)	Use electronic textbooks and publisher resources	Use resources (Explore Learning, Study Island, etc.)	Use resources (Geometer Sketchpad, Study Island, etc.)
Play educational games	Use productivity tools	View science videos and visit interactive websites	
		Conduct scientific investigations	
		Play educational games	
		Use electronic textbooks and publisher resources	

Source: Students' reports of technology use in core-content areas, with activities generally ordered high to low by the frequency with which sixth and seventh graders mentioned activities at the 21 immersion campuses.

English language arts and reading. In ELA classes, students' laptops most commonly provided a means to write compositions and create presentations, learn and practice skills, read and comprehend texts, use learning resources, and play educational games. There were no strong differences in the types of activities that students experienced at higher and lower implementing schools.

Write compositions and create presentations. Students at almost all schools used word processing or presentation programs (PowerPoint or Keynote) to write reports, stories, summaries, poems, journal entries, or to create presentations. A sixth grader explained one assignment in detail: "We had to get on our computer and write a story about a rock. You name it, you give it a job, where it lives, and stuff like that." Internet research on an assigned topic often preceded writing assignments. Students searched for information (e.g., Google, Ask.com) on topics such as famous people (Abraham Lincoln, Martin Luther King), Greek mythology, fairy tales, medical disorders, or self-selected topics. One student described an interdisciplinary language arts and social studies project involving research on different religions and the production of a two-page paper. In some classes, students searched the Internet for answers to questions on topics studied or for current events. One student explained: "We find out the latest things in the news like when we had Hurricane Katrina, we were looking up all sorts of information on how it happened, when it happened."

Many students used laptops to create presentations, which in some cases, they presented to classmates. Seventh graders at one school described multimedia presentations that included text, picture clips, and sound clips. Pre-Advanced Placement (Pre-AP) students in another school frequently searched the Internet for information on topics such as "Greek mythology or Romeo and Juliet," and prepared reports; in contrast, students in the school's regular ELA classes used laptops infrequently.

Several students described how their writing was improved by laptop-based scaffolds, such as "story boards," Internet examples for certain genre, and feedback from spell- and grammar-checkers that identified spelling errors or improved story phrasing. One student explained: "The Word document, Microsoft Word, kind of helps with students, I think, because people who are bad spellers, like me—I cannot spell really good—it helps me really good. And it also has a thesaurus with it…And, so it's more helpful."

Learn and practice skills. Laptops also provided a means to build students' knowledge and skills. At more than a fourth of schools, students used interactive workbooks or electronic activities to learn the parts of speech or sentence structure, to identify and correct grammatical errors, or to learn about word structure (prefixes and suffixes). One student explained the value of such activities: "When you're typing, you're learning because you're doing…you're seeing them and reading them on the laptops." Students at nearly a third of schools visited websites to find information about grammar, to read and answer questions about ELA topics (context clues), to find examples (sentences with similes and metaphors), or to do various ELA activities (SAILOn, ESL Bears). Students at a fourth of schools used laptops for vocabulary development. A student explained that after finishing a story, "they write the vocabulary words, find clip art from Yahoo!, and copy and paste pictures into their slideshow." Other students used online dictionaries to find and type definitions. Students in other schools used laptops for spelling lessons.

Read and comprehend texts. At a third of schools, students used laptops to read stories or to complete activities that enhanced their understanding of reading selections. Students visited websites to read stories, searched the Internet for information related to stories, visited websites to answer questions about reading selections, responded to teacher-provided questions in electronic format, completed enrichment activities, or typed book summaries. At three schools, students used Inspiration software to create graphic organizers or to classify information, such as characters, from stories they had read. In some cases, reading activities involved more complex projects. Seventh graders at one school completed a WebQuest for *To Kill a Mockingbird*, with activities related to the book's characters. Seventh graders at a different school created presentations or brochures each six-week period for a novel they had read (e.g., *The Cay*). Sixth graders at another school wrote a story book, edited it, and sent it to a publisher.

Use learning resources. Students used several programs included in the technology immersion packages or purchased by their schools. Students at the five Apple campuses used the KidBiz program to read articles, answer skill questions, and occasionally, to write compositions. Students at three campuses, two Apple and one Dell, regularly used My Access Writing to write stories and submit them for scoring. Students at five campuses used Study Island to either practice or assess their grammar and reading skills. At one school, students used Study Island as part of a TAKS reading class. At two other schools, students used laptops to take Accelerated Reader tests or used A-Plus software for reading activities.

Play educational games. At some schools, teachers guided educational games, whereas in other schools, students played games during free time. For black history month, a teacher at one school directed a scavenger hunt for information on websites. In other schools, teachers used laptop activities as a reward for the successful completion of traditional assignments. Students who worked hard during the week could play games on Friday, or students who completed assigned work could play games during free time at the end of class.

Social studies. Laptops frequently provided a means in social studies classes for students to research an assigned topic on the Internet and generate a product such as a composition or presentation, to take notes, and to answer content-related questions. Students at higher implementing schools described more complex social studies projects and explicit guidance from teachers.

Research an assigned topic on the Internet and generate a product. Students at most campuses used laptops in social studies classes to search the Internet for information on an assigned topic. They typically gathered information via an Internet search engine such as Google, visited specific websites identified by teachers (e.g., history website, MapQuest, or links on eChalk), or completed a WebQuest (an inquiry-based project that uses web resources). Research usually corresponded with the current topic of class study or permitted in-depth investigation of related subjects. Students researched topics such as countries, states, wars, famous people, cultures, religions, and holidays. Internet research almost always was tied to the creation of a product, such as a report, essay, brochure, newsletter, or presentation (PowerPoint or Keynote).

Although students across all schools described similar Internet-based research activities, students at higher implementing schools provided more detailed descriptions of projects they had completed and explicit guidance from their teachers. For example, sixth graders at one campus selected a "country" to study, and the teacher's handout specified the criteria for research ("history, government, economy, culture…"). Students wrote a report with Word and created a PowerPoint presentation. Seventh graders in the same school created a Texas brochure. One student explained:

> We had to do a Texas Tour, and we picked five cities out of Texas, and we had to visit them and tell about it and have a car and the miles per gallon in the car and everything like that…We had to write about the places and what we saw in the cities…like the major land sites.

At two other campuses, seventh graders used the Internet as a resource for analyzing political cartoons, and sixth graders completed a WebQuest that culminated in a presentation on India's cultures, locations, religions, customs, and social classes.

In some cases, students in lower implementing schools also had social studies teachers who were dedicated laptop users. Seventh graders at one school created multi-media presentations on the status of illegal aliens in the United States. Students used pictures from the Internet to create stories "about what's happening right now with immigration." Pre-AP students in another school used laptops more often than their peers in regular classes. Advanced students created and shared PowerPoint presentations with the class: "We had to do one on the Aztecs, and she put is in six groups, and one group had to do their clothing, another group had to do their lifestyle, and another had to do agriculture and stuff like that," explained one student.

Take notes and answer questions. At more than half of campuses, students used word processing programs to take notes during teacher-led discussions and to respond to questions. These activities were common in both higher and lower implementing schools. Students either summarized information from textbooks to answer assigned questions, or they searched the Internet for answers. Some activities had innovative formats. At one school, students researched "Fun Facts" about a famous person, while students at another school completed an Internet scavenger hunt to answer Texas history questions. Students in another school responded to "bell ringers" by searching the Internet for answers to questions about topics studied.

Use electronic textbooks and publisher resources. Students at half of campuses used electronic textbooks or other publisher-provided resources. Students at seven campuses said they used an electronic textbook (or i-Text) regularly for their social studies work. Textbooks were accessed online, downloaded onto laptops, or available on CDs. In addition to the textbook itself, students at some schools used digital resources furnished by textbook publishers (Glencoe/McGraw-Hill; Holt, Rinehart and Winston), such as online workbooks, maps, chapter-specific activities, and assessments. As a whole, students viewed electronic media positively. A student at one school explained:

> It [textbook] helps us learn more about the history and what was going on…If you were absent…if you left your textbook at school, you wouldn't have to wait. You'd have it on your laptop.

At one school that did not use an electronic textbook, students occasionally visited the publisher's website (hrw.com) after completing a chapter. A student explained: "You can just explore the places and it will give you information…different places that have a lot of volcanoes and stuff like that…Things about, like, the people that lived there." At another school, students could use the textbook on a CD in their free time, but technical difficulties with computers "freezing" made students dubious about their value. In two other schools, students used the electronic textbook as a backup if, for some reason, they did not have the hard copy of their textbook.

Use learning resources. Students rarely used learning software programs as part of their social studies lessons. At two Apple campuses, students used the KidBiz program on a weekly basis to read articles and complete questions. In contrast to program resources, the productivity tools included in Appleworks and Microsoft Office were valuable resources for social studies lessons. Students at nearly all schools used word processors, presentation software, spreadsheets, publishing software, or multi-media software as part of their social studies schoolwork.

Science. Availability of laptops in science classrooms most often allowed students to research an assigned topic on the Internet and create a composition or presentation, to define vocabulary words and take notes, and to use learning resources. Students less frequently viewed science videos, visited interactive websites, or conducted scientific investigations. Students at higher and lower implementing schools reported similar types of science activities.

Research an assigned topic on the Internet and generate a product. Students at three-quarters of campuses searched the Internet for information on a particular science topic and then used the information to create a product such as a report, essay, brochure, or presentation. Students typically used an Internet search engine (e.g., Yahoo!, Google) to find information, or they used links to science websites provided by teachers. Research topics usually correlated with areas covered in the science textbook. Students researched the human body (cells, brain, diseases, reproductive, circulatory, and digestive systems), animal species (mammals, amphibians, reptiles, vertebrates, invertebrates, endangered), weather (tornadoes), solar system (planets), geology (volcanoes, friction, earthquakes), ecosystems (food chain, food web), environment (rain forest, wetlands, weathering), and famous scientists. Many students spoke enthusiastically about what they learned through Internet research. Students at one school collectively described the value of a visit to the World Book website:

> We can learn a lot about Saturn…and Jupiter…I actually found a website that shows you the satellites. They even show pictures of its moons. The thing that's good is like if you're researching on planets, you can find if there's land on another planet.

Define vocabulary terms and take notes. Students at about half of schools used their laptop's word processor to type science vocabulary terms and definitions or to take class notes. After finishing a science chapter, students at one school created vocabulary flashcards to study for tests. At other schools, students searched textbooks or the Internet (Google, Wikipedia) to define science vocabulary terms. Students at some schools took notes during science class. For example, one science teacher presented information via PowerPoint, and students recorded notes in their “interactive notebook.” The science teacher posted class presentations on eChalk as a resource for students.

Use learning resources. At nearly half of campuses, students used learning software programs for science lessons. Students at two Apple and one Dell school described activities with Explore Learning. Students at one school investigated the growth of “aliens” and wrote about the experiment: “If you put sunlight, they grow shorter. If you put water or sunlight, they grow smaller or they multiply,” explained one student. Students at three schools used Inspiration software to create models for science concepts (food chain and water cycle), and students at one school used Beyond Books resources for science. Students at four schools used Study Island for either daily or supplementary science activities, and students at another school used the A-Plus learning program. Productivity tools included in Appleworks and Microsoft Office also were valuable resources for science lessons. Students in almost all schools used word processors and presentation software (PowerPoint and Keynote) for science activities, and students at some schools used Excel to make graphs and charts.

View science videos and visit interactive websites. Some science teachers used Internet resources to enhance whole-class lessons. At three schools, teachers projected online videos from sources such as Unitedstreaming and Cable News Network (CNN) as part of science lessons. At five other schools, students used laptops to visit interactive science websites. One student described a website with the periodic elements: “You just put your mouse over it, and you can see how they look and what’s their number.” Students in other schools explored cells: “We went on a website and looked up cells, and we saw these moving cells…and you could click on different stuff, and it would pop up bigger. It’s really cool.” Some students found the interactive experience helpful in understanding cells, while others preferred the textbook.

Conduct scientific investigations. Students at a fourth of schools explained how laptops enabled them to conduct actual or virtual science investigations. In one school, students conducted an experiment with a temperature probe that involved temperature monitoring with an electronic line chart: “We had these two cans, and they both had the same amount of water in them, and they looked different on the outside, and they were sitting in front of a lamp to see which one would get hotter faster,” explained one student. Students in a different school described a virtual knee surgery:

> We went through this process where we had to check the patient’s medical history to make sure they had the correct dosage, and then we went through the process of cleaning the leg and cutting it open, and then sawing off parts of the bone, and then we put the metal parts onto it.

Other students described investigations of mass and inertia, recessive and dominant traits, and rock classifications, as well as virtual frog and squid dissections.

Play educational games. Science teachers at about a third of schools allowed students to use laptops for educational games and activities after they finished their class work. Students said they could play science-related games or visit websites such as BrainPop.com.

Use electronic textbooks and publisher resources. In contrast to social studies, students seldom used electronic science textbooks (at four schools). One student explained: “We have our book on there…it’s on our computer. So, if we were to go home and work on it, it’s there. You don’t have to check out a book and be responsible for another thing.” Students at a different school did not have an electronic textbook, but they used electronic resources from the textbook publisher’s website (glenco.com).

