Small School, Big Results: Leveraging Technology and Project-Based Learning in a High School

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Overview

What are our learning outcomes, our core values? Really bringing them in like you would into a high tech start up and making them sure they know all aspects of that company and then deploying them on to a project that an outside customer has asked for. And that might be to build a rocket or it might be to deliver an orientation package to our new high tech company and build it. But I think the more we can get our kids into the real world of work and real world of college, the better we will meet our mission... (Principal)

Future High School (FHS) is a small high school in Napa, California (USA) in which technology plays a critical role. As an excerpt from the Future High School Mission Statement declares that FHS was founded in 1996 to prepare students to excel in an information-based, technologically advanced society.... As such, the school incorporates technology into every aspect of its curriculum. Technology is embedded in every aspect of the schools activities and culture. Every teacher and every student uses information and communication technologies (ICT) for instructional purposes in support of project-based learning activities. From its inception, the schools goals have been to create technologically savvy citizens and to prepare its students for college and the work world.

In the above quote, the principal of FHS speaks of the school using the metaphor of a high tech start-up, indicating that he believes the school resembles a small, cutting edge start-up company. The organization and structure of FHS embodies the image of a small, innovative business. From the beginning, the school district leaders wanted the size of FHS to remain small and focused. With an enrollment of approximately 240 students in two grades (11th and 12th grades), the school has no desire to increase enrollment. The teaching staff at FHS is similarly lean. Because the size of the staff is small, they put a priority on operating as a team. Each week they meet as a whole staff to discuss issues, make decisions, select students of the month, and identify any students about whom they have concerns. The teaching staff has collaborated over the past two years in a large school-wide project. Furthermore, six of the nine teachers regularly team-teach together in a shared classroom. The school staff makes extensive use of Lotus Notes for discussion. In Lotus Notes, they've created an agenda discussion database, which allows them to keep track of each others schedules and communicate with each other through email. The director and his administrative assistant create the agenda for the weekly meeting from the items staff submits to it. Anyone submitting a concern is expected to submit a proposed solution. Together they decide what and how to post items into a discussion database.

Technology plays a central role in every aspect of life at FHS. Technology is fully integrated into the curriculum at FHS, and students and teachers alike use ICT to perform a number of tasks. Students use computers on a daily basis for everything from research on the Internet to a multimedia integrated design project that combines interdisciplinary content from social studies, math, science, economics, government, and literature. Every teacher and student has an individual email account and access to Lotus Notes, which allows
them to create databases and store their own class work. Students are required to take one year of multimedia design and pass computer applications competencies in Microsoft Office (Word, Excel, Access, and PowerPoint) before graduation. In addition, students use technology to create a range of products from their own involvement in collaborative projects with classmates to address a real world issue or solve a problem. By the time they graduate, every FHS student must be technically literate at the following level: typing skills at 40 WPM with 90% accuracy; 80% accuracy in software skills, including presentation and word processing software; multimedia skills that involve creating a project that incorporates sound, animation, and interactivity; and technology communication skills, such as creating a web page and Internet research. Students may also participate in Cisco Networking Academy, a hands-on college course that teaches students how to design, build, and maintain computer networks (during the 2000-2001 school year, 30 FHS students were enrolled in the Cisco course). In addition, all students are required to complete an internship in local technology-oriented businesses.

Creating a learning environment that simulates the real world is an intentional goal of the school. Architecturally, the building was completely renovated to resemble a high-tech work environment. The classrooms have glass walls, the trays for the network cables exterior are exposed on the walls, and common areas are designated for networked printers. Additionally, there are no bells to signal the beginning or end of class periods at FHS. Each student knows their own schedule and is free to move from class to class at their own discretion. Each classroom at FHS is about twice the size of a typical classroom and has desktop computers for every student as well as movable desks, tables and chairs to accommodate a variety of small and large group seating arrangements. In most classes, students are assigned to project teams with specific roles to fulfill. Team members work together, using evaluation rubrics, to create products and complete projects that address some real world concern. Projects typically encompass integrated subject area content (e.g. math and science; history and literature; economics and government) and address a unique, real world problem or relevant issue. Students also have access to a wide range of web-based learning resources in all their classes that are accessible in school or from their home computers. In addition to focusing on high standards and specific learning outcomes for all students, teachers and students place a high premium on collaboration: team members are required to assess themselves and their peers on how well they work with team members. Collaboration is viewed as an essential workplace skill that every FHS student must cultivate and develop before graduating.

From all indications, teachers and students benefit equally from participating in the model of schooling occurring at FHS. Teachers are given a great deal of freedom to create curricula that addresses the district and state curriculum frameworks. This curriculum development is typically is not done in isolation but with the collaboration of other colleagues in the school. Team teaching has created partnerships that allow teachers and other students to benefit from the expertise of colleagues and manage classroom time more efficiently. Teachers at FHS appear to be learning a great deal as they learn how to use a wide range of ICT tools to manage their classroom, create curricula, and maximize their own professional productivity. Students benefit from schooling in this unique environment because they are given the opportunity to relate rigorous content to real world problems and activities. FHS students typically perform well on district and state examinations; over 95% of them go on to postsecondary studies. In addition to community service and internship experiences, students must also take and pass 4 community college courses before they graduate. Students at FHS are also given freedom and treated with a respect that is uncommon for the typical high school student in the U.S. As one parent in a focus group remarked, ¼Theres just an incredible amount of respect here. And I ve noticed that my son is being a lot more respectful because hes showing a lot more respect towards his peers, and actually his sister even¼(Parent #1, Focus Group). This mix of small size, adult work and learning experiences, the use of ICT, autonomy, and accountability has engendered high levels of self-esteem in FHS students.

