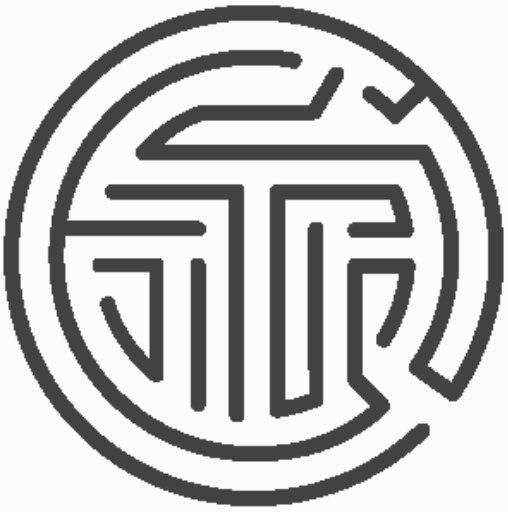

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PROJECT HILLER

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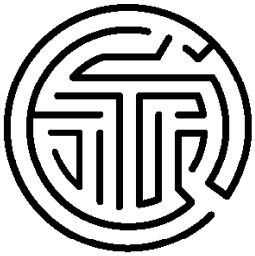

CCT REPORTS

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

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EXECUTIVE SUMMARY

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. With funding from the National Science Foundation (REC# 9815026), CCT undertook a three year study at Union Hill High School. 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:

- Encourage the best eighth-grade students to continue enrolling in the city's public school system
- 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
- Promote collaborative and project-based learning, and 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

- 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.

Research Framework

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:

- **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?

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.

INTRODUCTION

Technology is often promoted as being able to enhance a learning environment, to bring new resources and perceived opportunities to bear on interactions between learners, on classrooms, or school communities (Glennan & Melmed, 1996; Software Publishers' Association, 1997; U.S. Department of Education, 1996). Less frequently discussed in the research literature, however, is the importance of a coherent educational reform strategy to the realization of technology's potential for improved learning (McMillan Culp, Hawkins, & Honey, 1999). One positive example of such an alignment is Project Hiller, a laptop learning program initiated by the Union City Board of Education to further its on-going, comprehensive reforms at the secondary level and designed to target multiple areas of concern - from student achievement and teacher beliefs to parent-school connections. Due in part to the inner-city district's enterprising history of experimenting with technology to support systemic educational improvement, the Union City, NJ context 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. 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 the Project Hiller laptop initiative, 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 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, EDC's Center for Children and Technology (CCT) was invited to conduct a longitudinal research study of Project Hiller. To better understand relationships between the quantitative changes taking place and the contextual factors that make those shifts possible we focused on four domains using different indicators to capture changes over time: 1) students' academic and social engagement; 2) teacher and administrator beliefs about students' abilities and competencies; 3) the school's culture and climate; and 4) portability.

Research Framework

Our research strategy was designed to illuminate a complex issue at the center of debate in the educational technology community: does technology make a difference for student learning and, if it does, how? 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 et al., 1998; McMillan Culp et al., 1999).

One limitation for the use of an experimental research design is the intricacy 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 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, & Yocam, 1996; Honey, Hawkins, & Carrigg, 1998; McMillan Culp et al., 1999; Means, 1994; Sabelli & Dede, 2001).

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 theories, 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 & 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, 2001). 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 et al., 1993; Schofield, 1995; Schofield & Davidson, 2002). To examine relationships between the quantitative changes taking place and the contextual factors that define, drive, and make those shifts possible we focused on the four areas mentioned above: 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 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 identified specific factors to be qualitatively and quantitatively investigated. Dimensions and their definitions are described below:

- **Academic Press:** An effective school environment encourages, or "presses," students to high academic standards (Murphy, Beck, Crawford, Hodges, & McGaughy, 2001; Sebring et al., 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 to academic achievement (Kaplan & Owings, 2000; Sebring et al., 1996; Steinberg, Brown, & 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 creating an environment in which they feel personally known (McLaughlin, Talbert, & Kahne, 1990; Sebring et al., 1996; Wehlage, 1989). We understood this to be important to students and teachers. 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 relationship 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 uses of technology 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, & Spielovogel, 1996).
- **Perceived Benefits of Technology:** Another important factor for teachers regarding technology integration is their perception of its benefits for them and their students.

Data Collection

To generate a comprehensive picture of the impact of this initiative on the school community, CCT followed different actors across the school building. 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 & Miller, 2000; LeCompte & Schensul, 1999b). Ethnographic data was complimented by student achievement and tracking data provided by the school.

Over the course of three years, these strategies allowed us 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 identify transformations within 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 & 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 & 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 of 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.

Implementation

The research plan generated volumes of field notes, interviews, student products, and survey data about the experiences of the Project students and their peers. This data offered us a rich look into some aspects of life in an urban high school. However, over the course of three years the implementation ran into different challenges in maintaining a rigid research design in a real school.

Student Survey

Trying to conduct longitudinal survey strategies across the entire school proved to be complicated. The survey strategy also encountered two different problems administering the student survey. The original design called for two surveys a year for grades with Hiller cohorts and a total of six administrations in three years (Table 1-2). Due to complications, we were only able to do four administrations.

TABLE 1: ORIGINAL SCHEDULE FOR STUDENT SURVEY ADMINISTRATIONS

	Years	Semesters	Grades Surveyed
Year 1	1998-1999	Fall, Spring	9th gr.
Year 2	1999-2000	Fall, Spring	9th gr., 10th gr.
Year 3	2000-2001	Fall, Spring	9th gr., 10th gr., 11th gr.

TABLE 2: IMPLEMENTED SCHEDULE FOR STUDENT SURVEY ADMINISTRATIONS

	Years	Semesters	Grades Surveyed
Year 1	1998-1999	Fall, Spring	9th gr.
Year 2	1999-2000	Fall, Spring	9th gr., 10th gr.
Year 3	2000-2001	Fall, Spring	9th gr., 10th gr., 11th gr.

The school was very supportive of the research and the administration made the decision to allow us to give the survey during homeroom. This meant that the school would extend homeroom for all students on the chosen date and hand out the survey in the appropriate homerooms. This is a big decision for the school and we felt the need to be respectful of their support. In Year 1, because the laptops did not arrive and the selection process as not finalized until December, we decided to give the survey once in the Spring instead of attempting to do two surveys in one semester.

In Year 2, the surveys were conducted as planned, but Year 3 encountered a different problem. The Fall 2000 survey was administered without difficulties, even though we were now surveying nearly 1,000 students in 30 homerooms with surveys specific to three grades in both Spanish and English. By the Spring 2001, the school was caught up in critical bureaucratic regulatory problem unrelated to the research. New state regulations in New Jersey required urban schools receiving state aid to create their own budget that year. Every administrator, department head, coach or club teacher was involved in this complex new activity. Further complications developed when the Sate Department of Education undertook a long difficult review process repeatedly challenging budget items (Project Hiller being one of them). As the process dragged on into Spring, the tension and anxiety in Union Hill increased. In fact, the New Jersey State Department of Education did not approve any of the urban school 2001-02 budgets until September of 2001. Unfortunately for us, with the burden its staff was facing due to the budget crisis, the school decided to suspend the last survey administration.

The lack of the last round of student survey data hinders our ability to measure the full extent of some of the changes going on in the school. The Spring survey focused on classroom activities using technology. Our observations revealed a group of students engaging in new productive activities using the technology, and we can measure the extent to which some of these technology uses spread to the entire school population in Year 2, but we can not measure the changes in Year 3.

Teacher Survey

The teacher survey encountered other difficulties. The teacher survey was administered once each year in accordance with our initial design. A paper copy of the survey was distributed to each teacher in his or her school mailbox each year. The first year the response rate was 41%, but in Year 2 and Year 3 the response rate was over 90% each time. Comparing variables like years of experience and content areas between the Year 1 respondents and those in Year 2 and 3 indicated that the first sample was a self-selected one of older, more experienced teachers. Because this resulted in non-comparable samples between Year 1 and the following two years, we do not have clean baseline data from the beginning of the Project. We attribute the increased response rate to the effects of Project Hiller and our on-going presence in the building. In the first year, Project Hiller was not as well known, nor did the teachers know us. However, by the second year the teaching faculty had begun to view Project Hiller favorably and more teachers were aware of our presence in the school. We suspect that the broader commitment to the Project and to the research resulted in a higher response rate.

RESEARCH CONTEXT

Union City Demographics

Although Union City receives compensatory funds for education from the state, as recently as 1998 it was classified by the Brookings Institute as one of the 92 most impoverished communities in the United States (Chang et al., 1998); 27.5% of all children live below the poverty line (U.S. Bureau of the Census, 2000), and 80% receive free or reduced-price lunches (New Jersey Department of Education, 2001b). Of the 10,553 students in its eleven schools (three elementary, five K–8, one middle school, and two high schools), 93% are Latino; 95% are minority; 69% of the student body do not speak English at home; and 14% have been in this country for less than three years. Over one-third of its faculty teach in bilingual/ESL programs. The growing number of students arriving in Union City makes overcrowding a consistent challenge for the schools.

