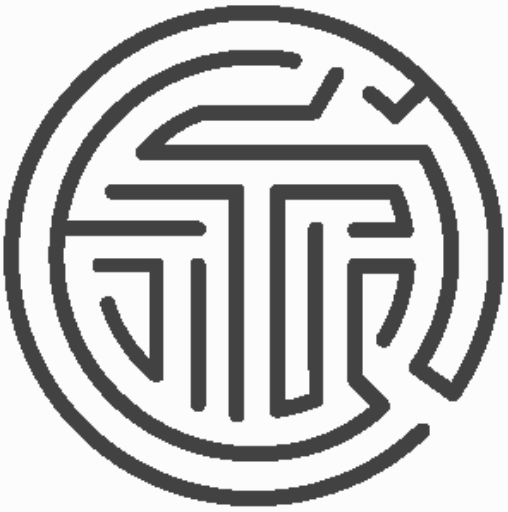

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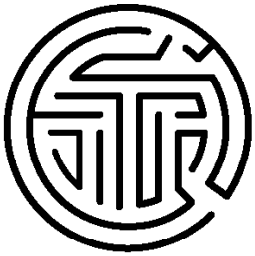
CENTER FOR CHILDREN & TECHNOLOGY



CCT REPORTS

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PROJECT HILLER: THE IMPACT OF UBIQUITOUS PORTABLE TECHNOLOGY ON AN URBAN SCHOOL

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Abstract

From 1998-2001, the Center for Children & Technology had the opportunity to document Project Hiller, an innovative laptop learning program initiated by the Union City Board of Education to further on-going, comprehensive reforms at the secondary level. The district's history of experimenting with technology to support systemic educational improvement offered us a unique chance to investigate the role ubiquitous technologies can play in a setting where many initial challenges associated with urban school reform and technology integration have been overcome. We were particularly interested in what fully-networked laptops would bring to the mix.

The research strategy was designed to illuminate this question: does technology make a difference for student learning and, if it does, why might this be the case? To better understand relationships between the quantitative changes taking place and the contextual factors that make those shifts possible we focused on three domains using different indicators to capture changes over time: students' academic and social engagement; teacher and administrator beliefs about students' abilities and competencies; and the school's culture and climate. Findings suggest that when technology is deliberately utilized as thoughtful support for educational reform in a school, a complex set of interactions occur that help make change possible.

INTRODUCTION

Over the past decade, the Union City School District has been developing and updating a community-wide networking infrastructure to support its comprehensive program of educational reform. The district and its technology initiatives provide an exemplary context in which to examine the potential of new technologies to support teaching and learning.

For this project, the Union City Board of Education committed three years of funding (1998-2001) to provide network-enabled laptop computers (with printers and Internet access) to 40 incoming freshman students and 20 teachers and administrators in one of the district's two secondary schools, Union Hill High School. In Years 2 and 3, additional cohorts of students and teachers were added to the program, reaching an immediate total of 70 teachers and 110 students, as well as others beyond the program itself. More than simple technology access, Project Hiller students and teachers received extensive technology training and were required to actively adhere to the academic and participatory expectations of the program.

To document the impact of ubiquitous technologies on a context in which many of the initial challenges associated with urban school reform and technology integration have been overcome, CCT was invited to conducted a longitudinal research study of Project Hiller. Specifically within the reform setting, CCT focused on how Project Hiller's goals and implementation affected students learning, teacher-students relationships, and the climate of the school.

Taking advantage of the portable and ubiquitous benefits of the laptop, Project Hiller targeted key areas across multiple levels of the school to:

- Create a cadre of technologically sophisticated students to advance the use of technology among peers and teachers at Union Hill High School
- Improve relationships between students and teachers and, by supporting students' facility with technology, enhance teachers' perceptions of students' capabilities
- Make technology more central to core teacher practices
- Increase student performance and outcomes on traditional measures as well as on more authentic measures such as students' multimedia project presentations
- Encourage the best eighth-grade students to continue enrolling in the city's public school system
- Provide urban students with technology comparable with that of suburban schools

Data gathered over the course of three years, complemented by eight-grade retention, honors enrollment and test performance materials collected by the school district, indicate that Project Hiller has been well implemented towards the above goals.