**School Background**

Future High School is a small high school that serves as an alternative to the two other large, comprehensive high schools in Redwood, California. Redwood is a town of about 62,000 people, located about 55 miles north of San Francisco at the base of the Redwood Valley, a famous Agriculture Region. There are 11 teachers on staff---nearly all of whom came from outside of the district--- with five support staff, and a school director.
(principal), a network system administrator, and the schools foundations director. When the school first opened in 1996, a large percentage of the students were from neighboring school districts. In the 2000-01 school year, FHS is mostly filled with students from the local Redwood district, which has priority for enrollment. FHS has a relatively diverse student body population of 240, with the following breakdown: 64% White; 15% Latino; 8% Filipino; 7% African American; 3% Asian; 1% Pacific Islander; and 1% Native American. 48% of the students live outside of the city of Napa, while the others come from nearby towns. There are approximately 120 juniors and 120 seniors attending FHS during the current school year. Students outside of the school district are chosen by lottery.

Future High School receives active support from the surrounding business and civic community. Businesses have contributed greatly to the creation and continuation of the school, through donations of money, time, and technology as well as by opening their offices to students for the schools required internship. In 1999, the Future Foundation was established to fund and support FHS, insuring the continued development of the school into a national model of educational reform. The foundation provides business management services to the staff of FHS, funds the annual refreshment and replacement of equipment (distributing previously used equipment to other schools within the school district), and oversees the effort to replicate FHS classes and market them to other schools in the nation.

Future High School is a college and career preparation program. It has high expectations for its students; 95-98% of them have gone on to continue their education in postsecondary institutions. While 15-20% of FHS graduates go on to receive two years of vocational-technical training in a community college or institute, about half of FHS graduates get accepted to four-year postsecondary institutions. In FHSs first year, student California Test of Basic skills scores were above district average and they have improved with each passing year. Additionally, FHS scores on the Stanford 9 achievement examination are consistently higher than the district and state averages (See Appendix C). The curriculum at FHS is work-based and instruction is interdisciplinary and project-based. The project-based learning using ICT is embedded in the daily instructional activities in all classrooms at the school. As the FHS School Improvement Plan states, Class work is integrated, project-based, and requires students to work as teams to accomplish and present their finished products...(p. 7). Teachers work with students on an individual level, and students collaborate as groups. Parents and students have a voice in the type and quality of work produced, while tutorial support is built into the daily schedule. The schedule is flexible and organized in blocks of two hours, allowing greater teacher-student bonding and more time for in-depth work. A thirty-hour, paid internship is required of all 12th graders in the areas of technology, education, or business. Juniors (11th graders) are required to perform 20 hours of community service with a local non-profit agency or in the high school itself. In addition, the Redwood Valley Community College has been an important linkage for the school from its start; all students must successfully complete 4 community college classes during their two years at Future High School. As a result of the rigorous curriculum, high expectations, and support from teachers and staff, students graduate with strong skills in information technology and problem-solving.

Local region business partners have been involved in Future High School since its inception. The very idea of a secondary preparation program focused on producing well-prepared, technologically proficient graduates originated from meetings between the district administration and local businesses in the Redwood Valley Applied Technology Group. Since its opening, Future High School has had at least 40 business partners who collectively have provided $4.4 million as well as additional services. The partners include national businesses from hardware and software companies who have donated, financed, or cut prices on products and services; local businesses and organizations who provide money or staff time, expertise, and internship sites for students; and financial or other support from politicians and staff from government or other non-profit agencies. In addition, the school has been awarded money from the Bill and Melinda Gates Foundation (described as an education venture capital partner) so they may replicate their education model in 10 sites in northern California. Parents have not been especially involved in the school during the planning phase or during its first five years of operation, but they are highly complimentary of the school and its impact on students.
The Past