Mathematics. Students used laptops less often in mathematics classes and the range of activities was less diverse than for other subject areas. Across all immersion schools, students most commonly reported that they used laptops to visit math-related websites for activities or games, or to take and

Engage in online math activities or play games. The most prevalent laptop use in mathematics classes was accessing educational websites or online games as an extension of class mathematics activities. Students at nearly all campuses said they used educational websites or electronic resources to practice skills, complete puzzles, or play math games. Although such activities were widespread, students usually said online math activities and games were not part of their math lessons. Instead, teachers allowed students to do online activities or play games at the end of the regular class period during "free time" or as a "reward" for successful completion of assigned work. Websites mentioned by students included AAAmath.com, SAILOn.com, Sudoku.com, Coolmath.com, BrainPop.com, Funbrain.com, MTV.com, CyberKids.com, Glencoe.com, and Math.com. Students cited games, such as Soda Game, Ice Cream Game, Builder Ted, and Little John's Archery.

As part of games and activities, students said they practiced math skills, including addition, subtraction, multiplication, division, fractions, decimals, and statistics (mean, median, mode, proportion). One student appreciated that educational websites, such as AAAmath.com, allowed him to do problems, get feedback on answers that were right or wrong, and to see an immediate "grade" or "score" for the work completed. Another student valued the step-by-step explanation for problem solutions. Students in a different school said they could advance to higher math levels. One sixth grader explained: "You go to it, like, for 6th grade, 7th grade, 8th grade…But if you're good at it, like an advanced student, you can go to 7th or 8th grade."

Take or prepare for tests. Students at two-thirds of campuses used laptops to either complete assessments or to do test-preparation activities. Students at eight campuses took practice tests, primarily as a way to prepare for the state mathematics assessment (TAKS). Students at two schools completed the TMDS assessment, while students at two other schools took math tests included with the Study Island and Glencoe Mathematics programs. Still other students simply reported the completion of either a practice or an online mathematics test. Besides taking math tests, students at eight campuses used laptops for practice activities that prepared them for the TAKS mathematics test. Students used various TAKS-preparation programs, including Study Island and Glencoe Mathematics. They described "warm ups" at the beginning of class for TAKS preparation, review, and practice.

***Use productivity tools for concept acquisition*.** Students at more than half of campuses used the various productivity tools for math lessons. At three campuses, students used calculators to solve math problems or to check answers. At four campuses, students used spreadsheets, such as Excel, to create graphs or charts and learn how to read them, or to explore math concepts (e.g., prime factorization). At one school, students used Excel for a math project involving the development of a budget for a "Christmas shopping list" with a $500 spending limit.

Students at a fourth of schools used word processors to write math story problems, create formula charts, make shapes (ovals, rectangles, quadrilaterals, etc.), or take notes. At two schools, students used PowerPoint to explore probability and create geometric shapes. At one school, students used iMovie for a complex project on "mathematical proportions, with speed and the unit rate." After being videotaped running at their athletic track, students solved a proportion problems related to their performance. The entire project was captured in iMovie.

Use math learning resources. Few students mentioned mathematics resources included in the immersion packages or purchased with grant funds. Students in one school used Explore Learning for an activity involving decimals, while students at two schools used Geometer Sketchpad to learn about geometry concepts. The program cited most frequently was Study Island. At four schools, students used Study Island for TAKS assessment, practice, or learning activities. Students in one school used a program called IT, and students at another school used the A-Plus program.

All in all, students did not use laptops for daily math lessons, but at most schools, they had opportunities for math activities during free time. Moreover, some mathematics teachers used technology resources to enhance their instruction. Students at some schools said teachers used LCD projectors for whole-class slide shows or “step by step” demonstrations. Students at one school described how their teacher used a website to explain “dimensions in math.” The teacher had students draw cubes on their laptops to solve a problem mentally, and they said this teacher-guided activity helped them to understand better. A teacher at another school posted videos of class activities on the school website daily, so students who were absent could watch the videos and keep up with the class.

Home Learning

In a fully immersed school, students should have access to laptops both within and outside of school, and they should use their laptops regularly outside of school for homework and learning. During the second implementation year, similar to the first year, 8 of 21 campuses either limited their students to in-school laptop use exclusively, or they allowed laptops to go home for homework or special assignments only. To gauge the prevailing trends, we asked surveyed students if they had used laptops at home, and if used, whether or not they had used the laptop for homework in the core subjects or for playing games to learn. Students in almost two-thirds of schools (62%) reported a minimal level of laptop use for home learning. These students used their laptops outside of school for homework and learning either *not at all* or *to a trivial extent*. Students in the remaining third of schools (38%) used laptops for home learning at a partial level (see Figure 4.2).

As a way to understand students’ behaviors outside of school, we asked sixth and seventh graders in focus groups to describe how they used laptops beyond the school day. Across all schools, students most often reported that *if* laptops were used for academic purposes outside of school, it was to complete assignments they had started during the school day. Students generally referred to these assignments as “homework.” As expected, given student survey results and prevailing student-access policies, the implementation strength of technology immersion was associated with more prevalent use of laptops outside of school. Students at higher implementing schools (those with a partial level of immersion) not only used laptops more often, but they also described specific homework assignments and academic activities more often, and they less often described activities such as playing games, watching DVDs, listening to music, or emailing.

Higher implementation. At higher implementing schools, the majority of students used laptops outside of school to some extent, even though their school’s policies sometimes restricted laptop access to homework only. Many students used laptops at home to finish assignments started during class. One student explained: “For my PowerPoint, I did some research, and I saved some websites, and I brought them up at home and kind of fixed my PowerPoint at home.” Another student said, “If I started an assignment at school on the laptop, I can take the laptop home and finish it up and put it on the CD and print it.” Students at a school that restricted outside access to laptops explained how it worked:

> If it’s for school, we can sometimes take it home if we need to work on something…Yeah, if like a project is due tomorrow and we haven’t finished it, at the end of the day, put your name on the board and then you can take it home.

As a whole, students used laptops for homework activities such as completing research projects, making PowerPoint presentations, doing interactive workbook lessons, answering chapter questions with an i-Text, typing or writing stories, and defining vocabulary terms. A few students used their laptops' productivity tools at home: "I listen to my music and get on my AppleWorks and go to Paint, and I just use it to do my name and everything and make a background," explained one student. Although some students at nearly all immersion schools used laptops at home to listen to music, play games,[7] email/instant message, or watch DVDs, comments about such activities were less common at higher implementing schools than statements about the use of laptops for homework.

Several students at higher implementing schools described Internet use outside of school, or they explained problems encountered in accessing the Internet. A few students used the Internet at home for email, games, and informational searches. Although not having Internet access was often cited as a hindrance, students found many ways to alleviate the problem. Students at several schools accessed wireless networks within or near school facilities. One student explained:

> The library has the wireless Internet, so we can go and do our work there…I stay after school, and sometimes I come on the weekend to come and finish it…That's only when he gives us work during the weekend.

Other students accessed the Internet outside of school buildings: "Like after school, some of us sit on the high school benches…for Internet," said one student. Students also used the Internet at a public library or at relatives' homes. At several schools, students loaded resources on laptops so they could use them at home (interactive workbooks, information from websites). Students at one school had learned a "trick" for saving Internet sites: "You know how you pull up the Internet at school, and if you have the game there, you can just shut your computer and just end it. Then you can go home, and you can still play it."

Despite possibilities for alternative Internet sources, many students believed home Internet access would be better: "I think every kid should have wireless so you can do more research because some projects come in late, and you can research at home," said one seventh grader.

Lower implementation. In contrast to their peers at schools with higher levels of immersion, many students at lower implementing schools (minimal level of immersion) did not use laptops outside of school. Typical student responses to the question about laptop use outside of school included "no," "never," "rarely," "not anymore," "not really," or "a little bit." Students at two schools described changes in the second year compared to the first year of immersion. "We could take them home before, but now we can't," said one student. Laptops at this school were distributed as class sets; students could check out a laptop, but none of the students had done so. A student at another school explained the negative effect of teacher turnover: "When we used to have homework, with my old teachers…we used to have them [assignments] with the laptop, but not anymore because they left…No other teacher gives us homework on the laptop."

The few students that described laptop use at home said they finished assignments started during the school day: "Sometimes if we have something unfinished in school, we take it home and finish the assignment at home," said a student. Like students in higher immersion schools, students in these schools used laptops for activities such as writing stories, practicing typing, finishing PowerPoint presentations, doing research, and working on projects. Several students liked to do schoolwork at home: "The thing I like about the computers is that it can help us with our work whenever we're home," said one student. "Like, if you have homework or an assignment, you can just get on the computer."

[7] When students mentioned games during focus groups at technology immersion schools, they could have been referring to educational games or games played for purely entertainment purposes.

Students at lower implementing schools mentioned other types of home activities nearly as often as they reported homework. Many students used laptops to listen to music, play games, watch DVDs, or send email/instant message. For example, students said: “I play games on the Internet,” “I play videogames and listen to music,” and “I use it to get on Solitaire.” Only a few students mentioned Internet-access issues. Students at some schools accessed the Internet outside of school facilities: “Lots of kids usually hang around the elementary school to get Internet after school,” explained a student at one school. A student at another school described problems using a “dial-up” service provided free-of-charge by the district. Students at another school said Internet access points were available “downtown” and “outside of school,” but students rarely used such places.

Students at five lower implementing schools described problems associated with laptop use outside of school, including issues pertaining to damage and inappropriate use. At one school, policy changes relative to laptop use outside of school were attributed to student laptop damage: “The kids are breaking them…they’re not breaking them, but they’re like taking off the buttons, and some of the motherboards are just going out and stuff…Screens are breaking.” At another school, students could take laptops home early in the year, but rules were changed when some students got in trouble. Students said, “People started going to chat rooms and bad sites…And looking at bad stuff…And they would mess up their computers and stuff.” Students at this school now have to go through procedures in the principal’s office to take a laptop home. One student said, “It’s just too much, so I don’t do it.”

Students at two schools mentioned the use of laptops for “chatting.” A sixth grader at one school said, “Lots of people used it for chatting, but once they knew it was bad they stopped.” A sixth grader at a different school was excited by the freedom allowed outside of school:

> There are like chat rooms that help you with your homework, and your work, and I’ll get on there, or maybe I’ll like be on Instant Messenger or something, and I’ll meet new friends. And it’s just really cool to be on a laptop after school because there are like no restrictions, and you can get on almost whatever you want.

Certainly, across all of the technology immersion schools, providing students with laptops outside of the school day presented new challenges for educators in dealing with students who had to demonstrate greater self-responsibility for their behavior than had previously been required before each student received a laptop for personal use.

Conclusions

This chapter described teachers’ second-year progress in creating technology immersed classrooms and the nature of their students’ technology access and use both within and outside of school. Major findings are the following.

Level of Classroom Immersion

- Core-subject teachers at many schools are not strongly committed to the instructional and learning practices advocated as part of the technology immersion model. Some teachers believe new technologies are not pertinent to their curriculum and instructional practices and, in some instances, technology integration and learner-centered instruction are inconsistent with teachers’ ideological beliefs and values.
- Teachers at the majority of technology immersion schools (81%) reported that students just *sometimes* (once or twice a month) use various technology resources to support core-content learning (partial implementation). At a fifth of schools, teachers said their students *rarely* or *never* use technology resources (minimal implementation).

- Even though the frequency of teachers' laptop use did not reach expected standards, as they became more comfortable with technology in the second year, many core-subject teachers drew selectively from a wide range of technology resources to enhance their teaching and students' learning experiences. Across subject areas, teachers used a variety of student learning resources or programs acquired through immersion packages or purchased with grant and local funds.
- Across schools, core-subject teachers frequently used new technology resources to enhance their own professional productivity (e.g., keep records, develop lessons, present content). Conversely, teachers at only a few schools used email (with students, parents, colleagues) or web-based communication tools on a regular basis.

Level of Student Technology Access and Use

- Students' access to laptops varied widely both across and within schools. Students at just a third of campuses had either substantial access to laptops (140 to 178 days per student) or full access (170 to 180 days per student). Some campuses failed to provide laptops for all students, and students with laptops sometimes lost days for repairs (20% of students), or for misuse or misbehavior (7% of students).
- Similar to teachers, students at two-thirds of schools (62%) used laptops in core classrooms *sometimes* (once or twice a month) to *often* (once or twice a week). Students at the remaining third of campuses (38%) said they *rarely* (a few times a year) or *never* used technology-resources in core classes.
- Sixth- and seventh-grade students regarded social studies teachers as the most consistent users of laptops for class activities. Students attending higher implementing schools used laptops in social studies, ELA, and science classes several times a week or on a nearly daily basis, whereas students in lower implementing schools more often used laptops sporadically (weekly, monthly, or less frequently). Across all schools, students used laptops least often in mathematics classes (less than weekly).
- Students believed teachers' tendencies to use laptops reflected the relevance of laptops to the subject area and teachers' personal traits (e.g., strict, out of date, technology proficient, beliefs about laptop value).
- Although the overall frequency of students' technology use did not reach either substantial or full immersion standards, sixth and seventh graders who participated in focus groups described a wide variety of ways that they used laptops in their ELA, social studies, science, and math classes.
- Although students in a fully immersed school should have access to laptops both within and outside of school, 8 of 21 campuses either limited their students to in-school laptop use exclusively, or they allowed laptops to go home for homework or special assignments only during the second implementation year.
- Students at higher immersion schools, compared to lower, used laptops more often outside of school and for more academic purposes. When students at lower implementing schools used laptops outside of school, it was more often for playing games, listening to music, watching DVDs, or emailing rather than for academic purposes.