Union Hill High School

Union Hill High School is one of two high schools in the district. The school had 1,380 students in 1999-2000 (New Jersey Department of Education, 2001a) in a building designed to hold about 900 students. It is sometimes referred to as the uptown school with students from a perceived better socio-economic background than the other high school in Union City. However, the statistics for Union Hill reflect a disadvantaged population – 72% of the students are eligible for free or reduced price lunch which is below the district mean (New Jersey Department of Education, 2001a). Twenty-one percent of the students were classified as limited English proficient (LEP) in 1999-2000 (New Jersey Department of Education, 2001a). The demographic makeup of the school's populations is represented by a wide variety of Spanish-speaking nations in Latin America and the Caribbean. No single nation is statistically dominant. While the district does not collect aggregate data on the country of origin for immigrant students and families, our research survey (2001) provides a breakdown for Union Hill High School. A detailed demographic snapshot of the class of 2002 revealed that 95% identify as Latino, 47% of respondents were born in the U.S. while 50% were born in Latin America and 3% elsewhere. The largest groups of non-U.S. born students are from the Dominican Republic (16%), followed by Ecuador (9%), Colombia (6%), Cuba and Peru (4% each), Puerto Rico (3%), and Honduras, Mexico, El Salvador, Nicaragua, and Venezuela with under 2% each.

Union City Reform Context

A crucial element of the story of Project Hiller is the systemic reform context of the Union City school district itself (EDC Center for Children and Technology, 2000). From the outset, Project Hiller was supported by key strategies employed by the district in its comprehensive educational reform efforts. 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 documenta-

tion, synthesis, and evaluation (Honey, McMillan 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, district and Union Hill High School administrators and project coordinators were able to scaffold the purpose, vision, and resources behind the endeavor.

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 its comprehensive reform efforts at the high school level, and targeted Union Hill. The district's decision to invest over $300,000 of its own resources into the Project Hiller initiative was largely motivated by the success of Project Explore, a 1993 Bell Atlantic–sponsored technology project at Christopher Columbus Middle School, in which participating students were given a desktop computer at home with home/school access to email and the Internet. Immediately, Project Explore students began to excel academically, evidenced by growth in their performance on standardized tests, increased enrollment in honors classes, and the number of students participating in the district's enrichment and summer internship programs such as Road to College and the Computer Applications Mentoring Program (Honey & Henriquez, 1996). The question of whether these impacts could be replicated motivated key administrators to pursue the project.

Specifically, the comprehensive systemic improvement efforts in the Union City school district have had demonstrable impact upon the elementary and middle school levels, but the pace of reform in the high schools has been slower. High school reform is, in part, complicated by departmentalization, which can make cross-disciplinary collaboration and curriculum-integration difficult to accomplish. Additionally, students are more rigidly grouped by ability, and principals are required to spend much of their time on non-academic matters such as discipline, scheduling, and budgeting. With the advent of high-stakes testing affecting high school graduation rates, teachers are often torn between test-prep and teaching their students the skills they need to learn across contexts.

PROJECT HILLER

Project Hiller: The Goals

As Project Hiller was developed to support district reform efforts in Union Hill High School, the steering committee brought together teachers with school and district administrators to identify and define core goals for the project:

- To retain the best eighth-grade students in the public school system
- To create a cadre of technologically sophisticated students to advance the use of technology among peers and teachers at Union Hill High School

- To improve relationships between students and teachers and, by supporting students' facility with technology, enhance teachers' perceptions of students' capabilities
- To promote collaborative and project-based learning, and make technology more central to core teacher practices
- To increase student performance and outcomes on traditional measures as well as on more authentic measures such as students' multimedia project presentations
- To provide urban students with technology comparable to that of suburban schools

Over the course of our three years of research, Project Hiller brought together 120 students and 46 teachers/administrators to engage in project work, to produce multimedia slide presentations in an academic area, and to create web sites for a broad range of school programs.

Program Design

Each year, project coordinators introduced Project Hiller to students and teachers as "a responsibility and a privilege." Over time, the project grew to expect its members to give something back to the school community (i.e. developing classroom materials for teachers). Prior to the first year of the program (1998–99), the steering committee decided that if Project Hiller were to have a broad impact, then participants would need to represent different academic tracks of the school. The committee developed a student and teacher selection process, a management structure, a set of requirements for students and teachers, introductory technology trainings, and dealt with the challenges of upgrading the technical infrastructure of the school. A significant logistical decision was made to house Project Hiller in the library-media center, a space that could be open to high traffic use, was a technology access point for the school, and housed a range of teaching and research materials.

Student Selection

Students were selected for the project during their freshman year. Project Hiller has three cohorts of students (one cohort per year since its inception). Cohort 1 (40 students) started in 1998-99 and were juniors in the final year of our research, Cohort 2 (40 students) started in 1999-2000, and Cohort 3 (30 students) started in 2000-01, the final year of our research[1]. Fifty percent of slots per cohort were reserved for honors students (i.e. 20 of the 40 students in Cohort 1), and twenty slots were distributed according to the proportional breakdown of the school into general, special education, and bilingual students. The Project was announced to all ninth graders. Student participants were selected in two slightly different processes, however, depending on which slots were to be filled (i.e. honors, special needs and bilingual). All incoming ninth graders in honors classes were eligible, but the project gave priority to students with the most honors classes. This meant that students in only one honors class face steeper odds. Possible candidates for the other targeted slots, bilingual and special education (two or three slots by track for a total of five), were identified by the bilingual and special needs teachers and were encouraged to apply. Any student,

regardless of track, could apply for the 15 remaining general slots. This meant that honors (especially the students in only one honors class), special needs and bilingual students joined the program through the general track and their numbers are sometimes higher than planned.

The Project held general orientation meetings for applicants and all interested students were required to submit an essay about why they wanted to participate in Project Hiller. At the meetings, coordinators explained the program's goals and responsibilities, and offered guidelines and criteria for the essay contest. Essays were judged for motivation and commitment to the project, and for not grammar, English ability or technological fluency. Students were encouraged to write the essay in their preferred language and to seek help from teachers.

The list of students submitting essays is cross-referenced against the school's discipline reports to eliminate students with a history of disciplinary problems. A team of Hiller teachers evaluated the essays and then selected bilingual, special education, general, and honors track students. Coordinators sought to balance the cohorts in terms of gender.

Teacher and Administrator Selection

During the first year of Project Hiller (1998–99), twenty-one teachers and administrators were selected. All ninth grade honors teachers were invited to join while the remaining teachers were selected to ensure that the four core subject areas were represented. In Year 2 (1999—2000), Project Hiller extended its reach across the school and brought eighteen new teachers on board and two administrators, both of whom were new to their positions in the building. With only a handful of tenured teachers not in the program (2000–01), a few non-tenured faculty were invited to join. Only one teacher left the program due to a scheduling conflict. By Year 3, forty-six tenured teachers and administrators were participating in the project on top of their regular course loads and other academic and administrative commitments to the school.

Project Management

Responsibility for the coordination of Project Hiller was shared by the district's Secondary Science and Math Curriculum Supervisor, who is based at Union Hill, and the library media specialist. A central figure in the project, the media specialist was the day-to-day coordinator of Project Hiller with the most contact with student participants. His media center has served as a student-centered technology hub with students in and out of the library all day.

Student Responsibilities

Participant students had to meet certain requirements to remain eligible for the program. Students agreed to:

- Maintain good attendance

[1] The number of new students shrank in the third year because of funding cuts.

- Maintain good grades
- Work enthusiastically with teachers and students on projects
- Attend before- and after-school meetings
- Create two PowerPoint presentations in the academic field of their choice.

At orientation meetings, project coordinators emphasized that the demands are not for straight A's and perfect attendance, but that students work to the best of their abilities. They must participate fully and responsibly in the program, and in the school. As one coordinator explained, "Basically, we're talking about privilege and responsibility and performing to the best of your potential. We want you to be the best that you can be." Students who did not keep up with the requirements were placed on probation for a marking period. If they did not fulfill them by the next marking period, the laptops were eligible to be taken back, to be reclaimed when they again met the project requirements. To make this a motivational rather than punitive experience, participant teachers and coordinators offered tutoring and contacted the student's other teachers to monitor progress.

Before receiving their laptops, students had to submit signed parental consent and Acceptable Use forms that permitted them to go online. These forms were in English and Spanish. After students returned all required documents, the project held parent meetings to address concerns and to distribute the new machines.

Teacher Responsibilities

Participating teachers and administrators were responsible for working with Project Hiller students outside of class time on multimedia and web projects. They agreed to:

- Attend all training seminars and complete Introduction to Internet and the Advanced Multimedia courses conducted by an on-site technology coordinator
- Produce two interdisciplinary collaborative projects and two PowerPoint presentations with students
- Mentor two or three assigned student to advise them on their required Project Hiller activities
- Perform duties assigned by the steering committee.

Project Hiller Activities

The activities specific to the project have changed over time. Every year, the program began with a series of training workshops for each cohort. The workshops were run by the school's technology coordinator and Project Hiller teachers with the help of older students from Project Hiller. Teachers and students took the workshops together. This was a deliberate strategy to model teacher-student collaboration, but had another intent. As one trainer commented, "[the training]

is mainly for the teachers. No matter how much or how many times we explain it, they don't quite get it until they see the kids doing it. Most of the kids already know this stuff and they've been using it for a while." Another goal of the workshop was to establish a bond between the students and teachers. As the ninth graders were new to the building and had little contact with teachers outside the classroom, these sessions were to help them integrate into the school and shaped conditions for them to grow into leadership roles.