The Tech Prep movement appeared to have an indirect effect on the Redwood district leaders who helped to develop what would eventually become Future High School. Tech Prep or vocational-technical education preparation originated as a movement in U.S. education in the early nineties that advocated an important school-to-work transition strategy, helping all students make the connection between school and employment. In 1992, the school district, working with the local business community discussed the need create a school that would help to meet the technology workforce needs in the Redwood area. As a district administrator described those discussions, they (business leaders) were telling me was that they needed entry-level workers who knew what it meant to work on a team, who knew what it meant to take responsibility for their own work, who knew what it meant to improve their skills so they could grow with the companies...(District Administrator). The district then sought curriculum they could use from University of California at Berkeleys National Center for the Study of Vocational Education. They framed the schools mission as preparation for students to be competitive as they enter the work force and vocational education philosophy appeared to some degree to influence the creation of FHS. District administrators were deliberate in making FHS small from the beginning. In addition to providing a new model of schooling to address workforce needs, district administrators viewed FHS as one way to help alleviate overcrowding at the district's two comprehensive high schools. The building, formerly a women's health club and elementary school, was completely renovated to resemble a high-tech work environment. It is important to note that the students who attend this school have average grades and have been placed in an environment that might allow them to thrive; they are not gifted and talented. District administrators believed that the average student in their system was underserved by comprehensive high schools due to the number of programs that targeted high achieving and low achieving students. Keeping the school small would allow them to address the needs of these students and create an environment that would duplicate an authentic work environment. From the beginning, FHS was positioned to have a narrow focus that would uniquely address local needs. Because of the desire to have a high technology program, district personnel felt that it would be difficult to sustain such a program while simultaneously supporting a music and arts program, a foreign language department, and athletic teams. Under the direction of the district board of trustees, FHS was established on the condition that its funding would not siphon additional resources from other districts school programs and that the funding level per pupil would be the same as other large comprehensive schools within the district. In order to accomplish its goals, fundraising for the new school became a major thrust for the district. A range of local service and business organizations contributed generously to provide what was initially needed to open and run the school. High tech companies such as Microsoft, Lotus, and Hewlett Packard donated a variety of equipment and software as well as free labor and technical advice. On opening day, the staff and the students helped to pull cable, set computers, load software, and do what was necessary to put everything in place. This early collaboration served as a harbinger of what the instructional program at FHS would become in the future. In line with the model of a high tech start-up company, district administrators envisioned that project-based learning activities would be best suited to help students at FHS prepare for the work world. FHS students would learn how to manage themselves and their time to create products and provide services to please a particular client. Immersion in the authentic world of work would be facilitated by the requirement for all seniors to work in a paid internship. The influence of the Tech Prep movement that led to the idea of FHS was also infused with a college preparatory emphasis, as students were required to take four community college courses in addition to fulfilling all the district requirements for graduation. Career preparation and college preparation became the twin goals of schooling at FHS. The school director sums up this tension between these goals in this way: ...the more we can get our kids into the real world of work and real world of college, the better we will meet our mission.... All instructional activities were to be tailored in such a way as to simulate authentic, adult work and learning environments. From the beginning, FHS has faced its share of formidable challenges. Just after FHS opened in the fall of 1996, its founding "director" resigned, leaving the new school without a school leader. An assistant principal at one of the comprehensive high schools took over in spite of the challenges he and the school would face in
its first year. One of the challenges faced by the new director was to do fundraising and build relationships with the community. Maintaining a technology infrastructure at FHS required a constant infusion of funds in order to keep things up to date. These fundraising efforts required the director to be off site a great deal during the first few years of the schools existence. Another major challenge faced by FHS for staff at the beginning was the enormous amounts of time they needed to invest at developing curricula that was suited for FHS. At the time there were few transferable models of using project-based learning in schools. The pressure and stress of constant innovation took its toll of a number of teachers who left FHS after a year or two. The fundraising challenges have been addressed by the creation of the New Technology Foundation, which has freed the director from being the primary fundraiser. Although teachers experience a great deal of stress during the first few years of creating curricula from scratch, team teaching has allowed teachers to share the load in creating curricula for their class activities. Additionally, teachers have been given support in the form of professional development activities that have provided them an outline to share what they have learned and to develop new ideas about learning.

FHS has received a number of national and state awards including being the first high school to receive recognition in California's Digital High School Initiative and being a U.S. Department of Education Demonstration site. It has also received funding from the Bill and Melinda Gates Foundation to replicate its curricula and culture in a number of schools in northern California.

The Present

As of the 2000-2001 academic year, enrollment at FHS was 240 students. The instructional philosophy of the FHS remains focused on creating independent learning opportunities for students. ICT continues to play a central role in supporting project-based and problem-based learning activities at FHS. Because the school is small in size, the staff knows the students. They care about students as individuals, and learn what their needs are. The school program is aimed at the average C student, who they hope to better prepare to enter a rapidly changing world and workforce by ensuring they have some technical skills, some teamwork and project skills, and a successful experience in taking community college courses. This vision for teaching and learning is described by FHS staff as school to career preparation. The project- and problem-based learning is used as a way to give students relevant academic work in a format they might encounter in a high-tech start-up business. According to staff, students experience what it is like to be in a business, meaning the students (workers) have projects (academic work) consisting of complex tasks with long-range due dates for which they have individual and shared responsibility. To further create the student-as-adult-worker atmosphere, the students do not have to have hall passes to leave the school during the day. FHS is an open campus, simulating a business work environment.

A fully developed system of learning outcomes has been articulated for FHS students, outlining the knowledge and skills necessary to fulfill school and district graduate requirements. These learning outcomes are:

- Technology Literacy
- Citizenship and Ethics
- Critical Thinking
- Career Preparation
- Collaboration
- Written Communication
- Oral Communication
- Curricular Literacy

These learning outcomes must be demonstrated and documented through the completion of an electronic portfolio that is evaluated by teachers and a review panel from the community. Each outcome has a rubric that lays out the various components of the work being completed as well as assigns a score or level of competence based on clearly articulated criteria. Students at FHS are regularly involved in a range of self-assessment and peer assessment activities examining these learning outcomes.