5. Effects of Technology Immersion on Students

As part of focus-group discussions, we posed questions that elicited the opinions of sixth and seventh graders about how being in an immersion school and having a laptop had affected them. Similarly, technology coordinators and core-subject teachers offered their perceptions of immersion effects. Findings below summarize respondents' views relative to student effects in seven main areas: resources for learning, technology proficiency, capacity as learners, responsibility, engagement in school and learning, academic achievement, and readiness for the future.

Resources for Learning

Preference for Laptops over Textbooks and Library Books

At almost all campuses, students said they preferred laptops over textbooks, library books, and other forms of print media. Students believed Internet search tools and various online resources permitted them to access information more quickly and efficiently. Additionally, students said that web-based research allowed them to conduct research on a greater variety of topics. Students said that textbooks are inherently boring, require more time to access specific information, are heavy to carry, and offer limited and often outdated information. One student explained, "I think it helps you grow smarter because some information we can't find in the books, and it's better to find it through the Internet on the laptops." Furthermore, students said that online sources provided text that was easier to understand or that, cumulatively, provided a wide variety of reading levels, perspectives, and "voices." One student, for instance, said that different sites on the same topic "would talk about the same stuff but in different ways." An important implication, as research suggests, is that students prefer and understand information that is acquired purposefully and provided in multiple modes (Wittrock, 1998; Gardner, 1993).

Of some concern, however, may be comments made by students regarding a general dislike for reading, and the potential for obtaining information from the Internet without reading extensive quantities of text. Some students made comments such as, "You don't have to think that much. You can get some things from the Internet and you really don't have to think about it anymore," or "You don't have to read the whole thing." Comments indicating that students no longer have to read long passages to find the right answer for a worksheet might indicate a potential concern for the development of reading for various purposes and to understand topics in depth. Nevertheless, technology has expanded the concept of literacy to include sound, strong and sometimes animated visuals, as well as instant two-way communication. It is important to note that several students remarked that they prefer to read text on computer screens rather than in printed form—a statement that teachers and many other adults might find difficult to understand.

Greater and Faster Access to Information

Tied to comments about the limitations of printed text, students said that their laptops and therefore, access to online resources, enabled them much faster and greater access to information. Indeed, except for the few campuses where Internet access was hampered by slow or faulty connections and where students were prohibited from using the Internet individually, students said they used Internet search tools regularly for project-based research. Many students also mentioned that they had more research options made available to them with the many online resources than they do with print media. For instance, students representing several campuses commented that they could select historical characters not included in their textbooks. Other students focused on the accessibility of online information praising not only its convenience but also its ever-expanding body of information. Some students noted that the research process for projects was "straightforward" and "shortens research time."

Interestingly, students from higher implementing campuses frequently noted how the Internet permitted them access to high quality continuously-updated information for research projects that culminated with product generation, while students in lower implementing schools more often made comments such as "we can look stuff up." Some students from lower implementing campuses also said they used closed-ended worksheets for which they sought specific answers from pre-determined websites, resulting in comments such as, "It is easy to look-up information." In general, student comments suggest that the term "research" has been interpreted differently across classrooms and campuses.

Students also commented about accessibility to research resources as a matter of convenience. More specifically, many students at higher implementing campuses noted that laptops permitted them to access information and resources from anyplace and at anytime. A student said, "It helps with learning in general because if you don't know about something it's just easy to bring out your laptops because they are portable so you can take them anywhere." They noted that they did not have to wait for access to computer labs that were often booked for weeks at a time and that all of the resources they needed were bundled together.

There was a clear trend related to students' comments at campuses rated as having minimal laptop access. These students reported that Internet access was blocked, email was not available, and that they seldom, if ever, used their laptops. Consequently, students at these campuses said the laptops had no effect on their education. Students representing campuses noted as having partial access fared only slightly better in terms of student comments. Many students said there was "no difference," "no effect," and that access was either denied or hampered. One student said, "They are boring because we never use them."

Similarly, teachers on some of these lower implementing campuses said that students' enthusiasm for laptops had waned during the second year of implementation. On some campuses, teachers reported that students grew weary of carrying the heavy laptops to classes, where they might not be used. Some teachers attributed students' diminished interest to restrictions on the use of games, explaining that the new policies had taken the fun out of computers. Teachers on campuses that blocked students' access to email and games said that some seventh graders resented the changes and voiced their protest by refusing to bring laptops to class. Students' comments, however, suggest that many factors contributed to student dissatisfaction at campuses with minimal to partial laptop access.

Technology Proficiency

Improved Keyboard and Typing Skills

Students at nearly all campuses said that their keyboarding skills had improved over the duration of the project. Whether treated as a separate effort through keyboarding class or typing programs or as an integrated component of their day-to-day use of technology, students commented that they had learned to type more quickly and with fewer errors. Most said they preferred to type over writing by hand since it seemed more natural and produced a neater product.

Application Exposure and Mastery

Students also said they were learning, mastering, and being exposed to a wide variety of software. Oftentimes, relatively simple applets such as spell check were treated with great praise. Most, however, made general comments about their sense of proficiency with learning technology. For instance, some said they used to become frustrated, but could now troubleshoot, that they were adept at using productivity software, and that they could master newly encountered software on their own. Students representing most campuses commented about learning resources and productivity tools such as Internet search tools, Word, PowerPoint, Excel, and Publisher, changing the ways they encountered and negotiated information. One student said, "On our laptops we can be creative." As described above and throughout this report, many students commented about the increased speed at which they could find information, could incorporate it into reports or other products, and present it to various audiences in a neat, organized manner. Technology coordinators also reported that students' technology skills had improved. For example, students used their laptops to take notes in class, even in classes where they had not taken notes previously, or they went to the library at night to access the Internet for research. Some students had developed the ability to troubleshoot laptop problems and solve them without requiring support from the technology coordinator.

Grade-Level Differences

Although both sixth and seventh graders generally regarded themselves as proficient technology users, teachers expressed a different view. Teachers at more than half of schools said that sixth graders lacked computer and typing skills, which made the pace of integrated lessons considerably slower than lessons without laptops. Sixth-grade teachers were frustrated by the need to devote class time teaching the basics of computer and program usage. "They…expect us to teach all the [technical] skills and then the lesson too," said one such teacher. In order to offset students' inexperience with laptops, one campus implemented a sixth-grade technology orientation covering laptop basics for sixth graders and another campus planned to do so in the future.

Because seventh graders were more adept at using laptops and were acquainted with package programs, seventh-grade teachers spent less time teaching technology applications and more time teaching subject-area content. On one campus, teachers said that seventh graders were more likely to become impatient with slow Internet connections or technical problems that impeded the use of laptops.

Capacity as Learners

Students at many campuses described ways that laptops affected their capacities as learners, including comments related to self-direction, organization, multi-sensory experiences, as well as creativity and ownership of learning.

Greater Self-Direction

Along with increased student-centered, project-based learning at most schools, several students noted changes in their responsibility for their own learning. The most prevalent change students noted was that they could work at their "own pace" and wherever it was convenient for them. Students from two schools said that laptops provided a source for self-direction since students could formulate and find answers to their own questions. Several students also commented that they had greater control over their own learning. One said that students seek help from one another rather than teachers, and another said that students feel freer to discuss ideas with one another than they did before. Yet another said, “Laptops are more individualized.” Clearly, a sense of autonomy and control were important themes. A student reflected:

> When you’re on the computer, it’s right in front of you. The lesson’s in front of you and everything. And, you could copy it or take notes from it…You might have a sloppy teacher and she might write ugly and you can’t even understand how she’s writing. You might know a website or something on your laptop, and you can go to it, and it’ll show you different educational things, and it will help you with your work and stuff.

Teachers on a third of campuses, likewise, said that having laptops had improved students’ responsibility and attention to their work.

Improved Organization

Students representing about half of campuses felt laptops permitted them to be better organized learners. For many, this comment referred to being able to carry online textbooks, resources, finished work, and ongoing work in neatly arranged electronic folders and directories. One, for instance, said, “Last year, I was always losing my papers. Now, since I have my laptop I don’t do that.” For others, it meant drawing from logical steps to complete tasks and having access to everything needed in order to be relatively self-sufficient in learning. For instance, many students said that because they had easy access to resources and the Internet they no longer put off follow-up tasks such as looking up concepts or important terminology.

Multi-Sensory Experiences

Students in more than a third of campuses believed multimedia and various resources aided their learning. Some indicated that different websites and resources provided different ways of understanding information. Some felt that learning is more dynamic and ongoing because of the interactivity of laptops. A few students said that laptops provided better recall and retention because of pictures and sounds. One student said:

> In science class, we do Study Island and Beyond Books and it’s helped. Like on the rocks and stuff, I can remember them better and it just seems easier than before.

Another student recalled three-dimensional, modifiable images of cells, for instance, and said the visual and sound elements improved recall. Many students also praised instructional games as innovative modes of learning and others said they appreciated online resources for virtual experiments; PowerPoint and Word presentations with embedded images, videos, and sounds; and online dictionary and encyclopedia entries that were multidimensional or multi-sensory.

Creativity and Ownership

Students at a fourth of campuses commented that learning with laptops permitted them to feel more creative. For instance, one student said, “We can be creative. Learning is like a game,” while another student said, “It opens our imagination.” For some, this sentiment was linked to the greater span of modes of learning beyond text—the incorporation of visual art, photography, and sound were important to many students. For others, the sentiment was tied to having a sense of ownership over both the specific topic of their projects and the kinds of sources they used to learn about those topics. Some students saw themselves as active, invested learners with a degree of control over how their work would take shape.

Engagement in School and Learning

Across all schools, the most consistently reported impact of technology immersion was stronger student engagement in school and learning. Students characterized engagement in terms of enjoyment, improved behavior, positive attitudes, and feelings of privilege.

Enjoyment of Learning

Students representing all campuses said that school with laptops is more fun than school without laptops. One student noted, "School is actually more interesting now that we have laptops and it actually is a little more fun." It should also be noted that focus-group students linked "fun" with a host of other adjectives and qualifiers including "important," "useful," "exciting," "easier," and "helpful." Thus, it appears students were cognizant of feeling more engaged while acknowledging laptops as important learning tools. Interesting to note, however, is how students' comments related to the school's level of implementation. Students at higher implementing campuses commented about learning, motivation, and increased interest in subject matter, whereas students in the lowest implementing schools described games and using the laptops as a reward for finishing class work rather than as a tool for doing class work.

Improved Classroom Behavior

Students also commented about behaviors they attributed to technology immersion that they had noticed in their classrooms. Students representing all but those campuses with the lowest implementation level indicated that overall students are quieter, pay more attention in class, and are more focused on class work. One student, for instance, said, "It's kind of weird but like whenever we're trying to do a report or something, like all of the classrooms are quieter because we're all just concentrating on our laptops." Some students commented that more students, including themselves, completed more assignments on time and, as noted previously, that the kinds of assignments—project-based and those requiring a modicum of open-ended research—are more pleasant to work on than those requiring only printed text. One student offered, "I really don't have a very big attention span, so whenever the teacher would be talking it would be a lot harder to pay attention. When I have the laptop, I'm actually doing something that interests me." Students at the lowest implementing schools commented that it is difficult to enjoy school because while laptops are available they are not being used.

Some technology coordinators also reported that student attendance had improved and discipline referral rates had decreased, and that the students were behaving better overall since implementation of immersion. "The kids just act better when they've got a computer in there," declared one coordinator. Teachers also reflected on student behavior. Teachers at several campuses said that laptops were a useful "carrot" for improving discipline and that the threat of losing laptops was sufficient to remedy most behavior problems. Although teachers valued the disciplinary effects of laptop confiscation, they found it difficult to teach integrated lessons in classes where many students were without laptops because of behavior problems. "It just creates more work for the teacher," explained a teacher, "When they're [students] in trouble, then it punishes us as well."

Positive Attitudes about School

Students representing two-thirds of campuses described a greater enjoyment of school in general, which they attributed to laptops. Many made comments such as "I look forward to school now," "[school] is not boring anymore," "school is more fun and easier," and "I don't dislike school so much now." One student said, "Everybody looks forward to coming and getting on their laptops everyday."

The only exception was one school that was lower implementing where students commented that they felt restricted in their use of the technology.

Sense of Privilege

Students representing half of campuses described a sense of privilege and opportunity from participating in the project. Most of these were astutely aware that they had been provided access that students in other schools did not have. One stated, “It’s not everyday someone gets a computer of their own.” Another said, “It made me feel special.” The technology coordinator at one school said parents were moving to the neighborhood so their children could participate in the immersion project. Several students also described a sense of empowerment because they were able to teach their parents how to use computers and could help teachers troubleshoot in the classroom. One student commented, “My aunt actually asked me to show her how to make a PowerPoint. So grown ups ask me stuff. I’m like, ‘Oh, I know it and you don’t.’”