The freshman cohort was assigned a Project Hiller teacher to help them on their required PowerPoint presentations, which they were able to do on any academic topic. They were encouraged to continue producing multimedia products as part of their course work for the rest of the year. The form of teacher-student mentor relations was different for the older students. While still required to submit at least two presentations to the project, the older cohorts took on more advanced work. Sophomores were divided into teams of students and teachers to work cooperatively to produce the school website. In Year 3, the project coordinators were experimenting with the juniors from Cohort 1 by having them work in teams on three separate activities. Working with a group of teachers, the student teams were assigned the following projects:

- Developing multimedia materials for departmental projects. Organized as a school service, faculty and students were to identify and produce curriculum materials for specific content areas (e.g., history — the Civil War)
- Producing a Project Hiller e-newsletter/bulletin board for students to keep each other informed since they could not meet all at once due to the program size and their personal schedules
- Learning how to be peer mentors. With only a few Cohort 3 teachers, 10 junior students helped mentor the Cohort 3 students in doing PowerPoint presentations.

The Cohort 1 activities were not completely successful — there were so many going on in the building with competing interests and time demands on teachers and students that it became an increasing challenge to keep it all moving forward. The coordinators tried these initiatives again after rethinking the management and organizational structures. The peer mentoring was an activity that many of the older students were excited about, and the development of classroom materials by students has since been incorporated into the advanced computer applications class.

Technology Infrastructure

Prior to Project Hiller, Union Hill High School, like the rest of the district, had a strong technology infrastructure that was not being fully utilized. The student/computer ratio in 1997-98 was almost 2.9:1, but only 67% of classrooms were connected to the Internet. Both of these figures were well above New Jersey's state average of a 7.6:1 computer ratio and only 30% of state classrooms connected (New Jersey Department of Education, 2001a). Currently, the school has networked computers in every room and 100% are connected (New Jersey Department of Education, 2001a), along with two updated computer labs for the Business, Technology and Vocational Department. The school's ratio is now at 2.7:1. Increasingly, however, the school's technology

hub is the library/media center. As a result of the laptop program, the media center now has over forty networked computers, wireless server access, a bank of computers reserved for teachers, and a conference area with a projector. The center is well used by the entire school. In addition, laptops float throughout the building.

As the technology has moved to the center of the school's culture, new technology initiatives have started and older ones have been revitalized (i.e. a student technical support staff program called Teen Tech run by the technology coordinator in which students get training, a salary, and academic credit for helping to maintain the school's computers). Teen Tech students also assist at the school's Saturday parent technology workshops. Additionally, Union Hill offers a CISCO training program after-school, along with Project SMART, Honors CAMP (Computer Applications Mentoring Program) and the BCE (Business and Community Exchange) program.

Union Hill has begun networking much of its administrative functions; teachers now submit grades online as well as online request forms for everything from professional development to field trips.

FINDINGS

Observable Impacts and Outcomes

Union Hill High School has entered a phase of expanding technology use. Project Hiller and the school's administration committed to providing the resources and environment necessary for students and teachers to undertake new activities that use technology to transform the school culture. Data indicates positive developments in twelve sub-domains across five interrelated educational reform areas (Table 3). Changes have been evident in aspects related to student self-efficacy, technological sophistication, teacher perceptions and learning activities. Taken together, the impact of both the project and the technology have broadened the range of valued roles students can play. Union Hill has always supported students who excel academically; Project Hiller has fostered a culture that values the academic engagement of students across tracks and abilities, encouraging them to work to their potential and participate in the community.

TABLE 3: OBSERVED OUTCOMES FROM PROJECT HILLER
IMPROVED RELATIONSHIPS BETWEEN STUDENTS AND TEACHERS
Academic Press and Engagement
Expanding Student Roles
Mentoring
A Welcoming, Student-Centered Environment
CREATED A CADRE OF TECHNOLOGICALLY SOPHISTICATED STUDENTS
Production of Artifacts
Student Conception of Technology
MADE TECHNOLOGY MORE CENTRAL TO CORE TEACHER PRACTICES
Changing Teacher Beliefs about Students' Abilities and Competencies
INCREASED STUDENT PERFORMANCE TRADITIONAL MEASURES
Student Performance on Traditional Measures
Increased Enrollment of High Achieving Students
Demonstrated the benefits of portable, ubiquitous computing
Infrastructure and Capacity Building
Family Impact

The following sections outline changes observed among students and teachers through technology use, shifts in the school environment, and the impact of a ubiquitous, wireless infrastructure.

Improved Relationships Between Students and Teachers

Project Hiller demonstrated a 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 over time 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."

Academic Press and Engagement

Students' investment in their school, its community and their academics has increased. Being an engaged and responsible student is a central requirement to Project Hiller. Distinct dimensions of school culture interact to create an environment that engages students in learning and academics, some of which we have been able to explore in Project Hiller. They include: student motivation, the value placed on grades and academics, and teachers' academic expectations of students.

Although Project Hiller has a dual selection process for honors students and for the general population of the school, the academic expectations for all participants are clear and consistent. From their first encounter with the program, students are told by coordinators and teachers that all Hillers are expected to be "good" students: "To stay in the program, you must do the best that you can. You have to come to school. No unexcused absences. You must be helpful and responsible members of the community – helping teachers and classmates — and you must get the best grades you can."

Project coordinators miss no chance to praise participants on their successes and to reinforce the project's responsibilities to the broader community. In 2001, the eleventh-grade Project Hiller students had very impressive results on the New Jersey graduation test (100% passed math, and 98% passed all three areas). Not only was this success common knowledge among the teachers and a large share of the student body, the ninth and tenth grades were encouraged to do even better and were explicitly told by project staff, "whether you like it our not, you are role models for everyone in this school. You must pay attention to your academics."

Project Hiller has created a large group of students who are motivated to achieve. They are more engaged in extracurricular activities, their aspirations have widened to include college and professional careers, and there has been a pronounced movement across academic tracks among and within the Project Hiller cohorts. In 1998, there were eleven general education students in the ninth-grade Cohort 1. By 2001, of those eleven students, four were in honors classes (one student had five classes, one had two classes, and two students had one honors class each). Three of those eleven general track students were in the lower-level English and math classes. All moved into standard academic math and English classes. There were four bilingual students in Cohort 1; all moved into monolingual classes, with two in two honors classes each. Cohort 1 also had three special needs students. One left the school and one voluntarily left the program, but the remaining student has moved out of low-level English and math courses into standard math and English

classes. As one general track Cohort 1 youth noted in an interview, he realized that if he wanted to "be somebody"[2] he had to invest in himself. He currently takes five honors classes.

The school has been able to cultivate a culture among the students (and staff) that values academics and all that entails – studying, getting good grades, and doing homework. The results on the student opinion surveys indicate a substantial portion of students feel they are dedicated to their schoolwork and have confidence in their intellectual ability (Tables 4 and 5). The school has been able to maintain a high level of student commitment, and even increase it for Cohort 1, as the students enter into their older teen years.

TABLE 4: "I HAVE CONFIDENCE IN MY ACADEMIC ABILITIES" PERCENT OF STUDENTS FROM EACH CLASS AGREEING WITH THIS STATEMENT

		Class of 2002 (Cohort 1)		Class of 2003 (Cohort 2)		Class of 2004 (Cohort 3)
YEAR		Hiller non-Hiller		Hiller non-Hiller		Hiller non-Hiller
1999	9th grade	91% 81%				
2000	10th grade	98% 88%	9th grade	100% 91%		
2001	11th grade	97% 89%	10th grade	97% 88%	9th grade	88% 93%

TABLE 5:" I WORK HARD TO DO MY BEST IN SCHOOL" PERCENT OF STUDENTS FROM EACH CLASS AGREEING WITH THIS STATEMENT

		Class of 2002 (Cohort 1)		Class of 2003 (Cohort 2)		Class of 2004 (Cohort 3)
YEAR		Hiller non-Hiller		Hiller non-Hiller		Hiller non-Hiller
1999	9th grade	94% 82%				
2000	10th grade	98% 88%	9th grade	97% 91%		
2001	11th grade	97% 89%	10th grade	88% 87%	9th grade	88% 85%

In an interview, one veteran teacher commented that with the aid of Project Hiller the school has been able to affect an impressive transformation of its culture: "Project Hiller has put the good kids in the front — it's now cool to study and get good grades." In part, this is a result of the demonstration effect that Hiller participants have on their peers as role models. Student interviews also revealed the importance given to their studies; they perceive the school has made an investment in them and they have a responsibility, as encapsulated in one student comment that he had a "responsibility to do exceptional work." Another reported being "grateful that the school gives this to us. It keeps you motivated to continue working well on academics."

Expanding Student Roles

Project Hiller brought about a rapid change in student roles, especially for the laptop participants. Over the course of three years we observed changes in student leadership, an expansion of student roles, and an increase in students as positive role models.