The School Reform Context

Laptop programs have rapidly appeared in schools across the country over the last decade, with many implemented at the middle school level. While the scope and purpose of these projects vary greatly, the impetus for Project Hiller arose from district's interest in exploring the potential of new technologies for supporting comprehensive reform at the high school level. Union City's improvement efforts have had demonstrable impact upon its elementary and middle schools, but the pace of reform in the high schools has been slower — in part complicated by tracking and departmentalization, which makes cross-disciplinary collaboration and curriculum-integration more difficult to accomplish.

From the outset, Project Hiller was supported by key strategies employed by the district to foster change. These included a strong and communicable core learning philosophy, leadership at the building and district level, professional development, an emphasis on students' expressing ideas in multiple, creative formats, and multi-text approaches to learning that stress documentation, synthesis, and evaluation (Honey, Culp, & Carrigg, 2000). By building on a community-wide networking infrastructure already in place and a record of using technology to support effective educational improvement measures, both district and high school administrators and project coordinators were able to scaffold the purpose, vision, and resources behind the endeavor.

Research Framework

Our research strategy was designed to illuminate a complex issue at the center of difficult debate in the educational technology community: does technology make a difference for student learning and, if it does, why might this be the case? Although research shows that technologies per se can improve student learning in experimental environments, these same strategies are unable to identify a direct impact on learning in the complex environment of schools (Chang, Henriquez, Honey, Light, Moeller, and Ross, 1998; McMillan Culp, Hawkins, and Honey, 1999).

One limitation for the use of experimental research is the intricacies of the school setting as a natural environment. Controlled experimental studies may tell educators that specific technology applications, such as integrated learning systems, can improve students' scores on tests of discrete information and skills, but these studies do not tell educators much about addressing the larger challenge of integrating technologies into diverse, uncontrolled classrooms and contexts. To be effective, technological resources must be used to support systematic changes in educational environments that take into account simultaneous changes in administrative procedures, curricula, time and space constraints, school-community relationships, and a range of other logistical and social factors (Chang et al., 1998; Fisher, Dwyer, and Yocam, 1996; Hawkins and Honey, 1990; McMillan Culp, Hawkins, and Honey, 1999; Means, 1994; Sabelli and Dede, in press).

Another limit of experimental research on technology in schools, especially studies focusing on test outcomes, is that correlation does not explain causality. Researchers and policy makers in the educational technology community are increasingly interested in establishing "explanatory theo-

ries, rather than just correlational studies of 'what works'" (DiSessa, 2000). DiSessa's call for explanatory theory highlights the need in technology evaluation research to understand the complex socio-technical relations that develop within schools and how this leads to change in young people's learning. The need for context-sensitive frameworks is echoed by Schoenfeld in a broader discussion of the need "to think of research and applications in education as synergistic enterprises rather than as points at opposite ends of a spectrum, or as discrete phases of a 'research leads to applications' model" (Schoenfeld, 1999).

Given the constraints of traditional experimental designs, researchers have come to understand that technology's effect on teaching and learning can be examined most effectively by focusing the multiple, interacting factors shaping the complex life of schools (Hawkins & Honey, 1990; Hawkins & Pea, 1987; Newman, 1990; Pea, 1987; Pea & Sheingold, 1987).

For the purpose of this study we adopted a dual strategy combining quantitative methods with qualitative strategies. The central research strategy was an instrumental case study intended to help us understand how the technology was integrated into the daily life of the school and how it influenced processes of change within the high school (Stake, 1995). The case study approach enabled us to examine how multiple factors are affected by the innovation, and how these factors in turn shape and inform the experience of Project Hiller participants (Means, Blando, Olson, Middleton, Remz, and Zorfass, 1993; Schofield, 1995).

To examine relationships between the quantitative changes taking place and the contextual factors that define, drive, and make those shifts possible we focused on four domains using different indicators to capture changes over time:

- Students' academic and social engagement;
- Teacher and administrator beliefs about students' abilities and competencies;
- The school's culture and climate; and
- Portability.

Research Questions

Research questions reflect key factors identified in the current literature on technology integration, school reform and school culture and focus on three discrete populations in the school:

- **Student learning.** What role does technology play in how and what students learn? Are students' perceptions of learning, attitudes toward teachers, and engagement in the school community changing as a result of their involvement with Project Hiller? Are there observable differences between Project Hiller students and comparable groups of non-Hiller students? What role does technology play in how and what students learn? What role are the district's educational reform initiatives playing?