Responsibility for Laptops

Students representing nearly half of campuses commented about their responsibility for laptops. One student reflected:

> It’s a very big responsibility. I mean, you can’t just be like some person who just wants a laptop because it’s cool. I mean, it’s true, but if you want to have a laptop, you have to follow all the rules and you can’t mistreat it because like even if a teacher sees you just drop the case down, you get in really big trouble.

For many students, the increased responsibility was voiced in terms of worry and concern about potential damages to laptops, copyright infractions, and the high cost of replacement or repair. Some went so far as to say they did not want the laptops because of the fear or having to pay $1000. A few students, however, said that they appreciated the sense of responsibility and trust extended to them through the project and their schools.

Teachers, particularly those on lower implementing campuses, were frustrated with students’ lack of maturity, poor care of the laptops, and interest in playing games rather than completing class assignments. Technology coordinators at some lower implementing campuses, similarly, noted that students seemed to be getting more careless and experiencing more damage to the laptops, whereas at other campuses, coordinators said students were taking better care of the laptops after becoming familiar with their operation and use. Teachers in three schools reported that sixth graders were less mature, frequently forgot to bring their laptops to class or did not charge them, and tended to view laptops as a toy or a vehicle for games.

Also related to student responsibility for laptops was the burden of carrying heavy laptops from place to place, with many students commenting about the weight of the laptops. At slightly more than half the campuses, students said the laptops were too heavy. Some students said that they caused back pain, especially when they were combined with textbooks in backpacks. At about one-fifth of campuses, students commented that the laptops were lighter than textbooks and much more convenient because there were fewer items to carry around. A more complete analysis is needed to flesh out differing student opinions and their relationships with factors such as the types of carrying bags, policies pertaining to other items students must or may carry in their bags in addition to the laptops, and the frequency of students’ laptop use in classrooms.

Academic Achievement

Students and teachers expressed differing opinions on the effects of immersion on academic performance. Some students in almost all focus groups said their grades had improved. Some, especially at higher implementing campuses, tied improved academic performance to more interesting class work and access to learning resources. Students in all focus groups at higher implementing campuses noted improvements in academic performance. One student, who had struggled in elementary school, said:

> I think it's better with laptops because you can learn more stuff on it. And, like in the 5th grade, since we didn't have our laptops, I didn't end up passing my classes. It helps me more with my classes.

While students in some lower implementing schools believed their grades had improved, other students volunteered comments that rejected a link between improved grades and laptops. One student, for example, offered, "Well, we don't really use them. I wouldn't really say that our grades got better because of the laptops."

Although teachers consistently reported that students were more engaged in learning when lessons incorporated laptops, only one teacher thought increased engagement was improving student achievement. A teacher on another campus expressed a different view: "I can't say that having a laptop is going to improve a kid's TAKS scores, but I can say that having a laptop is getting them well prepared for today's technological world." Some teachers, however, thought that laptops had improved students' vocabulary, creativity, and communication skills, as well as the reading skills of ESL students.

Readiness for the Future

When asked what they thought about using laptops for their class work, students in focus groups representing half of campuses said they were gaining valuable skills for their future. Most couched their comments in terms of career readiness, using such descriptions as "they give us an edge." One student said, "I think having laptops and using them and stuff makes us a lot more suitable for the future, because in the future, I think most of the time will have to do with computers and stuff. This school is helping us get ready for the future." Other students expressed their views in terms of college readiness. Students representing higher implementing schools appeared to be more likely to perceive or articulate a relationship between what and how they are learning and their lives, in terms of career and college, after secondary school. In fact, only one student in the lowest third of implementing schools mentioned a relationship between laptops and post-secondary opportunities.

One technology coordinator also described the immersion effect on students in terms of how technology will affect their life and work in the future.

> Our students have a much greater awareness of technology in terms of knowledge and skills… It's given them the opportunity to see things that students in a small rural community like this do not have the opportunity to see… they've got a whole different perspective of the demands that are going to be placed upon them as a result of living in such a technological age like we do.

Correspondingly, teachers on many campuses thought immersion was preparing students for the future, noting that students in immersion schools would be better equipped for the technological demands of high school, college, and the work place. Teachers in small towns also said that laptops provided students with greater access to the world than they might otherwise have. Recognizing that educational goals are not limited to test scores alone, one teacher explained, “If the goal was to educate and to facilitate and open these children’s minds to other things outside the world of [town name]…that’s happening with computers. We’ve been all over the world”.

Conclusions

This chapter summarized the perceptions of students, technology coordinators, and core-subject teachers relative to the effects of technology immersion on students. Key findings include the following.

- Students across campuses preferred laptops over textbooks, library books, and other forms of print media. Internet search tools and various online resources permitted access to information more quickly and efficiently and allowed students to conduct research on a greater variety of topics. The regular use of Internet search tools for project-based research permitted greater and faster access to information.
- Students’ Internet-based research activities differed in both quality and quantity at higher and lower implementing schools (project-based research versus searches for right answers). In general, the term “research” had been interpreted differently across classrooms and schools.
- Students at most campuses said their keyboarding skills had improved over the duration of the project, and they were learning, mastering, and being exposed to a wide variety of learning resources and productivity tools such as Internet search tools, Word, PowerPoint, Excel, and Publisher. Teachers, at more than half of schools, however, were frustrated by the need to devote class time to teaching sixth graders the basics of computer and program usage.
- Students at many campuses described ways that laptops affected their capacities as learners, including changes related to self-direction, organization, multi-sensory experiences, creativity, and ownership of learning.
- Across all schools, students consistently reported positive impacts of technology immersion on their engagement in school and learning, including increased enjoyment of learning, improved classroom behavior, more positive attitudes about school, and feelings of privilege and opportunity associated with laptops.
- Some students appreciated the sense of responsibility and trust extended to them through individual laptops, while others worried about potential laptop damages and associated costs. Many students complained about carrying heavy laptops from class to class. Technology coordinators at some campuses noted improved student responsibility for laptops, whereas coordinators and teachers at other campuses, particularly lower implementing, cited increased student carelessness and damage.
- Some students at almost all campuses believed access to laptops and learning resources had improved their grades, although at lower implementing schools, students typically did not link improved grades and laptops. Teachers thought laptops had improved some student skills (e.g., vocabulary, communication, reading) but not academic achievement or TAKS test scores.
- Many students and educators thought technology immersion enabled students to gain valuable skills that prepared them for the future in terms of college and career readiness.

6. Factors Associated with Implementation

In this chapter, we explore relationships among various implementation components of technology immersion and examine whether particular support mechanisms or school characteristics are associated with teachers' reported levels of classroom immersion and students' estimations of their technology access and use. The strength of relationships between implementation levels for immersion components (mean campus *z* scores) and school characteristics (mean enrollment counts, percentages of minority and economically disadvantaged students, and percentages of students passing TAKS tests) are examined individually through bivariate correlations.

Implementation Indices by Component of Technology Immersion

Table 6.1 presents the composite campus Implementation Index (*z* score) alongside implementation indices (*z* scores) for each of the seven components. Despite some variations in component scores, middle schools that had higher values on the Implementation Index tended to have component scores that indicated a stronger presence of the immersion attributes such as administrative leadership and teacher support for immersion. In contrast, middle schools that had extremely negative values on the Implementation Index generally had negative values for nearly all of the immersion components.

Table 6.1. Second-Year Implementation of Technology Immersion

Middle School (MS)	Leader-ship Index	Teacher Support Index	Parent/ Comm. Index	Technical Support Index	PD Index	Classroom Immersion Index	Student Access/Use Index	**Implemen-tation Index**
MS 1	1.78	1.18	1.05	1.28	2.09	0.58	1.78	**1.91**
MS 2	0.97	1.15	1.60	1.45	0.86	0.58	0.91	**1.48**
MS 3	0.65	1.25	0.50	-0.39	1.52	1.49	1.12	**1.20**
MS 4	0.79	1.24	1.45	0.32	0.78	0.28	0.62	**1.07**
MS 5	1.13	0.29	0.61	2.67	-0.04	0.07	0.21	**0.97**
MS 6	1.12	0.78	1.07	0.73	0.53	0.32	0.38	**0.97**
MS 7	0.36	0.42	0.95	-0.54	0.26	1.68	0.10	**0.64**
MS 8	0.43	0.44	0.50	-0.74	1.91	-1.03	0.53	**0.40**
MS 9	0.58	0.20	0.03	-0.80	0.03	1.06	-0.59	**0.10**
MS 10	-0.60	-0.16	0.12	-0.31	-0.18	0.95	-0.05	**-0.04**
MS 11	0.16	0.22	-0.14	0.24	-0.98	0.72	-0.48	**-0.05**
MS 12	-0.89	-0.35	-0.72	-0.75	-0.16	0.53	0.90	**-0.28**
MS 13	-0.62	0.33	-0.79	1.37	-1.44	-1.74	0.70	**-0.43**
MS 14	-0.69	-0.28	-0.55	0.08	-0.83	-0.86	0.23	**-0.57**
MS 15	-0.46	-0.33	0.05	-0.45	-1.13	-1.31	0.63	**-0.59**
MS 16	0.92	0.11	-0.14	-1.11	-0.23	-1.27	-2.55	**-0.84**
MS 17	-0.19	-0.72	-0.04	-1.42	-0.53	-0.39	-1.16	**-0.87**
MS 18	-0.77	-0.12	-1.16	-0.36	-0.07	-0.57	-1.68	**-0.93**
MS 19	-1.03	-1.99	-0.73	-0.45	-0.19	-1.07	-0.46	**-1.16**
MS 20	-1.42	-1.03	-1.10	-0.15	-1.30	-0.85	-0.63	**-1.27**
MS 21	-2.20	-2.65	-2.59	-0.68	-0.92	0.84	-0.50	**-1.70**

Note. Implementation indices are *z* scores with a mean of 0 and a standard deviation of 1.0. Scores above zero indicate a greater presence of technology immersion components and higher levels of implementation.

Campus scores show that the implementation indices are relatively effective in discriminating higher and lower implementing schools. Still, there are noteworthy exceptions to the prevailing trends. Some schools, such as MS 21, had generally lower implementation values for most of the indicators except Classroom Immersion (0.84). This indicates that teachers at that school are making strides toward classroom technology integration even though strong supports are not in place. In contrast, despite strong values for support indicators, teachers in MS 1 have a relatively low presence of classroom immersion attributes. The relationships among implementation variables are explored further below.

Correlations among Implementation Components and School Characteristics

Below, we discuss the results of the analyses of associations among immersion components, implementation components and school characteristics, and correlations of support components and school characteristics with elements of classroom immersion and students' technology access and use.

Immersion Components

Table 6.2 displays the correlations between the seven components of technology immersion, with statistically significant coefficients denoted in bold. As anticipated, teachers' perceptions of administrator's Leadership for immersion was strongly associated with teachers' collective support for technology innovation (Teacher Support), as well as their views on Parent and Community Support, the presence of Technical Support, and the robustness of Professional Development. And reasonably, teachers' commitment to technology innovation was significantly related to other support mechanisms in addition to the level of students' technology access and use. On the contrary, teachers' collective support for technology innovation showed almost no association with the strength of core-subject teachers' Classroom Immersion.

Table 6.2. Correlations of Technology Immersion Components

	Components of Technology Immersion						
Components	Leader-ship	Teacher Support	Parent Support	Technical Support	PD	Class Immersion	Student Access/Use
Leadership							
Teacher Support	**.85*** **		.				
Parent/Community Support	**.88*** **	**.84*** **			.		
Technical Support	**.42†**	**.42†**	**.38†**				
Professional Development	**.69** **	**.61** **	**.65** **	.13			
Classroom Immersion	.26	.02	.30	.02	**.38†**		
Student Access and Use	.29	**.45* **	**.46* **	**.49* **	**.45* **	.28	

Note. †$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$. PD=Professional Development.

Technical Support for immersion was most strongly associated with students' reported access to and use of laptops, suggesting that stronger technical support reduced laptop maintenance problems that kept computers out of the hands of students. The intensity of campus Professional Development supporting immersion was significantly associated with higher levels of implementation for both Classroom Immersion and Student Access and Use components. Significant correlations also were seen between the strength of professional development and teachers' perceived levels of support from administrators, technical leaders, and parent and community members.

The campus level of Classroom Immersion, unexpectedly, was significantly associated with only one implementation component (Professional Development). On the other hand, the ultimate goal of technology immersion—students' technology access and use for learning—was significantly related to increased implementation levels for four of five support components. Administrators' leadership appeared to affect students indirectly through the facilitation of other supports for immersion.

School Characteristics

We also explored the relationship between implementation components and school characteristics (see Table 6.3). Middle-school campus characteristics included the average student enrollment, percentage of minority students (African American and Hispanic), school poverty (percentage of economically disadvantaged students as measured by eligibility for federal free- and reduced-price lunches), and achievement (percentage of grades 6 to 8 students passing all TAKS tests in spring 2006).