Student leadership

Project Hiller functioned as a platform for student leadership. Participant students are frequently sought out for technical assistance by staff and students. They are often called on to troubleshoot, but they also undertake more substantial roles. For example, in the case of Union City's MultiArts Festival[3], Project Hiller students applied their leadership skills and technical expertise to manage and operate the two-day citywide arts event and even produced a live video that was subsequently broadcast on a local public access station. Project Hiller participants now overlap with a variety of Union Hill's social and academic clubs (including tutoring at the middle school level), and a number of extracurricular programs. Building on the potential of the technology, one Project Hiller student created a club, Proyecto Comunicación Literario 2000 (PCL2000), to collaborate with schools in Latin America. The goal of PCL2000 was for teenagers to share and learn about being a young adult in different parts of the world and all the work was done in Spanish. PCL2000 had more than 30 members, many of them newly arrived immigrants. In our view, PCL 2000 was popular among the immigrant students because it offered a rich activity for Spanish-speaking immigrant students whose level of English fluency might inhibit their involvement in other clubs.

Through the clubs and activities, Hiller students reach into classrooms and into the community. In a student interview, one young man commented that "Union Hill's reputation depends on Project Hiller students" because they increasingly represent the school in diverse places, brought there through other club events. Hiller students do not exclusively dominate leadership roles; both Hiller and non-Hiller students have begun to attend national conferences to speak about their learning and experiences with technology.

Student Technical Roles

Students have been able to leverage their technology skills as tech-support and trouble-shooters into new relationships with teachers. Prior to the project, teachers had been under pressure to adopt project–based reforms and integrate technology. With technology increasingly becoming a core feature of the school, pressure grew. However, Project Hiller represented an important shift in the teachers' work environment, the students themselves have the technical skills necessary to do many of the activities promoted by the reforms (i.e. Web research, web pages, multimedia presentations) and can help teachers learn how to use the technology. For instance, in the training sessions the student tutors can sometimes be heard bragging that the teachers they tutor "know the technology better than the rest." The context of district reform pushed teachers and students together with technology providing a means to realizing it.

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[2] For the students, "being somebody" means having a professional job that is respected, earns a good salary and nice clothes. Being somebody typically includes going to college.

Role Models

Participant students leadership contributed to the broader school population as role models. By demonstrating a confidence and capacity to be academically and socially integral to the culture of the school, they added to an overall environment that privileges participation and collaboration over traditional competition. For instance, a group of students that the teachers refer to as "Friends of Hiller" came into being. This is an informal group of students who socialize with the project participants, share the laptops with them and are engaged in the same extracurricular activities, clubs, and enrichment programs (summer and weekend college programs, web-design program, college support programs, etc). The president of the graduating class of 2001 and two members of the technology support team were part of this group.

At times, however, new responsibilities can be overwhelming; students are still learning to manage the pressure and time demands. For example, two of the most technologically adept Project Hiller students have complained about being unable to do their own work in the media center without being bombarded with requests for help from teachers, students and other staff.

As one longtime teacher noted in an interview, Project Hiller is not about the technology but, in fact, about belonging. The participating faculty and project coordinators set out to generate student investment in the school and academics through the project. A veteran teacher and department head reflected, "I used to have a poster up in my office as a reminder to my teachers that said 'If you want people to care, you have to show them you care.' Well, with Project Hiller we finally convinced the kids that we care." Surveys of students over the course of the project corroborate that sentiment (Table 6). Over time, a larger percent of students feel that they are important in the school.

TABLE 6: "I AM AN IMPORTANT PART OF THE SCHOOL COMMUNITY" PERCENT OF STUDENTS FROM THE CLASS OF '02 AGREEING WITH THIS STATEMENT

Class of 2002(Cohort 1)	Percent Agreeing
9th grade (1999)	60%
10th grade (2000)	72.5%
11th grade (2001)	73.3%

The technological sophistication of the laptop students and the growing demand for technology in the building continues to create roles for students as support staff, trainers, teachers, and in relation to their peers. Often Project students are called upon to share their expertise in classes; one special needs teacher asked a Project Hiller student in her science resource room to teach her and the rest of the students PowerPoint for a unit on the planetary system. With the student's help, each member of the class created a slideshow that was then presented to the group.

[3] The MultiArts Festival is an event at a local stage theater. For two straight days a constant flow of young people from all over Union City perform while the rest of the theater is turned into galleries showcasing student art and videos.

Personalism: Teacher-Student Mentoring

A central goal of Project Hiller was to develop mentoring relationships between teachers and students at Union Hill High School. The purpose of this effort was to foster a transition in the school culture from "vertical to horizontal," as one district administrator described it, and to create an affective shift from teachers as "dispensers of knowledge" to partners in learning. By utilizing the novelty of the technology to engage teachers and students in a process of learning (i.e. joint training sessions), Project Hiller cultivated opportunities for teacher/student interactions that pushed the traditional boundaries of the school. By encouraging teachers and students to work together in novel ways, in web teams for example, Project Hiller developed the notion of mentoring from that of technical supervisory to one of ongoing personalism.

Mentoring, as a project goal, aligned both with the broader reform vision of the district and Union Hill itself as it moved toward the gradual adoption of the Coalition of Essential Schools model for the school. For example, the Coalition's endorsement of collaborative structures, higher standards, student ownership of learning and leadership meshed with Project Hiller's own objectives. Regarding the Coalition's emphasis on the "personalization of education," one a project coordinator noted that mentoring within Project Hiller "was a good step in that direction …these kids now had somebody they could go to." That personalization was a positive outcome of the mentoring component over the three years. The school's technology coordinator reflected:

> *(there are)…more relations between students and teachers…the Hiller kids have a better sense of self due to a connection with a mentor, because a connection between teachers and students is the most important, and can even overcome a lack of content knowledge…connection has been important in that the kids that might typically lose their way in school don't fade away.*

Open to experimenting and revising, project coordinators tried a different approach to creating mentoring opportunities each year. In Year 1, students and teacher were assigned to each other in part based on scheduling and sharing class time together. Efforts were made to pair up Cohort 1 faculty (who were in this case predominantly department chairs and administrators) and Cohort 1 students across tracks. Their task was to work together to produce two academically-oriented PowerPoint presentations for the project. At this early stage, some teachers still perceived themselves to be "helping" students despite students' quick acquisition of technology skills. For others, it was a chance to help students manage themselves. For example, one teacher explained her role was to make sure "they do their PowerPoint presentation." During meetings, students would tell her what they had accomplished and she would give them deadlines.

In Year 2, project coordinators had many more classroom teachers involved in the program with who they could pair up Cohort 2 students. They sought to create more compatible matches by offering students the chance to choose a Cohort 2 teacher-mentor after the joint training sessions and accommodated where possible. As with Year 1, Cohort 2 teachers were paired with Cohort 2 students in small teams to work together on producing PowerPoint presentations. Cohort 1 teams were reassigned with Cohort 1 students to produce both PowerPoint presentations and develop web

page for the school's site.

Managing the mentoring component was largely turned over to teachers in Year 2 to coordinate on their own time. The results were mixed as scheduling became difficult and many students worked on their own. In response, project coordinators instituted regular meetings between teachers and students while the main coordinator for the program was available as a mediator, nudging teachers and students to get together and finish assignments.

By Year 3, a new Cohort swelled the ranks of participants to 120 students but only a few teachers were left to join the program, so project coordinators again refined the mentoring component. For example, rather than one teacher with 2-3 students, Cohort 1 students worked with a team of teachers and a larger group of students.

1. Cohort 1 (juniors) worked with teacher teams to: 1) continue developing the school web site, 2) draft a project newsletter for email distribution, 3) develop classroom materials for teachers, and 3) mentor the freshman group;

2. Cohort 2 (sophomores) worked with a teacher and students to develop HTML skills and contribute to the web site while completing their PowerPoint requirements;

3. Cohort 3 (freshman) worked with an assigned teacher and Cohort 1 student to focus on their PowerPoint projects.

Overall, Year 3's design worked well to address the mentoring needs of the growing Project Hiller population, as each Cohort had distinct skills and interests. As one student explained, "we have learned so much…and learned to work in teams with teachers. Get something done as a team. Before they'd teach you something and you would do it on your own."

Reflecting on Project Hiller, Union Hill's Principal reported, "Hiller has built a stronger connection between faculty and students. Hiller teachers get more involved with these kids. And it's spreading slowly…" He explained that Project Hiller has become the nucleus of a mentoring program that Union Hill plans to begin across the school. They plan to recruit 15-20 teacher volunteers to take on a group of 10-14 students in the freshman class to meet regularly. As the school seeks to eventually develop a cycle of teacher mentors, administrators based in the program have recognized that mentoring is a process that is best demonstrated rather than explained. For one administrator, "it is incumbent on the school to mentor and train its teachers."

A student-centered environment

Changes in the social environment are most clearly evidenced in the transition of the media center from a traditional library to the school's student-centered technology hub. On any given day, a visitor to Union Hill's media center can find a buzz of activity: students surround a laptop, collaborating on a project; a class works on half of the center's computers doing research; students read and study independently or hang out with friends. Close by, another teacher and her students complete production of a Spanish language web-zine on their laptops. Other teachers check email,

search for material, submit online special needs student progress reports, or work with students.