The principal at FHS is called director", in keeping with the notion of the school as a high-tech start-up business. The staff all spoke highly of the director, who has been there since midway through the first year of the schools operation. They described him as a visionary, who makes efforts to check in with staff regularly to find out what their needs are, works to communicate the schools goals and his expectations, and to keep
them happy and feeling emotionally and physically safe, so they can continue to work hard as innovators. As one teacher put it, Yeah, I find that he is very empowering, just the position, were very fortunate, but I think you would need somebody who empowers teachers, which I think that our current director does, but also, you know, he doesnt just say yes, hell give you hand, Id like to try this... (Teacher #3, Focus Group). The director identified his most important qualities as a being a leader who has the ability to embrace change, to trust people, and his commitment to respectfully communicate with his staff. The energy and focus he brings to the job is palpable; he is passionate about what he does and the teaching staff members recognize this. The relatively small school staff allows him to keep the organization hierarchy rather flat; the entire staff meets once a week for two hours to discuss the issues at hand. Through the use of the Lotus software, teachers can plan appointments with him, communicate via email, compile agendas for weekly meetings, and obtain student information. He clearly is out in the classrooms and halls with the students, where he always greets passing students by name. The school has a robust technology infrastructure with approximately 250 computers. There are four different kinds of computers of various ages and capabilities. The newest ones are dedicated to the multimedia design classroom. FHS has recently passed on their oldest computers to another school so they now are all faster than 166 MHz. In addition, they have 10 laptops that they can check out to students overnight, with a parent permission slip. Parents have access to all student information via the Internet. All the computers are on the network, which provides them access to the Internet and to the schools servers, where much class information and databases are stored. The network also provides access to two large capacity printers, which are located in the hallways for shared access. All staff members have access to student, course, and school information through Lotus Notes software. Students also have email accounts and access to a course database that allows students to retrieve course syllabi, assignments, rubrics, and other instructional resources. The software is standard across the school (i.e. all teachers use the same word processor) but not all computers have all the software on it. For example, the Adobe image-processing software is mainly on the fastest computers used in the New Media classroom. The network administrator stated that Windows NT and Windows 2000 are the main products that are common to all computers. She appreciated their built-in security features, which she thought deterred some students mischief-making. In addition, in the Tech Management class that she teaches, students can research new software and report on it in an assignment. This brings in new information for the school about helpful software. Technical support there is a full-time job for the network administrator in this small school because she has over 250 computers to support. She utilizes students from her Tech Management class to assist her in maintaining all computers and the network. The district also has an IT manager and some support staff. She explained their staffing to be at a higher level than a comparably sized school but that it was because they had so much more hardware. She also indicated that when necessary, she could get additional help from consultants.

**Hypotheses**

**Hypothesis 1:**

Technology is a strong catalyst for educational reform, especially when the World Wide Web is involved. The rival hypothesis is that where true reform is found, technology served only as an additional resource and not as a catalyst, that the forces that drove the reform also drove the application of technology to specific educational problems.

**Evidence in support of the rival hypothesis:**

Although technology plays a central role in supporting school reform and classroom innovation at FHS, teacher respondents, in general, described technologys influence in project based learning as more of a tool or resource than a catalyst. One teacher described the utility of technology for research purposes: But on a different level, the immediacy of research in that they can browse 12, 13 web sites to answer one question in a space of 15 minutes. Whereas we would need a library the size of all of Redwood and hours and hours of time for them to generate that much research in such a short window. So to me its an invaluable tool... (Teacher
#1, Focus Group). Another teacher, describing a software tool (Tegrity) that provides digital web video on demand to students, explained, I think it meets a variety of learning styles and I couldn't do that in the traditional classroom, but it's wonderful. I have kids, you know, begging me, hey Smith, you know, we need you to put that Tegrity lesson up because they go home and they can access these materials from home. It helps them access the material to decode their textbook to get through the lessons and it's a wonderful, wonderful tool... (Teacher #2, Focus Group). Another teacher highlighted technology's leveraging role in the project-based learning activities by saying, I guess when you look at the broader projects that happen in all of our courses, I think those could happen in another setting with less technology, but I think the presence of technology makes us more efficient, and makes our students more efficient learners... (Teacher #3, Focus Group). Technology also helps to promote greater student autonomy and responsibility according another teacher. She sums it up like this: I like the fact that there is more responsibility placed on the student. And that everything is on the web so they can access it here, they can access it at home, they can access it after school instead of saying, well, I wasn't there, wheres that paper, heres this paper, I lost this paper, can I have another one?...

School improvement for FHS involves creating a unique culture and mission around schooling that is facilitated by maintaining a small school and allowing it the freedom to function differently from a traditional high school. One of the distinctive aspects of their instructional approach is to provide content instruction using projects designed to address particular issues. Teachers at FHS organize stimulating and relevant learning activities for students designed to address important learning outcomes in a fashion not seen in most high schools. Technology was not the catalyst for this kind of reform; it is an important resource that helps students to engage in learning. The director of FHS characterized it this way as he contrasted the mission of schooling at FHS with the experience of education in a comprehensive high school:

Catapulting us is our mission, to prepare people for a rapidly changing world. And that [comprehensive] school back there does not prepare people for a rapidly changing world. It doesn't make them collaborative people, it doesn't make them necessarily think critically, and problem solve. It certainly isn't full of technology skills. There's not a whole lot of investigating what your talents are, and how you should apply those to where you want to be. It's a one size fits all model that I think inhibits our ability to fulfill our mission. So pushing us is the promise of something better. And pushing us is the reality of an information revolution that has changed all the rules of how we educate; kids know more about this stuff than we do and we have to give that up...

(Principal)

The founding principles of having a small school that operates different from a traditional high school have shaped the direction that FHS has undertaken since its inception and have created a new culture of schooling where technology can be used in authentic, project-based learning activities. The FHS learning goals and the activities surrounding project-based instruction at FHS allow technology to be utilized as a creative and productive resource in learning.

**Hypothesis 2.**

The diffusion of the reform (and therefore, of ICT) followed the traditional diffusion pattern for reforms and innovations, as outlined by Rogers (1995). The rival hypothesis is that technology functions differently from traditional innovations and reform, and that, therefore, different diffusion patterns occur.