Table 6.3. Correlations of Technology Immersion Components and School Characteristics

	Characteristics of Middle Schools			
Immersion Components	Student Enrollment	Percent Minority Students	Percent Economically Disadvantaged Students	Percent of Students Passing All TAKS Tests
Leadership	-.04	-.23	-.30	.14
Teacher Support	-.03	-.29	**-.42†**	.29
Parent & Community Support	.06	-.19	**-.40†**	.18
Technical Support	**-.46***	-.12	-.22	.32
Professional Development	-.05	-.01	-.20	.13
Classroom Immersion	.14	-.08	-.16	-.22
Student Access & Use	-.24	-.17	**-.41†**	.23
Implementation Index	-.12	-.21	**-.42†**	.21

Note. †$p < .10$, *$p < .05$, **$p < .01$, ***$P < 001$.

Results showed that school size was negatively associated with implementation levels for most technology immersion components. That is, schools with larger student enrollments tended to have slightly lower levels of implementation than schools with fewer students, although the negative relationship was significant for only one component. Teachers at larger schools reported significantly lower levels of Technical Support, which indicated that technical problems at these schools posed a greater barrier to technology immersion.

Higher percentages of minority students (African American and Hispanic) also showed a weakly negative relationship with implementation components, whereas higher percentages of economically disadvantaged students at a school surfaced as having an overall negative and sometimes significantly negative relationship with implementation levels. Schools with more disadvantaged populations had significantly lower levels of implementation for Teacher Support, Parent and Community Support, Student Access and Use, and for the composite Implementation Index.

In contrast to the negative relationships between school demographic characteristics and levels of implementation, the school's achievement context (percentage of students passing all TAKS tests) was positively associated with nearly all of the implementation indicators, although correlations were generally low and insignificant. Teachers' reported level of Classroom Immersion was the only immersion component that was negatively correlated with achievement.

Classroom Immersion

To further understand teachers' perspectives, an additional analysis examined the relationships among support components, school characteristics, and elements of core-subject teachers' Classroom Immersion. Correlation coefficients presented in Table 6.4 show generally low associations among variables, with some positive and some negative relationships. Still, a few statistically significant findings surfaced. Classroom Immersion elements that addressed the strength of teachers' ideological agreement with technology innovation and constructivist practices (Technology Integration and Learner-Centered Instruction) were significantly related to teachers' perceptions of the viability of various support components, including administrative Leadership, Parent and Community Support, and Professional Development. Teachers' perceptions of the robustness of Professional Development also showed the strongest relationship with the composite Classroom Immersion Index.

Table 6.4. Correlations of Support Components and School Characteristics by Elements of Classroom Immersion

	Core-Subject Teachers' Classroom Immersion					
Indicators/Characteristics	Technology Integration	Learner-Centered Instruction	Student Activities	Communi-cation	Professional Productivity	**Classroom Immersion Index**
Leadership	**.44***	**.40***	.09	.10	.02	.26
Teacher Support	.35	.33	.02	.23	.04	.26
Parent & Community Support	**.46***	**.40†**	.09	.22	-.01	.30
Technical Support	.09	-.01	-.02	.11	-.25	.02
Professional Development	**.38†**	**.51***	.23	.16	.27	**.38†**
School enrollment	.05	.08	.09	.17	.25	.14
% minority students	-.20	-.10	.12	-.22	.23	-.08
% Disadvantaged students	-.17	-.07	.19	**-.43†**	.11	-.16
% Students pass all TAKS	-.24	-.28	**-.47***	.19	-.39	-.22

Note. †$p < .10$, *$p < .05$, **$p < .01$, *** $P < .001$.

On the other hand, a school's mean achievement on TAKS was negatively associated with teachers' reported implementation levels for five of six classroom immersion elements. Notably, the association between campus TAKS scores and teachers' reported frequency of their students' classroom technology activities was negative and statistically significant. This suggests that simply increasing the frequency of classroom technology use may not produce desirable student outcomes. The only positive association between Classroom Immersion elements and student achievement was the frequency of teachers' technology use for communication via email or a class website. Teachers at campuses with higher achieving students used technology more often for communication, whereas teachers at campuses with larger minority and economically disadvantaged student populations communicated with technology less often.

Student Access and Use

Correlations for students' reported levels of technology access and use also revealed some important trends (Table 6.5).

Table 6.5. Correlations for Support Components and School Characteristics by Elements of Student Access and Use

	Student Technology Access and Use			
Indicators/Characteristics	Laptop Access Days	Classroom Learning	Home Learning	**Student Access/Use Index**
Leadership	-.06	.18	.32	.29
Teacher Support	.09	.20	**.50***	**.45***
Parent & Community Support	.12	.22	**.47***	**.45***
Technical Support	**.45***	**.46***	.18	**.49***
Professional Development	.04	.28	**.46***	**.45***
School Enrollment	-.29	**-.59****	.31	-.24
% Minority Students	-.10	-.29	.05	-.17
% Disadvantaged students	-.15	-.31	-.30	**-.41†**
% Students pass all TAKS	.05	.20	.17	.23

Note. † $p< .10$, *$p < .05$, **$p <.01$, *** $p < 001$.

First, the strength of the composite Student Access and Use Index was significantly related to stronger levels of implementation for various support mechanisms (teacher, parent/community, and technical support, and teacher professional development). The Student Access and Use Index, however, was negatively associated with larger school size, school poverty, and higher percentages of minority and economically disadvantaged students.

Second, as might be expected, the strength of campus technical support was significantly related to the number of days that students reported having their laptops available for use and the frequency with which they used their laptops in core-subject classrooms for learning. Results also suggested that certain types of support enabled students to use their laptops more productively at home. Significant correlations showed that the level of teacher and parent/community support for immersion, and the campus emphasis on professional development were positively associated with the extent to which students' reported using their laptops for learning at home (i.e., homework and learning games).

Finally, findings showed that the robustness of a student's technology access and use was associated with the characteristics of the school that he or she attended. Students attending larger schools and schools with larger minority and economically disadvantaged populations reported generally lower levels of technology access and use. Given the variations in student experiences across immersion campuses, it was noteworthy that students' reported technology access and use was positively, though weakly, associated with campus academic achievement.

Conclusions

In this chapter we examined the relationships among various implementation indicators and school characteristics. Major findings include the following.

- Leadership for immersion was strongly associated with teachers' collective support for technology innovation as well as their views on parent and community support, the strength of technical support, and the quality of campus professional development.
- Technical support for immersion was most strongly associated with students' technology access and use, suggesting that adequate support reduced maintenance problems that kept laptops out of students' hands. Students' robust access and use of technology also was associated with support from teachers, parents, and community members. Administrators affected students indirectly through the provision of other supports for immersion.
- The extent of teachers' Classroom Immersion was significantly associated with only one implementation component (Professional Development). Unexpectedly, teachers' reported frequency of students' classroom technology activities was negatively associated with campus TAKS scores. This suggests that simply increasing the frequency of classroom use may not produce desirable academic outcomes.
- Schools with more economically disadvantaged student populations had significantly lower levels of teacher support, parent and community support, student technology access and use, and overall implementation of the technology immersion model.
- The level of teacher and parent/community support for immersion, and the campus emphasis on professional development were positively associated with the extent to which students used their laptops for learning at home (i.e., homework and learning games).
- A student's technology access and use was associated with the characteristics of the school that he or she attended. Students attending larger schools and schools with larger minority and economically disadvantaged populations reported lower technology access and use.

7. Conclusions and Implications

The study of technology immersion (i.e., a laptop computer for every middle school student and teacher, wireless access throughout the campus, curricular and assessment resources, professional development and ongoing pedagogical support for curricular integration, and technical support for immersion) scientifically investigates the effectiveness of technology immersion in increasing middle school students' achievement in core academic subjects (English language arts, mathematics, science, and social studies). While the overarching purpose is to assess immersion effects on student achievement, the study also examines relationships that exist among contextual conditions, technology immersion, intervening factors, and student achievement. Accordingly, researchers have annually conducted site visits to treatment and control campuses as a way to better understand conditions that existed prior to the intervention and changes that have occurred over time.

Visits to campuses in fall 2004 established the comparability of treatment and control schools. Site visits in spring 2005 focused on schools' initial steps in implementing technology immersion and first-year implementation. In spring 2006, follow-up site visits to each of the 22 immersion and 22 control campuses focused on second-year activities (encompassing the 2005-06 school year). Researchers conducted interviews with principals, technology coordinators, and central administrators and focus groups with a sample of sixth- and seventh-grade teachers and students. In the second year, two middle schools in one district (one immersion and one control) were excluded from analyses due to disruptions of school operations caused by Hurricane Rita on the Texas Gulf coast. Thus, second-year results are for 21 immersion and 21 control schools.

Data collected at control campuses in spring 2006 verified that the availability and use of technology to support teaching and learning had not changed substantially at those schools since the project's inception. Data gathered at immersion campuses provided an in-depth examination of the extent to which the technology immersion model was implemented as designed in the second year. The focus on implementation is important because other studies of large-scale educational reforms and organizational change have shown that the level and quality of implementation largely determines the achievement of desired outcomes (Berman & McLaughlin, 1978; Datnow, Borman, & Stringfield, 2000; Borman, Hewes, Overman, & Brown, 2003; Borman, 2005). This report combines both qualitative data (from interviews and focus groups with selected subjects) and quantitative data (from surveys of all teachers and students) to provide the most accurate and meaningful portrayal of second-year implementation. The triangulation of evidence from multiple sources bolsters the credibility of findings.

Second-Year Implementation

In the second year, we measured implementation using standards defining four levels of immersion (*minimal*, *partial*, *substantial*, and *full*) and standardized implementation indices (*z* scores). Both types of scores produced measures for five immersion support components (Leadership, Teacher Support, Parent and Community Support, Technical Support, Professional Development) and two teacher and student immersion components (Classroom Immersion, Student Access and Use). Major findings on second-year implementation are discussed below.

School Implementation Levels

Most middle schools had difficulty implementing the prescribed components of technology immersion in the second year. The Implementation Index, a composite campus *z* score measuring the overall presence of seven immersion components, showed that some middle schools had a stronger presence of the technology immersion components compared with other schools, thus a higher level of implementation. Mean immersion standard scores (ranging from 2.48 to 3.06 on a 0 to 4 scale) showed that supports for technology immersion from school administrators, teachers, parents and community members, technical staff, and professional development providers typically fell short of full implementation standards (3.50 to 4.00). Given generally low-to-moderate supports for immersion, the levels of Classroom Immersion (2.48) and Student Access and Use (2.17) were below expectations.

Leaders at many schools reported implementation progress in the second year; however, others believed implementation reached a plateau. Some administrators thought the second year went more smoothly because their schools had established laptop management procedures, enacted acceptable-use policies, distributed laptops earlier in the year, stabilized school infrastructures, and/or increased Internet bandwidth. Moreover, teachers who received training in the first year were more comfortable with technology, and this permitted greater attention to classroom integration. Implementation progress was hindered, however, by obstacles that affected some schools more than others. A few schools faced financial challenges in providing enough laptops for increased student enrollments or dealt with some parents who refused student laptops, due in part to increased insurance or deposit fees. Implementation progress at other schools was curtailed by administrator and teacher turnover, competing reform initiatives, Internet safety issues, and a loss of teacher buy-in. Across nearly all of schools, technology coordinators' administrative roles reduced time to visit teachers' classrooms and support curricular integration.

Teachers were more comfortable using technology in the second year and made strides toward classroom integration. Many teachers in focus groups indicated that second-year implementation progressed more smoothly. Teachers cited progress relative to increased bandwidth that accommodated classroom Internet access and revised policies that limited students' access to email, games, and music or video downloads. Many teachers had received sufficient training in immersion package tools and were able to use them in classrooms. Teachers' comments generally coincide with second-year survey results showing that immersion teachers grew in technology proficiency and in their use of technology at significantly faster rates than control teachers (Shapley et al., 2007).

Schools with a greater proportion of economically disadvantaged students had lower implementation levels. Schools with more economically disadvantaged student populations had significantly lower levels of implementation. Accordingly, teachers at these schools grew in proficiency and created immersed classrooms at significantly slower rates than teachers in more advantaged schools. Evidence suggests that schools serving mainly disadvantaged and often low-performing student populations faced special challenges in implementing technology immersion, a whole-school initiative that involves profound school and classroom change. These schools needed additional time and external supports to plan for immersion, build staff capacity, and educate students and their parents about laptop privileges and responsibilities.

Supports for Immersion

Many immersion schools also needed stronger second-year implementation supports in the areas of leadership, parental support, technical support, professional development, and teacher commitment to innovation.

Administrators at about half of schools provided strong leadership for technology immersion. Surveyed teachers at 48% of schools believed administrators provided the kind of leadership necessary for at least substantial immersion. Although no clear distinctions could be made between higher and lower implementing campuses, successful leadership practices emerging from qualitative comments suggested that leadership for immersion was more effective if administrators established a clear direction for immersion (communicated expectations clearly; developed, communicated, and enforced policies; coordinated district and campus efforts; garnered support from parents and school board members) and helped build the capacities of staff (acted as coaches or mentors to teachers, supported professional development). A primary challenge in the second year was administrator turnover. Some schools had new principals and superintendents who had not been involved in developing and implementing the technology immersion model, and consequently, did not provide the leadership needed for continued progress. Considering that administrative turnover is inevitable, contingency plans should be in place to ensure that new leaders receive technology leadership training and guidance before assuming leadership roles. In one district, a leadership team approach helped to ensure that principal changes did not derail implementation progress.