Project Hiller, housed in the library/media center, plays a role in Union Hill's cultivation of a student-centered environment by fostering student investment in the school community. Project meetings are held in the media center, and the media center is also where participating students drop off their laptops for safekeeping, come to get help, work on projects, and meet with teachers. An outgrowth of this shift in where and how students work is a rise in the number of students investing time and energy in the media center and the school. The director of the media center and a coordinator of Project Hiller explains, "This is their space. They are investing in their school and their teachers and their learning." From 6:45am until 5:30pm daily, students fill the space, demonstrating visible ownership and investment in the media center, and by extension, the school. The director feels, "They believe in the library and behave as if they own it. It is theirs."

The center is a crucial access point for students and teachers, offering them an open space unlike many of the classrooms, where they can meet around a table to work collaboratively. The media center expanded its resources to 40 networked computers and set aside space with a projector for presentations. Additionally, as a result of increased daily Internet use for research and schoolwork, students began demanding updated print resources, no longer accepting of outdated books and materials.

Struck by the increasing number of students using the space, the media center began keeping usage statistics during Year 2 of the project (1999-2000). The daily average number of student users signing up for the computers was 215, about 17% of the student body on any day. The daily average for 2000-2001 was up to 242 students. These numbers do not include the teachers, laptop students (110) and Teen Tech students (approx. 30) who do not sign up.

Simultaneous with the emergence of a student-centered environment in the media center is an increase in student participation in social and academic clubs throughout the school. Union Hill believes clubs provide more opportunities for students to develop leadership skills and to explore new roles in relation to their teachers and peers. According to surveys of the ninth, tenth and eleventh grades, 58% of all students are in at least one club or sports team. Since there are more opportunities as students get older, the eleventh grade figure is 70%. Project Hiller students play a prominent role in the clubs. Overall, the Project Hiller students tend to be involved in more clubs and more likely to hold leadership positions. Even in the tenth grade, many of the Hiller students would speak about being on the executive committees of different clubs (i.e.: History Club, Student Council, Science Club). While in the tenth grade, Cohort 1 students organized the school's participation in the national America Reads Day (to encourage Americans to read) and arranged to send high school students to visit the elementary schools to read to the younger students. Program coordinators and teachers attribute the high profile of Hiller students to the program's impact on student's self-confidence, ability and leadership skills.

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.

Production of Artifacts

Students at Union Hill are now engaged in an increasing range of activities both in class and out of class. Students use the Internet, word processing, spreadsheets, databases, desktop publishing software, image software, presentation software, and html. Students are making more use of the Internet for research and conducting research in new ways (i.e. field research, surveys). Since Hiller started, students have begun creating web pages for the school, for student clubs and for class, the school newspaper was featured online and one class produced a web-zine in Spanish. Other classes have done desktop publishing projects and online field trips.

The introduction of PowerPoint is the clearest and most detailed example of changes in student artifacts we have seen at Union Hill. Survey data indicates that the use of presentation software for class work and demonstration has more than quadrupled in one year (from 12% the first year of Hiller to 51% the second year), and half the students surveyed now report using PowerPoint. Observations and interviews provide a richer picture of how and why this new practice came to be.

We observed the project coordinator (and media specialist) help Hiller students prepare required multimedia presentations on an academic topic of their own choosing. Students were encouraged to show their finished PowerPoint presentations to their classroom teachers. In this way, teachers were introduced to the potential of this tool and saw how competent their students were with the technology and non-participant students began asking to create PowerPoint presentations, too. In response, teachers began assigning presentations for all their students. Project Hiller's initiative was crucial to promoting this change within the school.

Why are teachers so quick to adopt this technology? In interviews, teachers often commented that a multimedia presentation was a powerful improvement upon the traditional written report since it motivates students and lets them be creative. The multimedia nature of the tool allows students to demonstrate a range of abilities, letting teachers discover new aptitudes. Compared to other multimedia software, the ease of PowerPoint allows students to concentrate on the content rather than on learning the software. As students have begun to present to each other more regularly, teachers push them to draw on more and various sources (and to cite them), demanding better quality information and synthesis.

Student conceptions of technology

It is not surprising that student perceptions of technology's capability has grown over three years

of experience. When talking about the web, the participating students have come to see the Internet as empowering and supporting their intellectual autonomy. The essays they wrote provide a look at their initial expectations about technology.

Project Hiller would let me enjoy the process of learning even more, and at the same time, open the door for me into the future: computers and modern technology. Receiving a laptop with access to the Internet would surely help me immensely in accomplishing my tasks as a student for the years to come.

— 9th-grade honors student

Project Hiller would help me intensly (sic) by giving me the chance to get a computer of my own hooked up to the Internet for many school projects and activities. It would help me keep track of my school-work and stay up to date with various projects and assignments. Project Hiller would keep me on top of my work and stay focused in many of my classes, and would also help me do my best in my academic career.

— 9th-grade special needs student

Por eso, al escuchar de este proyecto se abrió una brecha de esperanza en mi corazón para poder contar con una computadora que me ayude a ser alguien preparada para enfrentar el futuro.

So when I heard of this program, a small ray of hope opened in my heart, that I might be able to count on a computer to help me become somebody prepared to face the future.

— 9th-grade ESL student

Early interviews with students also flesh out the impression that technology can help them fit into the world of other people's making. Most perceive that basic technology literacy is necessary to get a good job (e.g.: in the first year, Cohort 1 students reported expecting their experience with Hiller to get them white-collar service jobs). As one 9th grade honors girl explained, "…everyone will need to know this for the future. In the newspapers it always says secretaries need to type so many words a minute or a job for computer programmers."

After three years of rich experiences, the students in the school have come to conceive of technology as a factor in their learning more broadly, as a means to an end, that allows them to pursue their interests, "to learn about anything," as one 10th grade honors student from Cohort 2 claimed, explaining that with her laptop, "I can do whatever I want and teach myself…before, I was clueless."

In one example, a ninth grade general track participant from Cohort 2 was involved in a class project to do field research and write about the impact of different inventions on society. On his own, he and his partner – who were studying the impact of the automobile – distributed surveys over the Internet to contacts in Miami and rural Tennessee so that they could compare trends in three

different locations. They got 10 responses from each site, as well as 50 in Union City, and were able to talk about different patterns of car ownership and driving age in each place. The teacher was pleased not only with the initiative but that the duo asked if they could exceed the 10-page limit for their report.

Another student, an honors student from Cohort 1, shared a similar story. While working on a poetry assignment for Advanced Spanish, she decided she was "bored" with the approach the teacher had taught. She searched on-line for "poetry analysis" to find other ways to look at poetry. She found ones she liked in English, and used the same manner to analyze a poem by Federico García Lorca (all activities for this class were to be published in a class web magazine).

While small examples, they are indicative of students' growing critical thinking skills, transference of information to new contexts, and intellectual curiosity as supported by certain technological affordances. These developments are not credited solely to technology; but are the result of multiple interacting factors such as good teaching, an increase in student-centered activities and project work.

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. This 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% to 51% by Year 2.

Changing teacher practices

The practices and beliefs of teachers, specifically those closest to the project, underwent change; several teachers spoke of and demonstrated higher levels of trust in their students by expanding opportunities for students to identify and investigate subjects that interested them. Furthermore, increases in the number of student presentations, improved performance on traditional measures, and more student-led activities heightened teachers' sense of students' competencies.

Generally, teachers appeared to be adopting teaching strategies that engaged students in learning activities that encouraged student autonomy and self-expression. Teacher surveys indicate they more frequently used learning strategies encouraged by the Union City reforms such as long-term project work, journal writing, multiple representations of ideas, and presenting to an audience. The number of teachers who report doing long-term projects (at least once a year or more) increased from 85% to 95%, as did the number of teachers who use journaling with their students, which rose from 58% to 68% (Tables 7 and 8).

TABLE 7: HOW FREQUENTLY DO YOU HAVE STUDENTS WORK ON PROJECTS THAT TAKE LONGER THAN A WEEK? PERCENT OF TEACHERS RESPONDING

Frequency	Year 2	Year 3
Never	15	5
1-2 times a year	18	32
Monthly	55	46
Weekly	11	16
Daily	2	2
Total	100% (n=55)	100% (n=44)

TABLE 8: HOW OFTEN DO YOU HAVE STUDENTS WRITE A JOURNAL? PERCENT OF TEACHERS RESPONDING

Frequency	Year 2	Year 3
Never	42	32
1-2 times a year	6	11
Monthly	17	18
Weekly	19	27
Daily	15	11
Total	100% (n=52)	100% (n=44)

The number of teachers asking their students to develop multiple representations of knowledge decreased marginally, but the frequency of using this strategy increased for the teachers who already use it from 23% weekly or more frequently to 28% (Table 9). The biggest impact has come in the area of student presentations, which has increased among the teachers who use them (Table 10). Fully 32% of teachers use presentations daily or weekly, up from just 11% the previous year.