**Evidence in support of the rival hypothesis:**

During a four year planning process, FHS opened with a handpicked staff from outside of the school district. The teaching staff from the beginning adopted the philosophy of using projects and posing problems that needed to be solved. They all worked together during the summer before the school opened to develop curricula and define how they would use projects in their instruction. Because the school had the stated purpose of preparing students to compete in the information age, the use of technology was to play a central role in instruction and all FHS teachers use technology in the projects they organize for their students. One might predict that only a few of the teachers at FHS were early adopters of ICT and project-based learning. From all indications, project-based learning at FHS did not neatly fit into a traditional diffusion pattern. Every
staff member who came to FHS was reform-minded and wanted to become a part of a learning community with established norms and values. As one teacher put it, ...the type of people you get here are the people that want to do all these things and change, and do a lot of things... (Teacher #1, Focus Group). Although teachers and students play a role in shaping the culture of FHS, many of its basic values had already been put into place from the beginning and are maintained by strong leadership and group beliefs and values focused on a common mission and identity. In such a small staff, it is unlikely that dissenters would remain in such a focused environment.

Operating a small high school with such a clearly stated mission permits the luxury of having everyone participating in school improvement activities with the same intensity and commitment. Adherence to basic norms and pursuing a single focus has been achieved by crafting a clear, targeted mission statement. In addition to a clear mission, FHS has a charismatic leader who has seen school improvement change implemented by a teachers from the beginning. The director summed up his and the staff commitment to their students by saying, I'm very passionate and so is the rest of the staff about making sure that our graduates have a leg up, are more competitive, are more likely to excel than people graduating from other schools, even with ten AP courses on their transcript. They don't have a college experience, they don't have a digital portfolio. They don't have a proven opportunity to solve a problem, a real world problem, and deliver something at the other end that I think is just going to put our kids in a very favorable position...(Principal)

Hypothesis 3:

Successful implementation of ICT depends mostly upon staff competence in the integration of ICT into instruction and learning. This hypothesis assumes that teachers mediate ICT applications when they are successful, and that ICTs academic value relates positively to teacher competence. The rival hypothesis is that the school technological infrastructure and student ICT competence rather than staff competence determine ICT implementation outcomes.

Evidence in support of hypothesis 3:

Teachers at FHS view ICT as one of many tools that can be useful in supporting problem-based project learning. Students are given access to a wide array of ICT resources that they must utilize in order to complete their projects and create the products that are required of them. Much of what students learn about ICT use comes from the teachers themselves. One student characterized what he had learned from his first year teacher at FHS:

You have access to your e-mail through, you know, through the web, this e-mail through the web. Also usually students have their own e-mail, so I think it helps a lot. Also with researching, I mean, just your being able to use different CD ROMs and searching the web, being able to learn how to search the web, we were taught that last year, right, by ----. She taught us where to look for the good information, you know, like is it .com, .EDU, .org, you know, what type of dot something is best for getting your information. That really helps... (Student #5, Focus Group)

All teachers have their course syllabi, assignments, assessment rubrics on-line with a variety of additional learning resources that students must consult and utilize daily. Lotus Notes provides students and staff with access to electronic mail, grades, schedules, and on-line portfolios. A wide range of application software is also available on each computer at FHS and the teaching staff plans and sequences activities so that students can make the best use of ICT in order to do their work individually and as a group. Due to the small size of the teaching staff, teachers at FHS regularly share their expertise with one another in small groups or in one-on-one sessions together. A combination of informal and formal professional development activities allow them to stay up-to-date on new software applications as well as ways to integrate ICT resources into their own instruction. One teacher described how he and his peers at FHS have developed competence in integrating ICT: My use of technology really comes as a practitioner and a user of it myself, you know, in working with my colleagues like ----here whos helped me out tremendously, implementing technology into my lesson
designs. But mainly on the job, you know, Tech High has done a good job mentoring me. But there's not a magic class out there that's teaching us these wonderful tools that were using... (Teacher #2, Focus Group). Teachers at FHS share a strong commitment to their profession and their ability to integrate technology into their instruction. As such, teacher competence to integrate technology into instruction appears to play a pivotal role in the success of ICT use at FHS.

**Evidence in support of the rival Hypothesis.**

In addition to a professionally competent staff, FHS has an extensive and reliable ICT infrastructure that permits students and teachers to actually implement technology-enhanced instruction. The school has approximately 250 computers. There are four different kinds, of various ages and capabilities with the newest ones dedicated to the New Media classroom. All the computers are on local area network, which provides them access to the Internet and to the schools servers, where much class information and databases are stored. The network also provides access to two large capacity printers, which are located in the hallways for shared, public access. A full-time network administrator maintains the schools ICT resources, utilizing a class of trained students to assist her performing a wide range of tasks.

Students come to FHS because they or their parents choose to do so. They come with a certain level of exposure and competence in using ICT. The vast majority of students have home access to a computer and the Internet. In effect, many students self-select to enroll at FHS with the knowledge that they will be using technology and that there will be high expectations for learning. One first year FHS student put it this way: A lot of the time it's because you choose to come here. I mean, I know there are some people who their parents have made them come, but a lot of the times the reason why people come here is because they want to. When you do projects and different things like that, its made very clear off the bat, like when you first come into this school, what the teachers' expectations of you are, and that you're held accountable for anything and everything that you do. You're treated like an adult, so if you do something that is unacceptable, you will be held accountable for that... (Student #1, Focus Group)

**Hypothesis 4:**

Gaps in academic performance between high and low poverty students will not increase when all students have equal access to ICT. The rival hypothesis is that equal access to ICT will lead to more advantaged students increasing the performance gap with disadvantaged (high poverty) students.