Parent support for immersion was an issue at some schools, but outreach from principals reduced concerns. Because parents must share responsibility for laptops, their understanding and support for immersion is essential. Administrators at four schools described problems in gaining complete parent support. A small number of parents refused to give permission for their children to have laptops, with reasons for denial centering on concerns about financial responsibility and Internet safety. At two higher implementing campuses, principals assuaged parental fears by telephoning or meeting with parents to discuss their concerns and offering parent training on laptop monitoring strategies. Principals also helped parents to understand how laptops contributed to students' development as self-directed learners and expanded their educational opportunities.

Even though schools expanded staffing for technical and pedagogical support in the second year, additional help was needed to address laptop repairs, Internet safety issues, and in-classroom support for teachers. In the second year, campus technology coordinators typically acted as both technical and pedagogical support providers, and several had other assignments that diffused their efforts. Thus, it was not surprising that surveyed teachers at the majority of campuses (81%) reported only partial levels of technical support. Technology coordinators also considered technical problems as the most urgent second-year need, and despite support from district technicians, time devoted to technical issues left little time to assist classroom teachers with curricular integration.

As campus technology infrastructure at many schools (wiring, Internet connectivity) stabilized in the second year, laptop maintenance demands increased. Nearly all of coordinators reported laptop repair problems, mainly due to normal wear and tear or manufacturing defects rather than student mishandling. Laptop maintenance often involved repairs or replacements of motherboards, chargers, power cords, and batteries. Emerging Internet safety issues also compelled coordinators to develop Internet monitoring approaches that reduced students' access to inappropriate websites. Teachers' limited proficiency also contributed to technical workloads, with coordinators frequently providing assistance with printer and peripheral issues, network and Internet access problems, and various difficulties with software packages, resources, utilities, and account management. All told, ongoing technical problems limited implementation progress in the second year.

Professional development received by many teachers in the second year was insufficient to advance classroom immersion. The quality of professional development also varied widely across schools. The technology immersion model calls for professional development that instructs educators in effective classroom integration and is delivered through proven methods such as sustained learning opportunities and ongoing coaching. Teacher survey results, however, showed that core-subject teachers at less than half of campuses received close to the prescribed number of professional development hours (about 80 hours over two years). Additionally, across all schools, teachers *rarely* (once or twice a month) or *never* received classroom coaching or mentoring. And, teachers who participated in professional development expressed varying views on the extent to which activities supported the curricular and instructional goals of immersion or met their personal goals and needs.

Core-content teachers involved in focus groups said that the bulk of professional development took place during the first year. As a result, new teachers, in particular, had insufficient training opportunities in the second year. Professional development also shifted in the second year from whole-group sessions to more individualized training through various scheduling configurations (summer, after school, Saturday, conference periods) and from vendor-provided training (Apple and Dell/Co-nect trainers) to increased reliance on multiple professional development providers (vendors, local staff, education service center staff, conferences). Similar to the first year, activities focused on identifying online resources for lessons. In-class support for teachers occurred infrequently, and when offered, teachers seldom took advantage of opportunities.

Teachers had little to say about the quality of second-year professional development, but those who offered opinions, said they had difficulty retaining the content because the pace of trainings was too fast and they had trouble remembering what was taught, or they had insufficient opportunities to practice what they had learned. Similarly, teachers described few notable effects of professional development beyond their increased comfort using technology and technology immersion package tools. The few teachers who identified professional development needs requested more classroom support and assistance with lesson development.

Teachers' support for technology immersion was weakened by challenges that often outweighed benefits. Implementation of technology immersion requires broad-based teacher support for changes in classroom practice, with teachers believing that efforts required to integrate technology are worthwhile. Although teachers at most immersion schools reported substantial support for learning about and using new technologies, teachers at a third of schools reported only partial support. Core-subject teachers' comments clarify the issues. Teachers at many schools were generally enthusiastic about the role of laptops in instruction, saying they appreciated that student laptops eliminated the need to schedule time in the library or in a computer lab, allowed more varied lesson plans and individualized learning, and provided opportunities for in-depth research. However, in spite of instructional benefits, teachers' often focused on the challenges of teaching with laptops. Teachers were concerned that time absorbed by laptops diminished curricular coverage and TAKS preparation. Additionally, teachers had difficulty finding time to prepare laptop-related lessons, making arrangements for students without laptops, handling technical problems, and monitoring students' appropriate laptop use. Reflecting the extent of teachers' concerns, the level of Classroom Immersion did not meet expectations in the second year.

Classroom Immersion

Teachers' progress in creating technology-immersed classrooms was measured by elements gauging their ideological orientation (Technology Integration, Learner-Centered Instruction), Student Activities (with technology), Communication, and Professional Productivity.

Some core-subject teachers were not strongly committed to the instructional and learning practices advocated as part of the technology immersion model. Some teachers believed new technologies were not pertinent to their curriculum and instructional practices and, in some instances, technology integration and learner-centered instruction were inconsistent with teachers' ideological beliefs and values. Consequently, teachers at most schools (81%) reported that students just *sometimes* used various technology resources to support core-content learning (partial implementation). At a fifth of schools, students *rarely* or *never* used technology resources (minimal implementation). Still, core-subject teachers' comments, as noted below, revealed progress.

As teachers became more comfortable with technology in the second year, many drew selectively from a wide range of technology resources to enhance their teaching and students' learning experiences.

- **English language arts/reading.** Across immersion schools, ELA teachers said students used laptops to research information about stories read, keep journals, write original stories, and make presentations.
- **Social studies.** Social studies teachers at all schools believed laptops enhanced their ability to conduct research with their students, and laptops permitted student access to more and better information through resources such as virtual tours or field trips, online newspapers, video clips, and electronic textbooks.
- **Science.** Science teachers at many schools had students use laptops to research a wide range of topics, present their research, conduct virtual experiments, take notes, and diagram or illustrate science concepts.
- **Mathematics.** Mathematics teachers at all schools found it difficult to integrate laptops in their classes, primarily because they had too few technology-based math resources and they believed students needed to use pencil-and-paper activities for math. Although traditional instruction prevailed, teachers at many schools used laptops for math extension (online activities and games) and diagnostic assessment.

Although many teachers embraced technologies that enhanced their professional productivity, few used communication tools to transform classroom management. Across schools, teachers frequently used new resources to enhance their own professional productivity (e.g., keep records, develop lessons, present content). Conversely, teachers at only a few schools used email regularly to communicate with students about class work or to contact parents. And, although teachers at many schools received web-based communication tools, such as eChalk, as part of immersion packages, few teachers used school or class websites to manage information.

Overall, immersion teachers' behaviors in the second year were consistent with other research on teachers' adoption of technology-based practices. Teachers used new resources to support their existing teaching practices and technology supported student learning to some extent (Sanholdtz, Ringstaff, & Dwyer, 1997; Windschitl & Sabl, 2002). Most teachers at immersion schools need additional time, high-quality professional development, and in-classroom support for instructional change.

Students believed teachers' tendencies to use laptops reflected the relevance of laptops to the subject area and teachers' personal traits. Drawing from their teachers' instructional preferences, a number of students believed laptops were more appropriate for some subjects than for others. Students considered laptops unsuitable for mathematics because problems had to be worked out on paper and inappropriate for writing because the TAKS test requires pencil-and-paper compositions. Conversely, students believed ample learning resources and websites made laptops ideally suited for social studies and science classes. Students also described particular characteristics of teachers that explained laptop use. Students said teachers who were strict, outdated, lacked technology proficiency, did not find laptops useful for schoolwork, or feared that students would behave irresponsibly seldom or never used laptops. On the other hand, students thought teachers who knew how to use technology and believed laptops provided a different way of learning used them more often.

The strength of professional development and other supports were associated with higher levels of classroom immersion. Variability in the extent and quality of each school's professional development approach lessened teachers' potential growth in creating technology-immersed classrooms in the second year. Even though the immersion model requires that a quarter of grant funds be expended for professional development, the design rests largely with individual districts and campuses and their selected technology vendors (mainly Dell or Apple). Analyses of associations between immersion support components and classroom practices revealed that the strength of professional development at a school was significantly correlated with teachers' level of Classroom Immersion. Teachers at schools with robust professional development also expressed positive ideological affiliations with technology integration and learner-centered practices.

Leadership for immersion was also important in advancing teacher change. Teachers' perception of administrative leadership for technology was significantly associated with their commitment to technology innovation, views on parent and community support, perceptions of the adequacy of technical support, and professional development quality. Thus, school administrators appeared to influence teachers through the provision of supports for changed practice.

Student Access and Use

The technology immersion model assumes that students' access to personal laptops both within and outside of school supports their development as independent and self-determined learners. Accordingly, in the second year, we measured three elements of Student Access and Use: Laptop Access Days, Core-Content Learning, and Home Learning.

Students' access to laptops varied widely both across and within schools. Students at just a third of campuses had either substantial access to laptops (140 to 178 days per student) or full access (170 to 180 days per student). Thus, students at higher implementing schools had laptops available for use a greater number of days. Students' access to laptops was diminished in some cases because schools did not provide laptops for all students, and some students who received laptops had them for fewer days because of repairs (20% of students) or penalties for misuse/misbehavior (7% of students).

Even though students as a whole used laptops infrequently for learning in core subjects, students in some schools and classrooms used laptops more often. Similar to teachers' reports, students at two-thirds of schools used laptops in core classrooms *sometimes* (once or twice a month) to *often* (once or twice a week). Students at the remaining third of campuses *rarely* (a few times a year) or *never* used technology resources in core classes. Although the frequency of student technology use generally did not meet expectations, sixth and seventh graders participating in focus groups described a variety of laptop uses in their core-subject classes.

Students, similar to their teachers, described a wide range of activities with laptops in core-subject classes.

- **English language arts/reading.** In ELA classes, students used laptops most commonly to write compositions and create presentations, learn and practice skills, read and comprehend texts, use learning programs, and play educational games. Students at higher and lower implementing schools used laptops in similar ways.
- **Social studies.** In social studies classes, students used laptops most often to research an assigned topic on the Internet and generate a product such as a composition or presentation, to take notes, and to answer content-related questions. Students at higher implementing schools described more complex social studies projects and explicit guidance from teachers.
- **Science.** In science classes, students used laptops most often to research an assigned topic on the Internet and create a composition or presentation, to define vocabulary words, and to take notes. Students viewed science videos, visited interactive websites, and conducted scientific investigations less often. Students at higher and lower implementing schools used laptops in similar ways.
- **Mathematics.** Students used laptops less often in mathematics classes than in other subject areas and the range of activities was less diverse. Across all immersion schools, students most commonly used laptops for online math-related activities or games, or to take diagnostic tests and prepare for the TAKS math test.

Students at higher implementing campuses used laptops more often outside of school and for more academic purposes. During the second implementation year, similar to the first year, a third of schools (8 of 21) either limited their students to in-school laptop use exclusively, or they allowed laptops to go home for homework or special assignments only. Students at higher implementing schools reported using their laptops more often outside of school and for more academic purposes, such as completing research projects, making PowerPoint presentations, answering chapter questions with an electronic textbook, typing or writing stories, or defining vocabulary terms. When students at lower implementing schools used laptops outside of school, it was more likely to be for playing games, listening to music, watching DVDs, or emailing rather than for academic purposes.

Students' access to and use of technology for learning was significantly related to their teachers' involvement in professional development as well as the strength of the school's supports for immersion. The quality of campus professional development supporting immersion was significantly associated with higher levels of Student Access and Use. Students' technology use also was significantly related to their teachers' support for technology innovation, parent and community support for technology, and the adequacy of technical support. Similarly, students' laptop use for learning at home (i.e., for homework in core subjects or learning games) was positively associated with the school's emphasis on professional development and teachers' belief that technology was supported by parents and community members. All told, investments at higher implementing schools in teacher training and other implementation supports helped to ensure that students' experiences with laptops more nearly approximated the immersion goal for core-content learning within and outside of school.

Effects of Immersion on Students

Teachers, technology leaders, and sixth and seventh graders offered their views on technology immersion's effects on students.

Students preferred and believed they benefited more from laptops and electronic resources than from traditional print media. Students across campuses preferred laptops over textbooks, library books, and other forms of print media. Internet search tools and various online resources permitted access to information more quickly and efficiently and allowed students to conduct research on a greater variety of topics. Of some concern, however, were students' general dislike for reading and the potential for obtaining information from Internet resources without reading extensive quantities of text. Thus, students needed explicit guidance from teachers to ensure that assignments required the use of appropriate reading strategies for comprehending electronic texts.

Students believed access to laptops improved their technology proficiency. Students at most campuses said their keyboarding skills had improved over the duration of the project, and they were learning, mastering, or being exposed to a wide variety of learning resources and productivity tools such as Internet search tools, Word, PowerPoint, Excel, and Publisher. Students' focus-group comments are consistent with survey results showing that immersion had a significantly positive effect on students' technology proficiency (Shapley et al., 2007). On the contrary, teachers at more than half of schools were frustrated by the need to devote class time to teaching sixth graders the basics of computer and program usage. To address this problem, some schools implemented or planned to implement a sixth-grade orientation covering laptop basics. Middle schools also may need to collaborate with elementary schools to ensure that the Technology Applications TEKS (Texas Essential Knowledge and Skills) are stressed in the fifth and earlier grades.