TABLE 9: HOW FREQUENTLY DO YOU HAVE ASSIGNMENTS WHERE STUDENTS REPRESENT AN IDEA OR RELATIONSHIP IN MORE THAN ONE WAY? PERCENT OF TEACHERS RESPONDING

Frequency	Year 2	Year 3
Never	14	16
1-2 times a year	20	21
Monthly	43	36
Weekly	23	23
Daily	—	5
Total	100% (n=56)	100% (n=44)

TABLE 10: HOW FREQUENTLY DO YOU HAVE STUDENTS DEMONSTRATETHEIR WORK TO AN AUDIENCE? PERCENT OF TEACHERS RESPONDING

Frequency	Year 2	Year 3
Never	13	12
1-2 times a year	27	28
Monthly	50	28
Weekly	9	30
Daily	2	2
Total	100% (n=56)	100% (n=44)

One illustrative example is the growth of a Spanish language teacher who joined the project in Year 2. This teacher had decided to create an on-line magazine with her students' work but got only as far as a collection of student poems and essays on paper. As a Year 2 entrant she was new to Project Hiller and the students in her advanced Spanish classes were in the grades prior to the laptop program. Other than two students who knew html, she and her students had relatively few technical skills. The delegation of tasks was a larger problem. Creating a web-zine is a complex endeavor, involving writing, editing, designing, layout, images and artwork, and at that point, all tasks flowed through a teacher unable to manage the coordinating and editing required. In Year 3, she started the project again with much greater success as she was newly trained in html and working with students in the grades influenced by Hiller. More importantly, she had reorganized project tasks (i.e. writing, the editing, layout and design, creating a prototype) to be almost completely managed by students.

Changing Teacher Perceptions of Students' Abilities and Competencies

In interviews both teachers and administrators commented on how technology-enriched activities and Project Hiller have allowed them to see their students in a new light. A veteran teacher and department head, who presents himself as a critic of Project Hiller, explained that one of the successes of Project Hiller has been changing teacher and student expectations. He has seen many changes at Union Hill during the first three years of Project Hiller, and he credits the project with playing an important role. Not only did Project Hiller represent a boost for participants' self-esteem but also, in exchange for the laptop, teachers can demand more from their students. Students met these new expectations because, he stated, "it became important for the kid to do a good job for the teacher." In this teacher's view, not only did teachers expect more, the students themselves expect more, as well.

One catalyst for the process of changing perceptions appears to be student involvement in creating products. The production process both allowed teachers to work alongside their students in very different ways from the traditional classroom environment as students demonstrate a more sophisticated set of skills as they select, synthesize and produce a multi-media product. The Project Hiller Spanish teacher introduced above recounted how changing her teaching strategies to include

multi-media presentations and web pages transformed both her teaching and her relationship to the students. She works with students from the bilingual programs and honors and general tracks. First, as she integrated more project work and group work she needed to schedule more time in the media center for access to the technology as well as access to open workspace. During her class, it was not unusual to observe some students using the media center computers and others clustered around a laptop at one of the tables. The project work changed the students' learning process and transformed her relationship to the students as she facilitated the process. She reflected:

> *When we meet at the media center, outside the classroom, that is the nitty-gritty of the work. It's a different way of learning, they are learning how to process information and what to do with it. I enjoy seeing them take it outside the classroom and get involved.*

She commented on the students' dedication to their projects and to learning: "the kids in Hiller are more academically inclined, you treat them as gifted and they act as expected and beyond. The students have surpassed my expectations and their commitment has impressed me."

District and school-level administrators also noted the role student projects play in supporting change in teacher-student relations. A district administrator observed "the technology allows students to do better work and get more involved in projects," and in turn the "teachers recognize unexpected talents in students." The school principal summed up his view of the project's impact on student-teacher relations, "Hiller students are committed, self-motivated. They have a direction. They still need guidance, but they have great aspirations." He noted the students affected were not typically high-performing students, "I don't think they are the kids who would have been committed. A good portion would have done okay, but they are doing better. Another set of kids would have been content with 70's but now they get A's and have high hopes." These observations of the teachers and administrators–that more students are academically engaged–are evidenced by the improved student test performance across tracks and students own reflections.

Increased Student Performance 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. 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.

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 respec-

tively, representing a 25% increase from 1998 in the number of high achieving eighth-graders choosing to enroll at the high school.

Student Performance on Standardized Tests

Along with the transformations in student learning activities, there has been a notable impact on measurable outcomes for Project Hiller participants. The test analysis focused on the students in Cohort 1 and their classmates since they would have the most complete data available from 9th to 11th grade. We collected data from all tests administered by the district as well as the Scholastic Aptitude Test (Table 11).

TABLE 11: TEST CYCLE ADMINISTERED AT UNION HILL HIGH SCHOOL

Grade	Ninth Grade	Tenth Grade	Eleventh Grade	College Admission
Test	Early Warning Test (EWT), released version	High School Proficiency Test (HSPT) Released version	High School Proficiency Test (HSPT) Official version	SAT I , (Scholastic Aptitude Test)
Ranges	Reading: range = 1 to 57; passing = 41 Math: range = 1 to 70; passing = 41 Writing: range = 40 to 100; passing = 77	Reading: range = 0 to 54; passing = 30 Math: range = 0 to 56; passing = 22 Writing: range = 0 to 100; passing = 73	All subjects:range = 100 to 500; passing = 300	Verbal and Math: range = 200 to 800 Combined score: range = 400 to 1600

To examine the relationship between the Hiller participants' test performance and their non-participating peers, we divided results by students' academic track in the ninth grade (the year they entered the program) and conducted two different tests of significance. We selected different tests of significance due to the different sample sizes, one for tracks with a small number of Hiller participants and one for tracks with a larger proportion of Hiller participants. We ran one sample t-tests comparing Hiller students' mean to the overall mean for students in the general track and Limited English programs where there were a small number of participants relative to the overall number of students in each track. Because the honors track is fairly evenly divided between participants and non-participants in Project Hiller, we conducted independent sample t-tests comparing the mean score of the participants to the mean of non-participants. We used the ninth grade EWT results to establish a baseline. The analysis of their ninth-grade scores showed no significance for LEP, Special Needs or honors track participants, allowing us to infer that, in regard test performance, the participants are a random selection from the overall pool (Table 12). The results did show significance for general track students in writing and math. We attribute this initial difference to issues of self-selection (i.e. what sort of general student wishes to join a school club?) and the selection criteria filtering out students with discipline and attendance problems, which would effect the general track population the most. Therefore, we considered the participants' test performance to be that of randomly selected students across all tracks.

TABLE 12: MEAN SCORES FOR COHORT 1 ON THE 9TH GRADE EWT SPRING 1999 BY ACADEMIC TRACK

		Reading	Writing	Math
Honors				
	Project Hiller	49.5 (n=20)	86.3 (n=20)	54.3 (n=20)
	Non-Project	48.7 (n=24)	80.0 (n=24)	52.4 (n=24)
General				
	Project Hiller	42.9 (n=10)	76.5* (n=10)	48.7* (n=10)
	Non-Project	39.7 (n=189)	70.8 (n=190)	40.4 (n=189)
Limited English				
	Project Hiller	34 (n=5)	65 (n=5)	30.6 (n=5)
	Non-Project	27.4 (n=45)	54.8 (n=45)	28.4 (n=45)
Special Needs				
	Project Hiller	39.5 (n=2)	73.5 (n=2)	37 (n=2)
	Non-Project	24.5 (n=33)	57 (n=30)	23.2 (n=33)
Overall Mean		37.7 (n=328)	69.1 (n=326)	38.8 (n=328)

Note: * p> .01.

By tenth grade, results on the High School Proficiency Test (HSPT) indicate that Project Hiller has an impact on student test performance (Table 13). To maintain consistency, scores were again divided by the students' ninth grade track (i.e. their starting point), but to create a valid comparison, only other tenth graders who had been at Union Hill since ninth grade were included in the analysis. Within each track, program participants posted higher mean scores than their non-Hiller peers across the board. On independent sample t-tests, participant students in the honors track now significantly out perform their peers. On one-sample t-tests, results in every subject were significantly higher for the general Project Hiller groups. In fact, the mean scores for Project Hiller general track students in each subject are higher than the non-Hiller honor student means. Scores for Limited English Proficient (LEP) and special needs students are also higher than their peers' test scores. LEP Hiller participants are roughly equivalent to their peers in the monolingual general track.

TABLE 13: MEAN SCORES FOR COHORT 1 ON THE 10TH GRADE HSPT (UNOFFICIAL VERSION) SPRING 2000 BY ACADEMIC TRACK

		Reading	Writing	Math
Honors				
	Project Hiller	41.9* (n=20)	89.6* (n=20)	32* (n=20)
	Non-Project	34.8 (n=19)	79.9 (n=19)	25.3 (n=19)
General				
	Project Hiller	37.3** (n=7)	82.3*** (n=7)	29.4** (n=7)
	Non-Project	29.4 (n=147)	76.3 (n=144)	20 (n=145)
Limited English				
	Project Hiller	28.8 (n=5)	75.6 (n=5)	21.6 (n=5)
	Non-Project	21.9 (n=36)	65.2 (n=36)	15.7 (n=35)
Special Needs				
	Project Hiller	40 (n=1)	77 (n=1)	22 (n=1)
	Non-Project	19.3 (n=22)	67.7 (n=21)	16.4 (n=19)
Overall Mean		29.1 (n=328)	75.6 (n=326)	20.7 (n=328)

*The above numbers include only students who have been at Union Hill High School for the ninth and tenth grades. These figures also exclude five students who resigned or were suspended from the project. Note: * p> .001; **p> .01; *** p> .02.*

We conducted the same analysis on the eleventh grade results, again dividing scores by the students' ninth grade academic track and restricting the sample to students who have been at Union Hill since ninth grade. On the eleventh-grade HSPT, the Project Hiller participants again posted very strong results, which tested significant across all three tracks and in each subject. The honors Hiller students scored highest across all three subjects, and the general track Hiller students were equivalent to the non-project honors students in writing and math. This test is a state graduation requirement: 100% of the Hiller students passed in math and 98% passed in reading and writing.