**Evidence in support of hypothesis 4.**

ICT resources at FHS are plentiful. With a 1:1 student-computer ratio, access at school is universal. Equipment is replaced and recycled (with funding from the Future High School Foundation) on a regular basis. Ninety-nine percent of FHS students have computers at home with Internet access. FHS have 10 laptop computers that can be checked out by students who don't own a computer at home. With such broad access, teachers at FHS reported that students from high and low poverty backgrounds perform equally well in academic subjects. The schools standardized test scores appear to bear this out although there are no comparative analyses examining differences between high and low poverty students (See Appendix C). However, ICT access is only one part of the picture at FHS. The school culture has had an effect on student performance. Only students with average grades enter FHS, providing all students an opportunity to compete with others students with similar academic backgrounds. Schooling at FHS provides students with authentic learning experiences in the context of a safe, learning community. All students are held to high standards and are required to meet a number of exacting requirements before graduating. In addition to meeting the district requirements for graduation, all FHS students must complete FHS standards in community service, internship, community college courses, and technology (software applications and multimedia design). Students are accorded respect and given a great deal of autonomy. They are also provided with opportunities to work collaboratively with others on a number of project teams. These elements of school culture have created a special environment at FHS where academic achievement is valued and sought after by all students, even
those who had no record of previous high achievement. Here is what a teacher from a focus group said about how FHS shapes student performance:
And one of the things that I noticed with last years juniors, and again this year, is kids that are just finally free to be who they are. Some of them decide to sort of say this is the year I'm going to break out of that reputation I've had of being a slacker since kindergarten. Because Redwood in this general geographic area is pretty stable, so a lot of them have been going to school with the same kids since they were five or eight years old. And they come here and they have a choice for who they want to be and, you know, some kids that come in with learning disabilities, that have been, you know, pegged and haunted from the time they were little, come here and nobody even knows, nobody has any preconceptions about them. And that, to me, I mean, I can't think of a day that goes by at the school when I don't say, you know, if only for that kid, I'm glad this school exists, because you just don't want to imagine what their lives would be like if they were back... (Teacher #1, Focus Group)

Equal access to ICT certainly plays a role in decreasing the performance gap between high and low poverty. ICT, combined with supportive environment and demanding expectations, may help to account for the high student performance at FHS among those from different socio-economic backgrounds.

**Hypothesis 5:**

Successful implementation of ICT will lead to the same or higher academic standards in spite of the low quality of many ICT materials. Academic standards are a function of teacher and school expectations and not of the standards of textbooks, ICT materials, and the like. The alternative hypothesis is that ICT use will lead to a lowering of academic standards as students spend more time on marginally beneficial searches and in browsing poor quality web and courseware content.

**Evidence in support of Hypothesis 5.**

The FHS case provides a solid example of how ICT and an instructional philosophy using projects influences learning expectations of the school. FHS demands that students become active participants in learning through interdisciplinary, project-based learning activities. Students are required to use rubrics that help them evaluate themselves and their peers work. Students must pass proficiencies examinations in using software applications and multi media design. Students are given a great deal of responsibility to monitor and control their own learning. FHS learning outcomes, articulated by the mission statement and reinforced by the director and the teaching staff, require students to meet high expectations for academic performance. ICT resources at FHS are seen as a tool to enhance student-learning experiences and, as a teacher noted, "the technology here allows them to be aggressive in terms of getting the information and digesting the information..." (Teacher #3, Focus Group). Students new to FHS recognize these higher expectations, especially as they contrast them to those of a previous school. One student summarized it like this: "At my old school, the kids there, they didn't really want to work that much. Like here, like, everyone's been saying, you choose to come to this school. You don't have to come here because it's, like, in your district. So here, the kids here, they want to learn and they want to, like, dedicate their work and all that. So that motivates you also to want to work..." (Student #3, Focus Group). Students at FHS can sense that they are in a different environment that has an effect on governing what they do.
The mix of project-based learning and using ICT has elevated learning expectations at FHS, confirming hypothesis #5.

**Projection to the Future**

The reform of project-based learning appears to be sustainable because of the structure and organization of FHS. Because FHS has a unique market niche, it is likely that their model of schooling will be sustained because there few schools offering such a focus. FHS has also intentionally organized itself to be a small, personalized learning community that targets what it believes is a traditionally underserved population in their school system: the average student. Maintaining a small school environment is a key to their future
sustainability. As one teacher noted, And my concern is if they double us in size, the whole model will collapse because of that... (Teacher #1, Focus Group). However, the size and structure of FHS has important implications for transferability. It is unlikely that most school districts would be unable to find the resources to create smaller high schools that offer the kinds of instructional and learning opportunities that FHS has. Creating more small schools, though appealing, is not a realistic option for most school districts that are trying to cope with increasing student populations and limited funding.