- **Teacher beliefs and practices.** How do teachers integrate technologies into their classroom practices and their professional lives? Do differences emerge between Project Hiller teachers and non-Hiller teachers (i.e.: change in perceptions of students' abilities)? What observed changes can be attributed to teachers' participation in Project Hiller and what observed changes can be attributed to the district's reform initiatives?
- **Administrators' beliefs.** Do administrators' perceptions of students and teachers change over the duration of the project? Are these shifts attributable to participation in Project Hiller?

From these guiding questions, CCT distilled a series of dimensions to be qualitatively and quantitatively investigated. Dimensions and their definitions are described below:

Academic Press: An effective school environment contains factors that encourage or press students to high academic standards (Murphy, Beck, Crawford, Hodges, and McGaughy, 2001; Sebring, Bryk, Roderick, Cambrun, Luppescu, Meng Thum, Smith, and Kahne, 1996). Academic press is generated by teacher expectations that students do good work, by classes that are challenging, and by fellow students who feel school and academic success are important.

Academic Engagement: A student's own commitment, motivation and engagement in academics and learning are key factors to academic achievement (Kaplan and Owings, 2000; Sebring et al., 1996; Steinberg, Brown, and Dornbusch, 1996). Since engagement is internal to students, we understood expressions of interest in learning, of connecting education to life goals, and desire to do well in school to be indicative of engagement.

School Engagement: We made a distinction between a student's commitment to academic success, and a commitment and engagement in the school community. School engagement refers to the extent that students participate in extra-curricular school activities, and reported feeling a valued part of the school community.

Personalism: Research literature identifies that an important variable for fostering children's engagement in learning is to create an environment in which they feel personally known (McLaughlin, Talbert, and Kahne, 1990; Sebring et al., 1996; Wehlage, 1989). We understood this dimension to be important to both student and teacher. For students, personalism meant they felt teachers cared about them. For teachers, this meant they saw students as individual learners with specific knowledge, skills and needs.

Core Pedagogical Beliefs: Literature on technology integration has identified the relation between teacher beliefs about teaching and learning and the perceived uses and benefits of educational technologies as an conditioning variable in the ultimate success of integration projects (Becker, 1998; Chang et al., 1998; Ravitz, 1998). The Union City reform model supports project-based, cooperative learning and student-centered instruction and technology uses encouraged by the project were reflected in these practices.

Shared Vision of Technology Intervention: Literature suggests that having a clear vision for technology use that is shared by the administration and faculty of a school is important to the success of a project (Hawkins, Panush, and Spielovogel, 1996).

Perceived Benefits of Technology: Another important factor for teachers to integrate technology is their perception of the benefits that technology or the prescribed activities offer them and their students.

Data Collection

To generate a complete picture of the impact of this initiative on the school community, CCT followed different actors in the school across the building. To ensure reliability and validity of our findings, we employed multiple data collection procedures (classroom observations, interviews, mapping and surveys), from multiple data sources (teachers, students, parents, and administrators), and used five different researchers in the data collection (Creswell and Miller, 2000; LeCompte and Schensul, 1999b). Furthermore, the ethnographic data is complimented by student achievement and tracking data provided by the school.

Over the course of three years, these strategies allowed CCT to better understand relationships between observable changes taking place and the contextual factors that define, drive, and make those changes possible. In addition, we also examined artifacts, conducted focus groups, and experimented with spatial mapping of the media center in order to define transformations within the social behavior of the school community.

The Quasi-experimental Study

We compared traditional outcome measures (i.e.: test scores) of participating students to those of a control group of non-participating students. Our research took advantage of the structure of the program to support a quasi-experimental analysis of the impact of the laptop project within certain limitations. This was a realistic field setting and we did not distort the design of Project Hiller to accord with academic research models. The design of Project Hiller and the goals of the project coordinators naturally created a nonequivalent control group (Cook and Campbell, 1979). From the beginning, project coordinators hoped to spread the possible effects of Project Hiller across all academic tracks in the school and they did not want the project to be for academically gifted students only. In essence, the selection was designed to pull participants from honors, general, bilingual and special needs tracks and the criteria valued attitude and motivation more than academic performance. By pulling participants from four tracks without regard for academic performance, the non-participating students within each track were considered an untreated control group for the participating students in the same track. We then used results of Union City's own tests to measure the impact of Project Hiller on student's test performance.