TABLE 14: MEAN SCORES FOR COHORT 1 ON THE 11TH GRADE HSPT SPRING 2000 BY ACADEMIC TRACK

		Reading	Writing	Math
Honors				
	Project Hiller	411.1* (n=19)	397.6** (n=19)	414.4* (n=19)
	Non-Project	375.06 (n=16)	373.75 (n=16)	396.14 (n=16)
General				
	Project Hiller	351.3*** (n=7)	371.14*** (n=7)	396.14* (n=7)
	Non-Project	312.15 (n=127)	338.68 (n=126)	321.98 (n=127)
Limited English				
	Project Hiller	292.4 (n=5)	325.4 (n=5)	358.8 (n=5)
	Non-Project	256.62 (n=26)	285.96 (n=26)	291.69 (n=26)
Special Needs				
	Project Hiller	319 (n=1)	354 (n=1)	326 (n=1)
	Non-Project	222.82 (n=22)	259.86 (n=22)	216.73 (n=22)
Overall Mean		310.62 (n=328)	333.07 (n=326)	323.09 (n=328)

HSPT scores range is 0 to 500, 300 is a passing scores in all three subjects.

Note: The above numbers include only students who have been at Union Hill High School for the ninth, tenth and eleventh grades. These figures also exclude five students who resigned or were suspended from the project. Note: * p> .001; **p>; .01 *** p> .05.

We were also able to examine student performance on the nationally administered SAT tests. Project Hiller students outperformed their peers on both the PSAT and SAT exams. At Union Hill, 190 students took the SAT in the fall of 2001. Thirty of those students were in Project Hiller. The average total SAT score was 796, the average for Hiller participants was 978 and the average for non-participants was 762.

TABLE 15 AVERAGE SAT I COMBINED SCORES FOR PROJECT HILLER PARTICIPANTS AND NON-PARTICIPANTS,FALL 2001

Sample	*Average SAT score*	*Number of Students*
Project Hiller Participants	978	30
Non-Hiller Participants	762	160
All Union Hill Students	796	190

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."

The Portability of Laptops and the Impact of Ubiquitous Access

An outcome of this research is an increased understanding of the potential benefits of portability across a school community (students, faculty, and families). Portability has been an important element in cultivating student ownership of the technology by allowing them to use their computers across settings, time and for distinct purposes. As an extension of portability, the laptops' wireless capabilities permit ubiquitous access to the Internet almost anywhere in the learning environment. 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. In conjunction with increased pressure to integrate technology into classrooms and the laptop's functionality as an individual or group work presentation station, the visibility of laptop's use encouraged other teachers and students to pressure the school to offer training and support to do similar activities.

The increased visibility of students engaged in school projects outside of class time and the novelty of many of these projects supported another of the district's reform goals – changing teacher expectations of students' abilities. Interviews with teaches and administrators during the last year of the research reveal:

- *Administrator:* The kids are more equipped for technology. They know more and push teachers to the side…The kids have more confidence in themselves, in their own abilities, and teachers have to react to that.

- *Project Coordinator:* We didn't anticipate that the laptop would be sort of like a center, a little center for learning…(we've) seen one laptop in the middle of a group of students and they're all kind of huddling around it…they could do collaborative work together and that worked out really nicely…other teachers who weren't in Project Hiller or weren't involved in it were utilizing those students in their classes who were Project Hiller students and used the laptop as a tool, which it was.

- *Project Coordinator:* I see a lot of laptop sharing in the media center. A lot of non-Hiller students talk about wanting to join the project…even middle of the road kids are doing more. It's

as if students see the benefits of the project and start to drive the demand, then teachers react because they are survivors. They deal with change and are forced to keep up with the higher standards. Teachers press for better materials and demand more of students who then rise up.

- *Teacher:* I definitely expect more of them, academically. I expect them to be able to do their research and hand in their assignments on time. They have tools right in front of them, so I feel there is no excuse.

Initially, the district and the school encountered technical difficulties in providing home access (Honey, et al., 1999) due to logistical problems wiring homes and coordinating billing for many telephone accounts. To effectively provide home access, the district changed strategies and offered free dial-up access to the web through the Board of Education server. Another technical aspect of the program that coordinators refined in Year 2 was switching from Macintosh G3s laptops used in Year 1 to Macintosh iBooks, which have wireless connectivity, longer battery life (nearly six hours) and are much lighter to carry. By comparison, the G3 laptops were heavier, had a limited battery life that barely lasted two class periods, and did not have wireless capabilities.

Along with moving Project Hiller to better utilizing the potential of the laptops, Union Hill and the district made wireless networking a priority for the building by installing a wireless network on the first and second floors. This substantially increased portability and student usage as the wireless connection to the school's network meant they were able to access the web from many parts of the building. Given the iBook's advantages, Cohort 2 and 3 students were more inclined to bring the laptops to school every day, while the G3s of Cohort 1 were seen less often, brought in for specific events such as group project presentations. As one project coordinator reflected:

> *….the wireless technology was a really big thing. A kid could come into the media center, pop open the laptop, didn't have to try and find someplace to plug in either to electricity or to the Internet, and then other kids would gather around and they could work together. It really made it more portable.*

For participating students, these features strengthened student ownership and autonomy as they used the computer whenever and however to create technology products and present them in class. For students outside the program, the portability and ubiquity of laptops indirectly increased their level of access to and awareness of technology through their Hiller peers who often shared their laptops with others in the media center or during class time.

For teachers, having a portable teacher station in the form of a laptop provided continuity regarding prep tools and workspace, as well as increased teacher control over confidential materials such as grades. This was important in a high school where many teachers move between classrooms. Although some teachers initially reported feeling less comfortable allowing students to bring laptops to class, citing concerns about equity and distractions, others grew comfortable, even surprised on occasion. One teacher recalled a bilingual student (using his brother's iBook) surfing the web during his science lecture and discovering that not only was the student taking notes on the

laptop but was double-checking the teacher's definitions online at a science education web site. Increasingly familiar and comfortable with the laptop's capabilities, both teachers and students prefer using laptops for in-class activities instead of the classroom computers.

Infrastructure and Building Capacity

As the laptops and students moved technology to the center of the schools activities, they not only raised the bar of teacher expectations, they increased student demand for computers and connectivity. In fact, demand began to overburden the school's infrastructure.

The students' project work raised the importance of two of the least visible elements of the technology – the internal network and storage. For the technology to work most efficiently for Internet use and multimedia production, networking and storage are crucial factors. Students need substantial storage capacity when creating complex products and presentations, since the files quickly exceed the limits of a floppy disk. They also need flexible access to this storage space so that they can work in class, study hall, or after school anywhere in the building (or beyond). This capacity is critical for project work since it is supposed to take place outside of class time. Network access also facilitates group work by providing this flexible access.

The laptop students can use their own machine to fulfill these needs, which eases the demand for desktop computers and addresses some of the storage issues. But the laptop is not a perfect solution since it benefits mostly the participant students and, if they are doing a group project with non-participants, places a larger share of the work on them. Union Hill has a sufficient number of computers for the student body and the school was able to meet that demand by shifting computers to more accessible spaces (i.e.: the media center). But, the school was hard pressed to expand and strengthen the internal network to meet the demand.

In Year 1, 1998-99, only 67% of classrooms were connected to the Internet. The school's goal was to network all classrooms and to create a folder for every student. Servers and networking became a revolving problem during Years 2 and 3. Part of the difficulty is typical of school bureaucracies. The approval process places the school in a bureaucratic loop with the district, the Board of Education and multiple vendors. All expenditures have to be authorized first by school administrators who forward it the District and then to the Board for approval. There is wait time involved in authorization and disbursement and again in delivery and installation.

The first major problem came in the second half of the year 2, 1999-2000, when the networked crashed because too many students were logged on. This was due to limitations of the server software whose capabilities had been misrepresented to the school. The server crashed the day it had to handle 251 concurrent users. It took the next year and a half to finally establish a stable network providing every student a folder.

At various times during Year 2 and 3, the school's servers would be off line for rewiring or to shift computers between servers. This was certainly a drag in the process of integrating technology into the curriculum since it placed an extra hurdle in front of teachers. To effectively use the

technology, teachers would have to find ways to for students to store their work, and to retrieve it each day in class as well as find ways for students to access their work after class. One positive consequence of the network's weakness was to raise the importance of the technologically proficient students, since they could create ways to overcome these problems. For example, the students in project PCL2000 used their technological prowess to create a mini-network out of the media center computer banks to take care of their own network and storage needs.