Another issue affecting the long-term sustainability and the transferability of the FHS model is the burnout factor. The director and the teachers were candid about the extra hours and hard work it took for teachers to perform their tasks at FHS. Several teachers noted that a number of teachers had left FHS due to burnout. In fact, the director, in using the high-tech metaphor, believes that burnout is a natural result of intensive innovation: It was a burnout model without doubt, but I dont think that that should be a surprise to anybody. Were modeled after a high tech start up. And if you really look at a high tech start up, theres three cycles to it, and its built on burnout... (Principal). If burnout occurs regularly, it is unlikely that schools can continue to find enough teachers, especially in the current climate of teacher shortages in most U.S. states.

One of the ways FHS has addressed burnout is to find outside funding resources that provide merit pay to their teaching staff. While the investment of time is great, teachers at FHS are committed to instructional innovation; they all utilize collaborative projects that allow students to grapple with engaging subject area content to address a real world problem. They work among themselves to learn new techniques and to continue their own learning and innovation. And, now with the support of the New Technology Foundation, extra finances have been raised to reward the teaching staff and the director to do what they do best. With a grant from the Bill and Melinda Gates Foundation, the New Technology Foundation has paved the way to support FHS as it seeks to replicate its model within the state and throughout the country. School district leaders have given FHSs special status as a result of special negotiations with the teachers union that allow FHS teachers to receive merit pay.

Another factor that affects the long-term sustainability and transferability of the innovations developed at FHS is the presence of a charismatic leader. The directors involvement in leading and supporting innovation at FHS has brought positive results. He is universally admired and respected by staff and students alike. He is committed to seeing project-based learning prepare FHS students for university work as well as a career of work. He is willing to fight battles with the school district in order to keep FHS on the cutting edge of school reform. Given the support provided by the school district and the foundation, a stable human and administrative infrastructure that would continue on even if the director were to leave. However, replicating charismatic leaders is not a predictable venture. Transferring the FHS model does not guarantee that one would find the kind of school leader capable of leading such an ambitious reform effort. The presence or absence of a gifted school leader constitutes a major constraint in transferring the FHS model to another setting.

**Appendix A: Methods**

**Description of the amounts and types of data collected**

**INTERVIEWS CONDUCTED**

With teachers (approximately 45-60 minutes each)

- Teacher focus group
- One science teacher
- One media teacher
- One internship coordinator
- One government teacher

With parents (approximately 45 minutes)

- Parent focus group
With students (approximately 45-60 minutes)
- One intern and interns supervisor
- Student focus group
- One alumnus

With building administrators (approximately 45-60 minutes)
- Administrative assistant
- Counselor
- Network administrator
- Schools director

With other administrators (approximately 45-60 minutes)
- Community College administrator
- Foundation director

OBSERVATIONS CONDUCTED
All are videotaped

Of school (approximately 45-60 minutes each)
- Tour of school
- Students at computers
- Student work on computers
- Political Studies (four tapes)
- New Media class
- Science Studies

Appendix B  Teacher ICT Practices Survey Results

Site 200 N=9 Teachers (of 11 teachers)

<table>
<thead>
<tr>
<th>How comfortable are you with using a computer to:</th>
<th>very comfortable</th>
<th>comfortable</th>
<th>somewhat comfortable</th>
<th>not comfortable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write a paper</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Create, maintain web pages</td>
<td>44%</td>
<td>33%</td>
<td>0%</td>
<td>22%</td>
</tr>
<tr>
<td>Send &amp; receive e-mail</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Programming</td>
<td>11%</td>
<td>11%</td>
<td>11%</td>
<td>67%</td>
</tr>
<tr>
<td>Draw picture or diagram</td>
<td>78%</td>
<td>11%</td>
<td>11%</td>
<td>0%</td>
</tr>
<tr>
<td>Present information</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
For work you assigned last year, how often did your students:

<table>
<thead>
<tr>
<th></th>
<th>1+ times weekly</th>
<th>1+ times monthly</th>
<th>a few times</th>
<th>never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use WWW</td>
<td>78%</td>
<td>22%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Create web pages</td>
<td>0%</td>
<td>44%</td>
<td>44%</td>
<td>11%</td>
</tr>
<tr>
<td>Send &amp; receive e-mail</td>
<td>89%</td>
<td>0%</td>
<td>11%</td>
<td>0%</td>
</tr>
<tr>
<td>Use word processing</td>
<td>78%</td>
<td>22%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Use computer for games</td>
<td>13%</td>
<td>13%</td>
<td>63%</td>
<td>13%</td>
</tr>
<tr>
<td>Use a graphics program</td>
<td>33%</td>
<td>44%</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Join on-line forum or chat</td>
<td>33%</td>
<td>22%</td>
<td>0%</td>
<td>44%</td>
</tr>
<tr>
<td>Use presentation program</td>
<td>33%</td>
<td>56%</td>
<td>11%</td>
<td>0%</td>
</tr>
<tr>
<td>Use instructional program</td>
<td>11%</td>
<td>44%</td>
<td>22%</td>
<td>22%</td>
</tr>
</tbody>
</table>

Rate your ability to use a compute

<table>
<thead>
<tr>
<th>Ability to use compute</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>good</td>
<td>100%</td>
</tr>
</tbody>
</table>

Experiences last year

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graded student computer use</td>
<td>88%</td>
<td>13%</td>
</tr>
<tr>
<td>Made Web site for my class(es)</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>Involved in virtual, on-line course</td>
<td>38%</td>
<td>63%</td>
</tr>
<tr>
<td>Students collaborated via Web</td>
<td>13%</td>
<td>88%</td>
</tr>
</tbody>
</table>

How much freedom did you allow students in locating WWW sites to visit?

