eTxTiP

Evaluation of the Texas Technology Immersion Pilot

Outcomes for the Third Year (2006–07)
January 2008

TCER
Texas Center for Educational Research

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For additional information about TCER research, please contact:

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

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

Contributing Authors

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

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

Prepared for

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

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Executive Summary

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

Technology Immersion

State statute provided a general description of technology immersion, but the concept and its component parts were defined operationally to foster uniformity. As a way to ensure consistent interpretation of the technology immersion model and comparability of implementation across schools, the TEA issued a Request for Qualifications (RFQ) that allowed commercial vendors to apply to become providers of technology immersion packages. Vendors had to include six components in their plan: (a) a wireless mobile computing device for each educator and student on an immersed campus to ensure on-demand technology access; (b) productivity, communication, and presentation software for use as learning tools; (c) online instructional resources that support the state curriculum in English language arts, mathematics, science, and social studies; (d) online assessment tools to diagnose students' strengths and weaknesses or to assess mastery of the core curriculum; (e) professional development for teachers to help them integrate technology into teaching, learning, and the curriculum; and (f) initial and ongoing technical support.

Through an 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]). Package costs, which ranged from about $1,100 to $1,600 per student, varied according to the numbers of students and teachers, the type of laptop computer, and the vendor provider. Of the 21 immersion sites studied in the third year, 5 middle schools selected the Apple package, 15 selected the Dell package, and 1 school selected the Region 1 ESC package (Dell computer).

Methodology

Evaluation Design

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). The evaluation also examines the relationships that exist among contextual conditions, technology immersion, intervening factors

(school, teacher, and student), and student achievement. The research design is quasi-experimental with middle schools assigned to either treatment or control groups. This report concentrates on information gathered during the 2006-07 school year, but analyses also include data from the first (2004-05) and second (2005-06) project years. Researchers answered the following questions:

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

The *Theoretical Framework for Technology Immersion* guides the evaluation. The experimental research design allows an estimate of the effects of the intervention, which is the difference between the treatment and control groups. The framework postulates a linear sequence of causal relationships. First, experimental schools are to be "immersed" in technology through the introduction of technology immersion components. An improved school environment for technology should then 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 in their classrooms, and use laptops and digital resources to increase the intellectual challenge of lessons. In turn, these improved school and classroom conditions should lead students to greater technology proficiency, more opportunities for peer collaboration, greater personal self-direction, more rigorous and authentic learning experiences, 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, prior student achievement and student, family, and school characteristics exert their own influence on learning.

Setting and Participants

The research includes 42 grades 6 to 8 middle schools drawn from rural, suburban, and urban locations in Texas. Schools are divided equally between the treatment group (21) and control group (21). The middle schools are typically small (402 students, on average); however, enrollments vary widely (from 83 to 1,447 students). While schools are mainly concentrated in small or very small Texas districts (less than 3,000 students), about a third of schools are in very large districts (10,000 or more students).

The study focused on three student cohorts in the third year. Cohort 1 included eighth graders (2,586 treatment, 2,863 control) who completed their third project year, Cohort 2 included seventh graders (2,644 treatment, 2,882 control) who finished their second project year, and Cohort 3 included sixth graders (2,597 treatment, 2,840 control) who concluded their first year. Students in the cohorts were predominantly minority (65%) and economically disadvantaged (67%). In the third year, a total of 1,253 teachers participated in the study, including 591 in immersion schools and 662 in control schools.

Data Collection and Analysis

Data collection involved a mix of qualitative and quantitative data sources. Researchers conducted site visits at each of the middle schools in fall 2004 and again in spring 2005, 2006, and 2007. For this report, we concentrate on data gathered through observations in a sample of grades 6, 7, and 8 classrooms (English language arts, mathematics, social studies, and science). Additional measures include annual online teacher surveys and student paper-and-pencil surveys. We also have gathered school and student data on a yearly basis from the Texas Public Education Information Management

System (PEIMS) and the Academic Excellence Indicator System (AEIS), as well as data on student disciplinary actions from schools.