Students thought laptops positively affected their capacities as learners. Students at many campuses described ways that laptops affected their capacities as learners, including changes related to self-direction (working at their own pace, formulating questions and finding answers, seeking help from peers rather than teachers, discussing ideas with peers), organization (information arranged in electronic folders and directories), multi-sensory experiences (interactivity, pictures and sounds, three-dimensional, modifiable images, videos, virtual experiments), creativity (imagination, multiple learning modes), and ownership of learning (degree of control over work). Given that several researchers have linked technology use with increased self-direction of learning, students in the study have completed the *Style of Learning Inventory* (*SLI*), a measure of self-directed learning, each year. In contrast to students' comments, results for the *SLI* have shown no significant differences in the self-directed behaviors of immersion and control students. However, the *SLI* does not measure the same types of learning strategies that students described in focus groups.

Students said technology immersion increased their engagement in school and learning. Students representing all campuses said school with laptops is more "fun" than school without laptops. Students linked fun with other terms such as "important," "useful," and "helpful," thus acknowledging laptops as an important learning tool. Students also attributed improved classroom behavior to technology immersion, saying that students are quieter, pay more attention in class, and are more focused on class work. Students also described a greater enjoyment of school in general, which they attributed to laptops, and many students expressed a sense of privilege and opportunity associated with laptops. Many students were astutely aware that they had been provided technology access that students in other schools did not have. Students' comments about improved behavior are consistent with quantitative data showing that students in immersion schools had significantly fewer disciplinary actions than students at control schools (Shapley et al., 2007).

Laptops challenged middle school students to assume greater responsibility than had previously been expected. Some students appreciated the sense of responsibility and trust extended to them through individual laptops, while others worried about potential laptop damages and associated costs. Technology coordinators at some campuses noted improved student responsibility for laptops, whereas coordinators and teachers at other campuses, particularly lower implementing, cited increased student carelessness and damage. Many students also complained about their responsibility for carrying heavy laptops from class to class, especially when they were not consistently used. Without a doubt, providing students with individual laptops presented new challenges for students who had to demonstrate greater self-responsibility for their behavior than had been expected before immersion.

Although opinions about the effects of technology immersion on academic achievement varied, most believed that immersion had prepared students for the future. Some students at almost all campuses believed access to laptops and learning resources had improved their grades, although at lower implementing schools, students typically did not link improved grades and laptops. Some teachers, on the other hand, thought laptops had improved student skills (e.g., vocabulary, communication, and reading) but not their academic achievement or TAKS test scores. Second-year quantitative analyses showed no significant effects of immersion on TAKS scores, although immersion schools had more positive TAKS achievement trends in reading and mathematics than control schools (Shapley et al., 2007).

Although respondents expressed differing opinions on academic achievement, students and educators alike thought technology immersion had enabled students to gain valuable skills that prepared them for the future in terms of their college and career readiness.

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Appendix A

Characteristics of Individual Campuses

Table A.1 provides campus-level data for each of the 42 schools included in analyses. Data in the table show that the treatment and control schools are reasonably well matched on baseline characteristics. Middle schools are highly concentrated in rural and very small districts across the state. Still, over a third of districts and schools are in large cities or suburban locations in or around cities. The sample also includes campus charter schools (one each for the treatment and control group) located in a major urban district.

The primary limitation of the study is external validity—the extent to which the results of an experiment can be generalized from the specific sample to the general population. Schools eligible to become part of the treatment group were limited to those serving children from families living in poverty[1] and middle schools with grades 6 to 8. Only schools that applied for the grant, and submitted applications that met a threshold of quality, were eligible for consideration. Due to these restrictions, the treatment group is not representative of the average middle school in Texas.

The majority of students in the sample are economically disadvantaged. The percentage of sample students who qualify for federal free or reduced-price lunch exceeds the state average for middle schools (67% vs. 51%). The sample also is substantially more Hispanic and less White and African American than state middle-school students as a whole. Overall, about 58% of sample students are Hispanic compared to about 37% of Texas middle school students. Conversely, the sample includes fewer African American students (7% vs. 14%) and white students (36% vs. 46%) compared to the state averages.

The sample schools also differ structurally from Texas middle schools as a whole. Middle schools in Texas, on average, enroll more students (667 vs. 402 in sample schools) and are concentrated in larger districts (11,575 students enrolled, on average, vs. 3,672 in sample schools). Thus, compared to the state overall, sample schools and the districts they reside in are smaller and serve more economically disadvantaged and Hispanic students. Differences almost certainly reflect funding restrictions (Title II, Part D) and the amount of available funds per grant. The maximum grant amount ($750,000) fell well short of dollars required to support one-to-one technology in larger middle schools.

[1] Federal definition used: 27% of population or more than 2,500 people living below poverty line.

Table A.1. Characteristics of Technology Immersion and Matched Control Schools

	Location			Students							
Campus	District	District Enroll-ment	Community Type	Grades 6, 7, 8 Number	White (%)	African American (%)	Hispanic (%)	ESL (%)	Special Ed (%)	Eco Disadv (%)	Mobility (%)
Immersion											
Fruitvale Middle	Fruitvale	448	Rural	100	93.0	1.0	6.0	1.0	29.0	62.0	14.6
McLeod Middle	McLeod	478	Rural	138	93.5	4.3	1.4	0.0	17.4	44.2	14.6
Monte Alto Middle	Monte Alto	501	Rural	151	4.0	0.0	96.0	19.2	13.9	90.1	14.3
De La Paz Middle	Riviera	511	Rural	123	35.0	0.8	63.4	6.5	17.1	62.6	12.9
Charlotte Junior High	Charlotte	514	Rural	118	16.9	0.0	83.1	1.7	17.8	66.1	12.0
Memphis Middle	Memphis	530	Rural	124	46.8	12.9	40.3	12.9	19.4	65.3	14.6
Morton Junior High	Morton	540	Rural	117	23.9	11.1	64.1	5.1	9.4	78.6	12.2
Post Middle	Post	986	Non-metro: Stable	207	45.4	6.8	46.9	0.0	14.5	56.5	27.1
Floydada Junior High	Floydada	1,041	Non-metro: Stable	240	32.5	4.2	63.3	11.3	10.8	63.3	15.1
Newton Middle	Newton	1,307	Non-metro: Stable	299	53.8	41.8	2.0	0.3	18.1	57.9	18.8
Dublin Middle	Dublin	1,331	Non-metro: Stable	309	53.7	0.3	45.3	5.2	12.6	64.4	17.2
Brady Middle	Brady	1,385	Non-metro: Stable	295	54.9	3.1	41	1.4	19.3	62.0	14.5
Franco Middle	Presidio	1,516	Non-metro: Stable	341	0.6	0.0	99.1	38.1	10.6	93.5	15.0
Bernarda Junior High	San Diego	1,542	Non-metro: Stable	354	1.1	0.3	98.6	11.9	13.8	82.5	11.5
Austin Middle	Bryan	14,104	Central city	962	32.7	19.4	47.1	6.1	12.4	65.0	21.7
Woodland Acres Middle	Galena Park	20,388	Major suburban	416	7.2	7.0	85.8	22.8	11.1	85.6	12.0
Cigarroa Middle	Laredo	24,359	Central city	1,447	0.3	0.1	99.6	57.3	18.9	99.4	17.1
Memorial Middle	Laredo	24,359	Central city	713	0.7	0.0	99.3	51.6	19.1	97.5	20.1
Baker Middle	Corpus Christi	39,185	Central city	861	21.7	2.2	71.8	0.8	9.5	49.0	17.9
Cullen Middle	Corpus Christi	39,185	Central city	448	37.1	1.3	61.4	0.9	13.2	44.9	23.0
Kaleidoscope (Charter)	Houston	211,157	Major urban	110	0.9	6.4	90.9	30.0	1.8	96.4	6.1
Immersion school means				**375**	**31.2**	**5.9**	**62.2**	**13.5**	**14.7**	**70.8**	**15.8**

(*Continued*)

Table A.1. Characteristics of Technology Immersion and Matched Control Schools (*Continued*)

	Location			Students							
Campus	District	District Enroll-ment	Community Type[a]	Grades 6, 7, 8 Number	White (%)	African American (%)	Hispanic (%)	ESL (%)	Special Ed (%)	Eco Disadv (%)	Mobility (%)
Control											
Ore City Middle	Ore City	817	Non-metro: Stable	203	85.2	6.9	7.9	0.5	18.2	50.7	19.9
Harleton Junior High	Harleton	624	Rural	155	97.4	2.6	0.0	0.0	12.3	25.2	15.9
Hamlin Middle	Hamlin	522	Rural	106	54.7	6.6	37.7	0.0	23.6	65.1	22.0
O'Donnell Junior High	O'Donnell	373	Rural	83	44.6	0.0	55.4	0.0	18.1	67.5	17.3
Odem Junior High	Odem-Edroy	1,175	Non-metro: Stable	287	19.5	0.0	80.1	2.8	11.5	53.3	11.3
Wellington Junior High	Wellington	555	Rural	141	55.3	7.1	37.6	7.8	16.3	62.4	12.2
Seagraves Junior High	Seagraves	589	Rural	142	26.1	11.3	61.3	2.8	21.1	63.4	6.5
Skidmore-Tynan Jr. Hi.	Skidmore-Tynan	713	Rural	176	35.8	0.6	63.6	1.7	16.5	60.2	18.8
Slaton Junior High	Slaton	1,382	Non-metro: Stable	335	36.1	8.7	54.9	2.1	12.5	61.5	18.6
Timpson Middle	Timpson	568	Rural	140	65.7	29.3	4.3	2.1	12.1	60.7	18.6
Cameron Junior High	Cameron	1,638	Non-metro: Stable	372	43.5	19.9	36.3	1.3	11.8	63.2	11.0
Coleman Junior High	Coleman	1,025	Non-metro: Stable	248	71.8	1.6	25.8	0.0	13.3	54.0	22.3
Truman Middle	Edgewood	12,873	Major suburban	482	0.2	0.2	99.6	10.6	21.2	96.9	25.3
Newman Middle	Cotulla	1,264	Central city sub.	281	8.5	0.0	91.5	14.2	13.5	82.9	13.9
Rayburn Middle	Bryan	14,104	Central city	1,190	51.4	27.1	20.8	2.4	11.1	47.6	16.2
Galena Park Middle	Galena Park	20,388	Major suburban	1,009	5.0	8.5	86.4	15.5	13.8	78.3	12.7
Lamar Middle	Laredo	24,359	Central city	1,390	1.3	0.2	98.1	26.6	17.7	90.1	14.8
Faulk Middle	Brownsville	48,857	Central city	888	0.8	0.0	99.2	37.6	19.3	99.1	18.0
Hamlin Middle	Corpus Christi	39,185	Central city	805	25.8	3.7	69.9	1.1	17.4	56.5	19.3
Haas Middle	Corpus Christi	39,185	Central city	476	65.4	6.5	59.5	0.6	18.9	50.6	26.4
Briarmeadow (Charter)	Houston	211,157	Major urban	89	48.3	15.7	32.6	3.4	12.4	29.2	1.5
Control school means				**429**	**40.1**	**7.5**	**53.5**	**6.3**	**15.8**	**62.8**	**16.3**
Immersion school means				**375**	**31.2**	**5.9**	**62.2**	**13.5**	**14.7**	**70.8**	**15.8**
Overall school means				**402**	**35.7**	**6.7**	**57.8**	**9.9**	**15.3**	**66.8**	**16.1**

Source: Texas Education Agency AEIS reports 2004.
Note. Two campuses (one experimental and one control) were excluded from the groups in the second year.
[a] Community Type: Major urban (six largest districts in the state), Major suburban (other school districts in and around major urban areas), Central city (largest districts in other large, but not major, Texas cities), Central city suburban (school districts in and around the other large, but not major, Texas cities), Independent town (largest districts in counties with 25,000 to 100,000), Non-metro: Fast growing (school districts smaller than other categories, exceed state median, and have 5-year growth rate of 20%), Non-metro: Stable (school districts smaller than other categories, exceed state median, and have stable growth), Rural (number of students is between 300 and the state median or less than 300)

Appendix B

Site Visit Data Collection Methods

From late February to early May 2006, researchers conducted site visits at each of the participating campuses (22 treatment and 22 control).[1] Campus visits typically involved teams of two to three researchers who collected data for one to two days. Researchers were paired in a rotating sequence that ensured each researcher was paired at least once during site visits with each of the other researchers.

During site visits, data collectors conducted audiotape-recorded interviews with principals, technology coordinators, and central administrators as well as focus groups with a sample of sixth- and seventh-grade core content-area teachers and students. Table B.1 summarizes the number of data collection events occurring during site visits in spring 2006.