Family Impact

An additional benefit of the laptop's portability has been the wide use of computers among families at home. For many, the Project Hiller laptop (with printer and phone line) was their first form of comprehensive home access to technology, small enough to fit in crowded spaces and flexible enough to be used by many in one setting. As students developed skills with applications from spreadsheets and word processing to web research and email, they began to share the computer and their knowledge with their siblings, parents, cousins and friends outside of school, which was encouraged by the project coordinator. Often, the Project Hiller laptop was the Internet access point for the entire family, allowing parents to email with relatives in their home countries, and siblings to do homework and web research. "Once I get home," one student explained, "my sister gets the computer first for her homework, then me, then my brother and then me again if I want to chat." Another student commented that while he shares his laptop with his sister, "I might teach my mother more because there is more access to information if you use it correctly."

Several students from Cohort 1 and Cohort 2 reported that their parents used the laptop to locate foreign-language on-line newspapers from their countries of origin (Ecuador, Columbia and Albania, for example). Other parents wrote resumes, typed up letters, produced budgets in spreadsheet applications, emailed the school and even learned PowerPoint. One student reported helping his parents write letters on the laptop disputing medical insurance bills while another students helped siblings with science reports, presentations and web research.

Initially, there was trepidation from both parents and the school about providing Internet access at home because of "acceptable use" worries from parents' concern regarding the dangers of the Internet flooding into their homes. Additionally, damage and theft were also of concern – that students carrying the laptops between school and home could lose the laptop or might be the victims of crime. To address these concerns, project coordinators strongly conveyed to parents at a Project Hiller meeting early on that, "if it is stolen, we will make provisions. Your child is more important than the computer. Your child is important to us. Your child will be carrying it back and forth and your child is more important than any computer to us. It is fragile but all we expect is that you take reasonable care of it." This commitment from the school appeared to reduce parents' safety concerns, clearing the way for their children to participate in the program. For students who carry computers to school, the media center office is a safe place to leave the laptops during classes in which they cannot have the laptop (i.e. gym). With experience, the teachers and parents now have few concerns about theft since the laptops have not become specific targets for crime or violence. There have been only two laptops lost. In Year 1, a laptop was stolen from a

locker, despite warnings not to leave the laptops there. The other laptop lost was stolen along with all the families' belongings when their house was burglarized.

Families dealt with the on-line safety concerns, each in their own way, just as parents craft their own responses to any other challenge of parenthood. Project coordinators suggested that parents keep an eye on where their children went online and recommended keeping the laptop in a common room so its use was public. They likened knowing where their children were on-line to knowing who their children's friends were off-line. While Internet access to the web was provided for free through the district server and was therefore subject to blocking software, project coordinators stressed the importance of parents keeping a watchful eye on students. A mother with a daughter in the program reflected in an interview that even though she had initial worries, "all you can do is talk to your girls about risks and where they should go. I trust them." For the students, many reported understanding their parents concerns and seeing it as a form of "protection" rather than "distrust." One student reported that his mother would worry about what he did online so sometimes she would sit next to him to watch, but added, "she trusts me and she knows I won't go where I'm not supposed to."

In interviews students reported that parents were using the laptops to search the Internet, write letters, create cards and posters, play games and email. Parents' use of the laptop has given them greater familiarity with computers and the Internet, and potentially this has allayed some of parental fears about the Internet and their children's use of the technology. Access to the laptop, its capabilities, and its prominence in students' schooling – including the school's approach to demanding students treat technology as a privilege and a responsibility - allow parents to recognize the utility of the computer for their children's learning and for themselves. Oftentimes, students were able to juggle work, sports, and family obligations because home access to the laptop and the web allowed them to conduct research and do homework after school. For some students their sense of ownership and affective attachment to the laptop made an impression on parents. For example, one mother noted about her daughter, "it's the only thing she cleans!"

Over the course of the project, and initiated by the school's PTA, an organization dominated by Project Hiller parents, Union Hill was able to introduce and offer the community a series of student-taught, parent technology workshops. These bilingual sessions begin with an introduction to computer hardware and software and, importantly, the practicalities of what a parent needs to know to buy a computer. The technology workshops eventually progressed to where parents were creating personal web pages and calendars, and were well attended as parents sought ways to catch up with their children's growing technical expertise. It also offered another way for the school to connect with families. From a school perspective, Union Hill's Principal initially expected Project Hiller to be a very complicated administrative effort and worried about keeping track of 120 computers and printers dispersed all over town. But, he reflected, "It's going amazingly well. I don't even think twice about those issues anymore. My concern now is what to do with the laptops after four years. Will they still be usable? Can they be refurbished?"

Challenges

A technology intervention that presents as many complexities and open-ended opportunities for youth and teachers as Project Hiller was bound to encounter challenges as it unfolded within a high school. As Project Hiller grew both in size and value to the school community over three years, program coordinators faced several teaching, learning and technology challenges. Although there were many kinds of obstacles that ranged from sustainability to the need for ongoing professional development, we observed the emergence of particular issues related to the lives of students that speak to the goals and difficulties of this work.

Meeting Multiple Needs. The attrition rate of students from Project Hiller was relatively low (i.e. Cohort 1 lost 8 students over the course of 3 years). The few cases in which students were actually asked to leave the program were result of extreme academic or behavior issues. When students exited the program voluntarily, it was most often reported to be the result of their moving out of district, transferring schools, or in response to larger family and academic pressures. In the Spring 2000, 17 students from Cohort 1 and 2 were placed on academic probation and were expected to get their grades up. The probationary period was a warning accompanied by more attention and focus from program staff. Helping bilingual, special needs, and general track students balance their academic life with the requirements of Project Hiller meant devising ways to address multiple needs.

The special needs students presented a unique set of challenges that reflected their particular relationship to school. One special needs teacher reported that her students often expected to fail, and generally demonstrated low self-esteem and a low sense of entitlement. Even when she assured her students that acceptance into Project Hiller was not dependent on grades or test performance but on desire and commitment, her students were hesitant to apply for fear of rejection. Retaining students with special needs remained a concern for same reasons.

In interviews, teachers commented that special needs students felt anxiety about the responsibility of being part of Project Hiller. As one teacher explained, the increase in expectations may have been "wonderful" on some level for these students, but they needed support from their mentors that moved beyond the technology. Talk of probation and warnings to "hand in" required technology products placed additional burdens on special needs students, for example. According to one teacher, "the other students know that there are always second chances, or they can put together something at the last minute," but the special needs students generally did not feel that way because this "has not been their previous experience of school." Although the pressure was a concern Project Hiller was also recognized as offering special needs students new pathways into the school experience. One teacher was reported to have effectively used Hiller's responsibilities to work with her classified mentee to strengthen the student's self-esteem and confidence. Recognizing the distinct pressures and anxieties special needs students feel in regard to academic performance and public identity will help the program fashion appropriate ongoing support. Closer teacher-mentor ties, expressive and focused applications for technology activities and increasing the volume of special needs students in proportion to the other students may help prevent them from experiencing potential isolation.

Creating manageable expectations and developing time-management skills. One outcome of the project already mentioned was increased student engagement in the school community and in their academics. For all the positive impact of this development, it presented at least one challenge in terms of time. Along with their schoolwork, jobs, and family obligations, many participating students were involved in multiple clubs and activities (belonging to five or six clubs is not unusual) or were much sought after support technicians. As students became recognized as leaders in the school, they were often tapped to help with technical problems, conduct presentations, participate in competitions and school productions, produce better work and help peers learn the technology. As a result, many students had difficulty navigating these time demands and learning to say no.

IN SUM

Through interviews, observations, and surveys, CCT has been able to chronicle the development of Project Hiller as a means for change and to document its visible impact on the school community. We have observed shifts in the school environment, improvements in student work practices, products, and performances on traditional measures, the beginning of experiments in classroom practices, better understandings of students' abilities in general, and of their evolving mastery of technology in particular.

One thing stands out in our experience, however. The program has been successful not because of the mere presence of technology but because of the way students were empowered to use their laptops and their new skills. Moving beyond simple access issues to promote the larger reform concerns of the Union City Board of Education, Project Hiller's design gave students opportunities to excel as academic and peer leaders and opportunities for teachers to participate in and witness these changes. As a strategic support for developing teacher-students relationships and demonstrating student knowledge in new ways, technology was intentionally used to evolve the culture of school. As one teacher reflected, "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."

By placing technology in the hands of the students, Project Hiller was able to use the students themselves as change agents. By using technology as a platform to showcase their talents and abilities, the students developed ownership of their learning. In turn, teachers began to see what students can do, and raised their expectations in a cycle of reciprocal impact. Project Hiller has met its initial goals because the design and implementation of the project gave the students substantial responsibility and autonomy in relationship to technology and their learning. It created a student-centered space at the heart of the school.

The introduction and integration of computer and advanced telecommunications technology in school does not alone guarantee the transformation of the school into such an environment. But technology projects can reshape a school culture when supported by appropriate changes in school and district policy that are grounded in an educational vision for improved teaching and learning. This research reveals the importance of decisions that capitalized on the potential of technology to help create necessary conditions for student empowerment. As a technology initiative and reform program, Project Hiller was able to foster a change in the social dynamics of the school within a policy environment that supported those changes, transformed through the affordances of the technology.

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