We used either two- or three-level hierarchical linear models (HLM) to analyze immersion effects on teachers' and students' perceptions of technology and proficiencies, immersion effects on students' TAKS achievement, and associations between implementation and outcomes. Three-level HLM growth modeling estimated the effects of immersion on rates of growth for dependent variables across time (2004, 2005, 2006, and 2007). When only two data points were available, we used two-level HLM models to estimate the effects of immersion on 2007 scores. For two-level HLM models, we calculated effect sizes (ES) in standard deviation units (usually Cohen's *d)*. Effect sizes greater than 0.5 are typically interpreted as large, 0.5 to 0.3 as moderate, 0.3 to 0.1 as small, and less than 0.1 as trivial.

Study Limitations

The sample selection process and matching procedures used with the quasi-experimental design appear to have produced a sample of schools with good internal validity, in that there are no large, statistically significant treatment-control group differences. However, a threat to internal validity was introduced in the third year when control schools began to plan for technology immersion and most of the control teachers received laptops, instructional resources, and more intensive professional development. Generalization of findings to a broader population (external validity) is a primary study limitation. Compared to Texas middle-school students as a whole, students in the sample schools are substantially more Hispanic and less White and African American. Middle schools are also smaller than the statewide average, and schools are located either in small or very small districts (64%) or large districts (36%), which differs from the statewide distribution of schools. Additionally, for many variables, the study relies on self-reported data from surveys of teachers and students—thus, some findings on changes in proficiencies and practices reflect respondents' perceptions. Nonetheless, the triangulation of evidence from multiple sources (surveys, classroom observations, state demographic and test databases, multiple student cohorts) verifies the robustness of findings.

Major Findings

Effects of Technology Immersion on Teachers and Teaching

In the third year, immersion teachers continued to grow in technology proficiency and in their use of technology for professional productivity at significantly faster rates than control teachers. Technology immersion has accelerated teachers' growth in meeting the state's Technology Application Standards. In a self-assessment of their technology proficiency across four time points, immersion teachers considered themselves to be increasingly more technology literate than control teachers in areas involving technology operations and pedagogical skills. Similarly, teachers in immersion schools are using technology significantly more often for management purposes, such as communicating with students through email and websites, administering assessments, and accessing model lesson plans.

Teachers at schools with higher concentrations of student poverty grew in technology proficiency at a slower rate. Consistent with previous years, teachers who taught at schools with higher levels of student poverty grew in technology proficiency at significantly slower rates than their peers in more advantaged schools. Weaker supports for implementation at higher poverty immersion schools may at least partially explain teachers' slower progress.

Teachers in immersion schools expressed increasingly stronger ideological associations across years with technology integration and learner-centered practices. Although immersion and control teachers initially expressed similar views on instructional practices involving technology, immersion teachers altered their instructional beliefs at a significantly faster rate. Thus, immersion teachers increasingly employed actions supporting curricular and instructional infusion of technology. Immersion teachers also expressed increasingly stronger affiliations across years with constructivist or learner-centered practices, such as having students establish individual learning goals and emphasizing experiential learning.

Teachers at immersion schools had more collegial interactions on technology-related issues than control teachers, and students used technology more often in immersion classrooms. Teachers at immersion schools reported increasingly more frequent collaborative interactions with their colleagues that supported instructional practices involving technology than control teachers (e.g., developing lesson plans or exchanging information about students), and immersion teachers increased the frequency of their students' Classroom Activities involving technology at a more rapid pace. Although student activities with technology have steadily increased in immersion classrooms, third-year statistics indicted that students still used various technology resources infrequently (i.e., about once or twice a month). While the overall level of classroom technology activities remained low, practices varied substantially across teachers and core-subject areas.

Cumulative evidence suggests that laptop computers and digital resources have allowed students in technology immersion schools to experience slightly more intellectually demanding work. New resources in technology immersion schools and classrooms are expected to promote students' higher level thinking through more challenging and relevant learning activities that support academic achievement. Although observations of core-subject classes in spring of 2005, 2006, and 2007 revealed no statistically significant differences between the overall Intellectual Challenge of immersion and control teachers' instruction, the sizes of effects favoring immersion teachers increased across years. In particular, immersion teachers' lessons compared to control had a greater emphasis on Higher Order Thinking over time. Across both immersion and control classrooms, however, the intellectual demand of instruction was typically low (mostly below 2 on the 5-point challenge scale).