Data Analysis Strategies

Case Study: During three years of ethnographic data collection, we developed an extensive coding scheme in a deductive process starting from our research questions and the above dimensions extrapolated from current literature on technology integration (LeCompte and Schensul, 1999a). We eventually developed a codebook of over sixty factors (i.e. new responsibilities, future aspirations, peer support) spread over 15 domains (i.e. classroom practice, student-teacher relations). Since many of the factors are high-inference codes, all the coding was done by principle researchers.

The Quasi-experimental Study: The district provided us with each year's test data and we coded each individual student for academic track and project participation. The test administration policy of the Union City Board of Education uses a different test at each grade that does not permit us to analyze yearly gains. Instead we conducted tests of significance between group means.

Project Hiller Findings

From 1998 to 2001, the CCT research team documented how Project Hiller helped to advance change at Union Hill High School. Findings include:

Created a cadre of technologically sophisticated students

Project Hiller contributed to making technology use a central element of the school, and fostered students who became a technical-support resource for teachers and peers through out the building. These same students lead many of the school's technology-focused operations and assist with school-related activities such as public presentations, production of the school paper, coordination of the Multi-Arts Festival and the Adelante Scholars program.

Improved relationships between students and teachers

Project Hiller demonstrated a visible and positive impact on teacher-students relations. We define positive teacher-student relationships as those personalized interactions in which teachers raised their expectations for students, and in which students took ownership of their learning. Analysis of observational data and interviews with Project Hiller teachers, students, and coordinators revealed an increase in the occurrence and quality of informal, project-based and small group interactions between teachers and students participating in the program (i.e.: students recognized teachers' investment in their academic success and well being). As one teacher explained, "Project Hiller is more than technology. It is self-reliance, group work and teacher responsibility. What students need is mentoring and belonging. That is the answer to school reform."

Made technology more central to core teacher practices

A programmatic requirement of Project Hiller was that teachers and student work together in teams to complete project activities such as producing PowerPoint presentations and developing the school web site, which initiated a series of project-based work. Analysis of survey data suggest

that technology was increasingly integrated into core practices, evidenced by a dramatic hike in teachers' assigning online research, from only 6% in Year 1 to 27% in Year 3, and by the percentage of students using PowerPoint, which rose from 12% in Year 1 to 51% by Year 2.

Increased student performance and outcomes on traditional measures

Standardized test scores rose significantly for Project Hiller students across all tracks. Analysis of ninth-grade scores for Cohort 1 indicated no difference between participants and their peers prior to Project Hiller, however, by Years 2 and 3 of the project, participating students scored significantly higher than their non-Project Hillers peers. For example: within the honors track in specific regard to math scores, Project Hiller students scored 414.05 on the New Jersey State High School Proficiency Test (HSPT) versus the 396.14 scored by their non-Hiller peers.

Increased enrollment of high achieving eighth-grade students in the high school

The possibility of participation in Project Hiller encouraged high performing eighth-grade students to stay in the public school system. In the year prior to Project Hiller (1997-1998), Union Hill enrolled just 38 ninth grade honors students, while in 1998-'99, the first year of the program, Union Hill drew 44 freshman students into its honors program. In the second and third year of Project Hiller, Union Hill admitted 59 and 55 students into the ninth grade honors program respectively, representing a 25% increase from 1998 in the number of high achieving eighth-graders choosing to enroll at the high school.

Demonstrated the benefits of portable, ubiquitous computing

The combination of portability and wireless connectivity has made the laptop a highly visible demonstration tool, and one easily shared among students for a variety of academic tasks like Internet research and PowerPoint. Portability created the potential for roving, impromptu training sessions by Project Hiller students as they shared technical knowledge; Project Hiller students were frequently found teaching their teachers and peers in the media center, in the cafeteria, or in class. One administrator reported an increase in students sharing not only their laptops but also their "technology knowledge …they seem to be more connected to the media center and engaged with the curriculum."

Additional research findings regard changes in teacher beliefs and student products, the role of mentoring, access and the impact of technology on the family.

CONCLUSION

Aligned with the objectives of the larger district, this program's purpose was to push for a climate of high expectations. Project Hiller met its initial goals because the design and implementation of the project gave students substantial responsibility and autonomy in relationship to technology and their learning. Our findings suggest that when technology is deliberately utilized as thoughtful support for educational reform in a school, a complex set of interactions can occur that help make improvement possible.

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