Table B.1. Data Collection Summary for Spring 2006 Site Visits

	Number		
	Immersion	Control	Total
Principal Interviews	20	20	40
Tech Coordinator Interviews	20	23	43
Central Administrator Interviews	18	0	18
Teacher Focus Groups (# of teachers)	35 (157)	22 (94)	57 (251)
Student Focus Groups (# of students)	42 (265)	21 (133)	63 (398)
Grade 6 (# of students)	21 (131)	10 (60)	31 (191)
Grade 7 (# of students)	21 (134)	11 (73)	32 (207)

Note. Numbers reflect site visits for 21 immersion and 21 control schools.

Data sources for the study included interviews, focus groups, classroom observations, and surveys of teachers and students.

Interviews

Researchers conducted semi-structured interviews with campus principals and technology coordinators at all sites. Interviews at treatment campuses concentrated on the implementation of technology immersion and changes that occurred during the school year. Interviews at control sites explored changes in technology access and use and the implementation of other initiatives that might affect the study's outcomes. We interviewed 40 principals, including principals at 20 treatment and 20 control sites.

Campus technology coordinators encompassed a wide range of positions (e.g., hardware technician, technology trainer, curriculum integration specialist). Interview questions at treatment campuses addressed the implementation of technology immersion, the characteristics of technical and pedagogical support, the impact of immersion on coordinators, and changes in access to technology. Interviews with technology coordinators at control campuses addressed the use of TIP funds, school or district initiatives that may have affected technology use, and changes in access to technology use over the course of the school year. We interviewed 43 coordinators (20 treatment, 23 control).

[1] Researchers conducted site visits to two campuses that were excluded from data analyses due to the effects of Hurricane Rita. Findings for these schools are not included in this report.

We also conducted interviews with 18 district-level administrators directly involved with TIP implementation at immersion campuses. The district-level administrators interviewed included superintendents, assistant superintendents, district curriculum coordinators, and district technology coordinators. Interviews focused on administrators' roles in the TIP project, their views of the project's successes and challenges, and the issues involved in continuing the project in the coming school year.

Focus Groups

In spring 2006, focused teacher discussions involved groups of six to eight sixth- and seventh-grade teachers of core academic subjects (reading/English language arts, mathematics, science, and social studies). On each campus, we held either one or two teacher focus groups, depending on the number of teachers. The spring discussions with treatment teachers focused on the immersion project's effects on teachers' access to and use of technology, their assessment of TIP professional development and instructional resources, and their views of immersion's effects on students. On control campuses, focus-group discussions explored teachers' ability to access and use technology resources as well as their assessment of TIP-funded professional development. A total of 157 sixth- and seventh-grade teachers participated in 35 discussion groups at treatment campuses. At control campuses, we used a sampling strategy that so that focus-group discussions at a campus involved either sixth- or seventh-grade teachers (94 control teachers in 22 discussion groups).

We also held focused discussions with a randomly selected sample of sixth- and seventh-grade students at each treatment and control campus (about six to eight students per group). On treatment campuses, focus group discussions probed students' perceptions of the effects of the immersion project, their access to and use of technology in and outside of school, the challenges involved with using laptops, discipline and behavior issues, and the personal impact of using a laptop. On control campuses, student discussions explored students' access to and use of technology in and outside of school and the challenges involved in using computers. At treatment campuses, an equal number of focus groups were held with sixth and seventh graders (21 for each). Similar to teachers, a sampling strategy at control campuses involved the selection of either sixth- or seventh-grade student at a campus for participation. This yielded 21 focus groups nearly equally divided across sixth grade (10 groups) and seventh grade (11 groups).

Teacher Survey

Immersion and control teachers completed an online technology survey in spring 2006 (April to May). The survey included items related to school technology, teachers' technology proficiency and use, and professional development experiences. A total of 1,175 teachers completed surveys (93% of all teachers, 92% of treatment, and 95% of control). For this report, the responses of treatment teachers were used to calculate measures of the implementation fidelity of technology immersion.

Teachers responded to 33 items pertaining to their perceptions of school technology. They rated their strength of agreement with statements on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Item analysis using maximum likelihood factor analysis with Varimax rotation revealed five distinct factors, including Leadership (12 items), Classroom Technology Integration (4 items), Technical Support (5 items), Innovative Culture (4 items), and Parent and Community Support (2 items). Measures of internal consistency (Cronbach's alpha) for school-level factors ranged from 0.66 to 0.94.

Surveys also included measures of teacher mediating variables, with items pertaining to teachers' perceptions of Technology Proficiency (27 items), Professional Productivity (17 items), Student Classroom Activities (17 items), and Collaboration (11 items related to teacher interactions with colleagues). Additionally, confirmatory analysis of items adapted from the Levels of Technology Implementation (LoTi) Questionnaire (Moersch, 2001) showed reasonable fit indices for a model having

Technology Integration (10 items), Learner-Centered Instruction (4 items), and Resistance to Integration (3 items). Cronbach's alpha for scales ranged from 0.70 to 0.99.

For Technology Proficiency items, teachers indicated their skill level on a 7-point scale with 1 and 2 indicating low proficiency (*not true of me now*), 3, 4, and 5 indicating moderate proficiency (*somewhat true of me now*), and 6 and 7 indicating proficiency (*very true of me now)*. Measures of integration—Technology Integration, Learner-Centered Instruction, and Resistance to Integration—also involved a 7-point scale ranging from 1 (*not true of me now*) to 7 (*very true of me now*). For Professional Productivity, Student Classroom Activities, and Collaboration, teachers used a 5-point scale to rate the frequency of activities or interactions: 1 (*never*), 2 (*rarely–e.g., a few times a year)*, 3 (*sometimes–e.g., once or twice a month)*, 4 (*often*–e.g., *once or twice a week)*, and 5 (*almost daily*).

Student Survey

Students in sixth, seventh, and eighth grade completed paper-and-pencil questionnaires measuring their technology proficiency and use in spring 2006. For this report, the responses of treatment students were used to calculate measures of the implementation fidelity of technology immersion. Survey items measured students' Technology Proficiency (22 items), Classroom Activities (12 items), Technical Problems (6 items), Small-Group Work (6 items), and School Satisfaction (6 items). Cronbach's alpha coefficients ranged from 0.77 to 0.94. As a measure of Technology Proficiency, students indicated how well they could use various technology applications on a 5-point scale: 1 (*I can do this not at all or barely)*, 2 (*I can do this with some difficulty*), 3 (*I can do this fairly well*), 4 (*I can do this very well)*, and 5 (*I can do this extremely well*). For measures of Classroom Activities, Technical Problems, and Small-Group Work, students used a 5-point scale to rate the frequency of activities or interactions: 1 (*never*), 2 (*rarely–e.g., a few times a year)*, 3 (*sometimes–e.g., once or twice a month)*, 4 (*often*–e.g., *once or twice a week)*, and 5 (*almost daily*). Students rated school satisfaction items on a 5-point agreement scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Technology survey response rates for students were 80%.

Appendix C

Measuring Implementation Fidelity

In the second 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 C.1 shows the scoring rubrics for immersion indicators, and Table C.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 involve 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 two-year technology immersion implementation period. 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 C.1. Scoring Rubrics for Measuring the Implementation Fidelity of Technology Immersion

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 2.18 to 3.48 M=2.90 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 -2.20 to 1.78
Teacher Support (Innovative Culture)					
Campus Scores 2.33 to 3.41 M=3.06 SD=0.28	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 -2.65 to 1.25
Parent and Community Support					
Campus Scores 1.58 to 3.28 M=2.63 SD=0.40	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 -2.59 to 1.60
Technical Support					
Campus Scores 2.32 to 3.50 M=2.73 SD=0.29	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 -1.42 to 2.66

Table C.1. Scoring Rubrics for Measuring the Implementation Fidelity of Technology Immersion (*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 0.50 (10hrs) to 4.0 (112hrs) M=2.30 (47.8hrs) SD=1.16	Core-subject teachers, on average, participated in 35 or less hours of PD over the past two school years.	Core-subject teachers, on average, participated in 36 to 59 hours of PD over the past two school years.	Core-subject teachers, on average, participated in 60 to 74 hours of PD over the past two school years.	Core-subject teachers, on average, participated in 75 or more hours of PD over the past two school years.	-1.44 to 2.09
Classroom Support Campus Scores 1.42 to 2.83 M=2.13 SD=0.35	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 3.71 M=2.97 SD=0.38	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 1.87 to 3.53 M=2.54 SD=0.39	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 0.93 (147 days) to 3.94 (180 days) M=2.69 (172.2 days) SD=0.71	Students' laptop access days vary to an *extremely large extent* at a campus, with laptops available from about 42 to 169 days per student.	Students' laptop access days vary to a *large extent* at a campus, with laptops available from about 100 to 176 days per student.	Students' laptop access days vary do a *moderate* extent at a campus, with laptops available from about 140 to 178 days per student.	Students' laptop access days vary to a *small extent* at a campus, with laptops available from about 170 to 180 days per student.	-2.55 to 1.78
Core-Content Learning Campus Scores 1.18 to 2.71 M=2.07 SD=0.46	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 0.42 to 2.66 M=1.75 SD=0.57	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 C.1. Scoring Rubrics for Measuring the Implementation Fidelity of Technology Immersion (*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 -1.74 to 1.68
Technology Integration Campus Scores 1.75 to 3.09 M=2.48 SD=0.38	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 1.63 to 3.07 M=2.45 SD=0.41	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 1.83 to 2.91 M=2.33 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 1.13 to 3.37 M=2.38 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 2.44 to 3.16 M=2.73 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 -1.70 to 1.91

Table C.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 C.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 two school years (i.e., since August 1, 2004).	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 C.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 C.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	

Table C.3. **Level of implementation for Support Components: Number and Percent of Schools at each Implementation Level and Mean Implementation Score**

Immersion Supports	Overall Mean Score	Number and Percent of Schools and Mean Implementation Score											
		Minimal 0-1.99			**Partial** 2.00-2.99			**Substantial** 3.00-3.49			**Full** 3.50-4.00		
		n	*%*	*M*	*n*	*%*	*M*	*n*	*%*	*M*	*n*	*%*	*M*
Leadership	2.90	--	--	--	11	52	2.64	10	48	3.48	--	--	--
Teacher	3.06	--	--	--	7	33	2.78	14	67	3.20	--	--	--
Parent/community	2.63	1	5	1.59	15	71	2.53	5	24	3.13	--	--	--
Technical	2.73	--	--	--	17	81	2.62	3	14	3.12	1	5	3.50

Note. Standards-based scores measured on a 0 to 4 scale.

Table C.4. **Level of implementation for Elements of the Professional Development Component: Number and Percent of Schools at each Implementation Level and Mean Implementation Score.**

Element of Professional Development	Overall Mean Score	Number and Percent of Schools and Mean Implementation Score											
		Minimal 0-1.99			**Partial** 2.00-2.99			**Substantial** 3.00-3.49			**Full** 3.50-4.00		
		n	*%*	*M*	*n*	*%*	*M*	*n*	*%*	*M*	*n*	*%*	*M*
Contact Hours	2.30	11	52	1.28	1	5	2.53	6	29	3.48	3	14	4.00
Classroom Support	2.13	7	33	1.76	14	67	2.31	--	--	--	--	--	--
Content Focus	2.97	--	--	--	9	43	2.62	11	52	3.19	1	5	3.71
Coherence	2.55	2	10	1.90	16	76	2.49	2	10	3.11	1	5	3.53

Note. Standards-based scores measured on a 0 to 4 scale.

Table C.5. **Level of implementation for Elements of the Classroom Immersion Component: Number and Percent of Schools at Each Implementation Level and Mean Implementation Score**

Element of Classroom Immersion	Overall Mean Score	Number and Percent of Schools and Mean Score											
		Minimal 0-1.99			**Partial** 2.00-2.99			**Substantial** 3.00-3.49			**Full** 3.50-4.00		
		N	%	M	N	%	M	N	%	M	N	%	M
Technology Integration	2.49	3	14	1.86	16	76	2.53	2	10	3.06	--	--	--
Learner-centered Instr.	2.45	2	10	1.77	17	81	2.46	2	10	3.05	--	--	--
Student Activities	2.33	4	19	1.89	17	81	2.44	--	--	--	--	--	--
Communication	2.38	5	24	1.63	13	62	2.50	3	14	3.15	--	--	--
Professional Productivity	2.73	--	--	--	16	76	2.63	5	24	3.07	--	--	--

Note. Standards-based scores measured on a 0 to 4 scale. Instr.= Instruction.

Table C.6 **Level of implementation for Elements of the Student Access and Use Component: Number and Percent of Schools at each Implementation Level and Mean Implementation Score**

Elements of Student Access and Use	Overall Mean Score	Number and Percent of Schools and Mean Score											
		Minimal 0-1.99			**Partial** 2.00-2.99			**Substantial** 3.00-3.49			**Full** 3.50-4.00		
		n	*%*	*M*	*n*	*%*	*M*	*n*	*%*	*M*	*n*	*%*	*M*
Laptop Access Days	2.69	3	14	1.40	10	48	2.57	6	29	3.15	2	9	3.86
Core-Content Learning	2.01	8	38	1.59	13	62	2.37	--	--	--	--	--	--
Home Learning	1.75	13	62	1.40	8	38	2.25	--	--	--	--	--	--

Note. Standards-based scores measured on a 0 to 4 scale.