Effects of Technology Immersion on Students and Learning

Technology immersion significantly increased students' technology proficiency and reduced the proficiency gap between economically advantaged and disadvantaged students. Across three cohorts, students in technology immersion schools have made greater progress in mastering the Texas Technology Applications standards than control students. Technology immersion had a positive and enduring effect on the technology proficiencies of Cohort 1 students from lower socioeconomic backgrounds. By the end of the third year, economically disadvantaged eighth graders in immersion schools were growing in proficiency at a significantly faster yearly rate than their more affluent immersion peers and control-group students. For Cohort 2 (seventh graders) and Cohort 3 (sixth graders), technology immersion had a significantly positive effect on technology proficiency for both economically advantaged and disadvantaged immersion students.

Technology immersion significantly increased the frequency of students' classroom technology use and their interactions with peers in small-group activities. Across three cohorts, students in immersion schools used technology applications significantly more often in their core-subject classrooms than control students. Despite significant increases, third-year statistics (similar to teachers' reports) indicated that students used technology resources infrequently in core classrooms (about once or twice a month). Students in immersion schools also had more frequent opportunities to learn in small groups with their classmates, whereas control students reported less frequent small-

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group activities as they advanced to higher grade levels. In general, as immersion teachers altered their beliefs about instructional practices, they began to configure classroom activities differently.

Students at immersion schools, compared to control, reported mounting technical problems over time when they used computers at school. Cohorts 1 and 2 immersion students reported increasing technical problems using computers across years compared to control students, with the growth in problems statistically significant for Cohort 1. Cohort 3 students at immersion schools (sixth graders), who inherited laptops that had been used by students during two previous school years, also reported significantly more technical problems than control students. Although increased problems appeared to accompany aging laptops, mean scores in spring 2007 indicated that students, on average, rarely (a few times a year) or just sometimes (once or twice a month) had problems using computers at school.

Technology immersion and control students regarded themselves as similarly self-directed learners. Since the independent and self-guided learning afforded through one-to-one technology was expected to positively affect students' personal self-direction, we asked students to complete the Style of Learning Inventory as a measure of Self-Directed Learning. Findings in the third year replicated first- and second-year results showing there was no significant immersion effect on students' self-direction. In fact, as both immersion and control students in Cohorts 1 and 2 progressed from lower to higher grade levels, their responses to statements measuring self-direction revealed significantly negative growth trends. Thus, students reported less self-regulated learning behaviors across time.

Students in immersion schools had significantly fewer disciplinary actions, similar levels of school satisfaction, and significantly lower school attendance rates than control-group students. One-to-one computing is often credited with increased student engagement as measured by indicators such as stronger commitment to academic work, reduced discipline problems, and increased school attendance. However, consistent results for three student cohorts involved in our study show that immersion students exhibited significantly stronger school engagement through more positive behavior, but they did not express greater satisfaction with school, and they attended school less regularly than control students.

- **Behavior and discipline.** Disciplinary Action Reports for each student during the 2006-07 school year, similar to the previous two years, showed that immersion students had proportionately fewer behavioral and disciplinary problems than their counterparts in control schools. Cohorts 1, 2, and 3 immersion students had an average of 0.65, 0.53, and 0.47 disciplinary actions, respectively, compared to 0.90, 0.86, and 0.75 for control students.

- **School satisfaction.** For each of three cohorts, there was no significant difference in the school satisfaction expressed by students at immersion and control schools in the third year.

- **School attendance.** Contrary to expectations, across three cohorts, students in immersion schools had significantly lower school attendance rates than control-group students. For example, at the end of eighth grade, Cohort 1 advantaged students in immersion schools had an average attendance rate of 96.3% compared to 97.2% for control students. Economically disadvantaged immersion students, similarly, had significantly lower attendance rates than their control-group counterparts. Surprisingly, as detailed in the section to follow, immersion students' lower average school attendance was not always associated with lower academic achievement. This contrasts with other research linking lower school attendance rates with lower test scores.

Effects of Technology Immersion on Academic Achievement

For analyses reported below, students' TAKS scale scores were standardized and then normalized as *T* scores with a mean of 50 and a standard deviation of 10. We used two-level HLM models and three-level HLM growth models to estimate the effects of immersion on students' test scores. Texas students complete TAKS tests annually in reading and mathematics, so reported evidence is stronger for those subject areas. In contrast, evidence for science, social studies, and writing is limited because students complete those assessments periodically.

Technology immersion had no statistically significant effect on students' TAKS reading achievement. After controlling for student and school poverty, there were no statistically significant effects of immersion on the TAKS reading growth rates for either Cohort 1 (eighth graders) or Cohort 2 (seventh graders). The immersion effects were positive but not by significant margins. Across cohorts, economically disadvantaged students grew in reading achievement at significantly faster rates than their more affluent peers. For disadvantaged immersion students, positive annual growth rates provided a substantial boost in reading achievement over time. For Cohort 3 sixth graders, after controls for students' prior achievement, demographic characteristics, and school poverty, there was no statistically significant effect of immersion on students' 2007 TAKS reading scores. Similar to the other cohorts, the immersion effect was positive but not by a significant degree.

Technology immersion had a statistically significant effect on TAKS mathematics achievement, particularly for economically advantaged and higher achieving students. After controlling for student and school poverty, technology immersion had a statistically significant effect on students' TAKS mathematics growth rates for Cohorts 1 and 2 students. For Cohort 1, a significant interaction effect revealed that economically advantaged students in immersion schools increased their math achievement at a significantly faster rate than disadvantaged immersion students, and at a faster rate than both economically advantaged and disadvantaged control-group students. For Cohort 2, economically advantaged and disadvantaged immersion students had TAKS mathematics growth rates that significantly outpaced their control-group counterparts. For Cohort 3 sixth graders, after controlling for students' prior achievement, demographic characteristics, and school poverty, there was a statistically significant effect of immersion that acted through students' pretest scores. Other factors being equal, as students' TAKS pretest scores increased, the achievement gap favoring immersion students over control widened for 2007 TAKS mathematics scores. Thus, immersion had a stronger and significant effect on math scores for higher achieving sixth graders.

Students who had greater access to laptops and used laptops for learning to a greater extent, especially outside of school, had significantly higher TAKS reading and mathematics scores. We used a series of HLM models to investigate the relationships between implementation levels and student academic achievement. Specifically, Student Access and Use was an aggregate implementation measure of the extent to which a student had access to a laptop throughout the school year (number of days), the frequency of technology use for learning in core-subject classes, and the extent of laptop use for homework and learning games. HLM results showed that Student Access and Use was a statistically significant positive predictor of students' TAKS reading and mathematics achievement for each of the three student cohorts. Of the three elements of Student Access and Use, students' use of their laptops for Home Learning—a measure of the extent to which students used laptops outside of school for homework in the four core-subject areas and for learning games—was the strongest predictor of both TAKS reading and mathematics achievement. In contrast, we found that reading and mathematics teachers' reported levels of Classroom Immersion were typically insignificant predictors of students' academic achievement. Results highlight the important role that individual laptops play in promoting ubiquitous learning and in equalizing the out-of-school learning opportunities for students in disadvantaged family and school situations.

The effects of technology immersion on reading and mathematics achievement generally became stronger over time as teachers and students became more accomplished technology users. The immersion effects on reading and mathematics achievement evolved across three project years. In the first project year, the immersion effects on TAKS scores were negative. In the second year, immersion effects were typically positive, but not by statistically significant margins. In the third year, significantly positive immersion effects on TAKS mathematics emerged for each of three student cohorts, and links were established between higher levels of student technology use and achievement. These findings underscore the importance of longitudinal studies in assessing the impacts of educational initiatives on student academic achievement.

Evidence regarding the effects of technology immersion on students' TAKS social studies, science, and writing achievement is inconclusive. Since TAKS tests for social studies, science, and writing are not administered annually, immersion effects for these subject areas cannot be replicated across cohorts and years. Accordingly, it is not possible to draw definitive conclusions about the effects of technology immersion for these subject areas. Available results typically show no statistically significant effects of immersion, with differences between groups favoring immersion students for TAKS social studies and control students for TAKS science and writing.

- **Social studies.** After controlling for Cohort 1 eighth graders' reading achievement (7th grade), demographic characteristics, and school poverty, there was no statistically significant effect of immersion on 2007 TAKS social studies scores. The immersion effect was positive but not by a significant degree.

- **Science.** After controlling for prior achievement (5th grade science score), demographic characteristics, and school poverty, there was no statistically significant effect of immersion on Cohort 1 eighth graders' TAKS science achievement. The immersion effect was negative, and a statistically significant interaction showed that as TAKS pretest scores increased, the achievement gap favoring control students over immersion widened for 2007 science scores. Thus, there was significantly negative effect on TAKS science scores for higher achieving eighth graders at immersion schools.

- **Writing.** For both Cohorts 1 and 2, after controlling for pretest writing scores (4th grade writing), demographic characteristics, and school poverty, there was no statistically significant effect of immersion on students' TAKS writing scores as seventh graders. The immersion effect was negative across both cohorts.

Nature of Third-Year Implementation

Although the overall level of implementation increased between the second and third project years, just a quarter of schools reached substantial levels of technology immersion. Full implementation of the technology immersion model requires Leadership, Teacher Support (buy-in), Parent and Community Support, Technical Support, and Professional Development. Given adequate supports, teachers are expected to reach high levels of Classroom Immersion, and Student Access and Use of technology is expected to be robust. Mean immersion standard scores revealed small increases between the second and third implementation years for each of the immersion support components as well as for teachers' overall level of Classroom Immersion. In contrast, the level of Student Access and Use was stable across years. Although the quality of schools' implementation improved slightly in the third year, we estimate that about a quarter of middle schools (5) achieved *substantial immersion,* while the remaining schools (16) had *minimal* to *partial immersion* levels. Nevertheless, third-year results show that technology immersion can have positive effects on teachers and students even at lower implementation levels.

School administrators advanced implementation through their provision of supports for teachers' technology immersion efforts, whereas teachers' greater support for immersion along with technical support elevated Student Access and Use. Teachers' opinion of the strength of administrative leadership for technology at their school was significantly associated with their perceived levels of implementation support (i.e., collective support for technology innovation, parent and community support, the prevalence of technical support, and the robustness of professional development). Additionally, teachers' overall support for technology innovation and the extent to which they believed that the quality of technical support addressed infrastructure and maintenance issues causing barriers to students' laptop use, were significantly associated with greater Student Access and Use. To reach higher levels of immersion, many schools needed stronger supports for implementation in the third year.

Core-subject teachers at the majority of schools reported only partial levels of Classroom Immersion in the third year; teachers at some schools, however, made collective progress in creating technology-immersed classrooms. Immersion standard scores for each of five elements of Classroom Immersion showed slightly stronger implementation in the third year, with the largest increases for teachers' ideological affiliations with Technology Integration and Learner-Centered Instruction, and the smallest change for Student Activities with technology in the classroom. There were notable increases in teachers' use of technology as a communication tool and for the enhancement of their own professional productivity. Core teachers (as a whole) at about a fifth of schools reached a substantial level of Classroom Immersion. HLM analyses for individual students and their teachers showed that reading and mathematics teachers' reported levels of Classroom Immersion, in most cases, were statistically insignificant predictors of students' TAKS reading and mathematics achievement. Measurement issues, within classroom variability, and interdisciplinary teacher effects provide potential explanations for the unexpected results.

Students' access to and use of laptops for learning within and outside of school generally fell short of substantial to full implementation. Students at more than two-thirds of schools had just partial levels of Student Access and Use in the third year, whereas students at about a third of schools had only minimal access and use. Students' opportunities to use their laptops both within classrooms and outside of school were affected by the number of days that students actually had their laptops. Year-to-year comparisons indicated that students' Laptop Access Days declined between the second and third project years. In contrast, students reported small increases in their use of laptops for Core-Content Learning and Home Learning.

Larger schools and schools with a greater proportion of economically disadvantaged students had lower levels of implementation. Overall trends showed that schools with larger student enrollments tended to have slightly lower implementation levels than schools with fewer students, and schools with higher percentages of economically disadvantaged students tended to have lower implementation levels. Technical support was a significant problem at larger schools, whereas collective teacher support for technology innovation was a significant issue for schools with greater proportions of disadvantaged students. Teachers at higher poverty schools also grew in technology proficiency at significantly lower rates, and student access to and use of technology decreased as the percentages of minority and economically disadvantaged students increased. In contrast, the schools' achievement context (percentage of students passing all TAKS tests), was positively associated with nearly all of the implementation indicators. Clearly, if students are to realize the full potential of laptops and technology resources, larger schools and schools serving disadvantaged student populations must have adequate supports for technology immersion in place to meet the specific needs of the school's teachers, students, and parents prior to implementing an immersion project.