<table>
<thead>
<tr>
<th>Students' web restrictions</th>
<th>no restrictions</th>
<th>some restriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>%</td>
<td>88%</td>
<td>13%</td>
</tr>
</tbody>
</table>
Appendix C

Site Documents Collected
- Redwood Valley Unified School District character traits
- Semester 1 weekly agendas for Political Studies
- Weekly agenda for Political Studies, with assignments
- Political Studies presidential election assignment
- Political Studies topic agenda
- Introduction to Political Studies New Economy project
- Analysis of the Old Economy for New Economy project
- Your Role in the New Economy
- Web design overview of New Economy student project
- Death of a Salesman article to which students are to respond for New Economy project
- Rubric for Death of a Salesman final essay
- New Economy rubric
- Political Studies chapter bookwork
- New Media Design stamp series
- Future High School parent interest survey
- Future High School online resources and links, from website
- Future High School SAT and PSAT scores, post-high school preparation, and graduation requirements
- Future High School Overview document
- Future High School School Improvement Plan
- Future High School directory
- Future High School Staff Handbook  Mission/Vision
- Future High School Staff Handbook  FHS Learning Outcomes
- Future High School Graduation Portfolio guidelines rubric
- ESLR Technology Literacy
### Table B

<table>
<thead>
<tr>
<th>Date Grade Level &amp; Content Areas Tested</th>
<th>State Percent of Students Scoring At or Above the 50th Percentile</th>
<th>Redwood Valley Unified School District Percent of Students Scoring At or Above the 50th Percentile</th>
<th>Future High School Percent of Students Scoring At or Above the 50th Percentile</th>
<th>Overall State Ranking*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spring 1999 Grade Level (92% tested)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading 9th</td>
<td>34%</td>
<td>33%</td>
<td>35%</td>
<td>41%</td>
</tr>
<tr>
<td>Math 9th</td>
<td>48%</td>
<td>44%</td>
<td>45%</td>
<td>56%</td>
</tr>
<tr>
<td>Language 9th</td>
<td>49%</td>
<td>38%</td>
<td>47%</td>
<td>52%</td>
</tr>
<tr>
<td>Science 9th</td>
<td>40%</td>
<td>45%</td>
<td>42%</td>
<td>45%</td>
</tr>
<tr>
<td>Soc. Science 9th</td>
<td>44%</td>
<td>37%</td>
<td>57%</td>
<td>44%</td>
</tr>
<tr>
<td><strong>Spring 1998 Grade Level (96% tested)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading 9th</td>
<td>34%</td>
<td>32%</td>
<td>36%</td>
<td>49%</td>
</tr>
<tr>
<td>Math 9th</td>
<td>47%</td>
<td>41%</td>
<td>43%</td>
<td>56%</td>
</tr>
<tr>
<td>Language 9th</td>
<td>48%</td>
<td>37%</td>
<td>45%</td>
<td>60%</td>
</tr>
<tr>
<td>Science 9th</td>
<td>39%</td>
<td>44%</td>
<td>41%</td>
<td>47%</td>
</tr>
<tr>
<td>Soc. Science 9th</td>
<td>44%</td>
<td>38%</td>
<td>57%</td>
<td>52%</td>
</tr>
</tbody>
</table>

*Because Future High School is an alternative school, their Academic Performance Index (API) or State ranking will not be available until July, 2000. This is clearly stated in the following text pulled directly from*
the California Department of Educations Website. The following schools do not have an API score for 1999: Those with fewer than 100 students with valid SAT-9 test scores; Those with fewer than 65% of students tested in a subject; and, County-administered, community day, alternative, continuation, and independent study schools. July 1, 2000 is the target date to develop an alternative method of accountability for these schools. Future High School is an alternative school and therefore will receive their state ranking index (API) in July.

FHS serves only 11th and 12th graders and the STAR program assesses only up to 11th grade. Therefore, 9th and 10th grade data are not applicable to FHS. It is clear from the performance of the 11th graders at FHS that they eclipse both the state and district in their high and impressive academic achievement scores. Although not reported here, the CTBS scores from FHSs first year of operation also eclipsed the state and district.

Because the school has only been in operation for two years, we can only look at the data that exist for those first two years. So far, the school has exceeded every hope of a successfully reformed school, evidencing scores far higher than the district and state.

Redwood, California

Start-up ventures launched by 20-something business moguls are yesterdays news. Students at a small school in Redwood Valley are redefining the concept of young entrepreneur. Teenagers are developing companies and operating as CEOs before they even graduate from high school.

Future High was launched in September 1996 to prepare students to compete in an advanced, technology-based society. Using business-operating principles in a state-of-the-art computing environment, they get a classic high school education in a new millennial setting.

They call it the school that business built, says Mark Riller, the Mountain View-based Hewlett-Packard sales representative who dedicated two years to help build the infrastructure for the technologically advanced high school.

Essentially, IBM and HP were invited to bid on the first 125 computers, reports the director of Future High School. Hewlett-Packard won the bid because of its technology and because it was willing to work with us to break the mold of education. Its a showcase for any business not just education, Mark Riller says. At Hewlett-Packard, we didnt have a focus on the education market at the time, but everyone came to bat. More than 50 division people during pre- and post-sales and installation came up to the school. Throughout the process, we were very creative and gave Future High School a lot of ideas on setting up the network.

Its designed to look exactly like a start-up company, Mark adds. They have departments and each student has his or her own PC. In the center of the school is a glass room with highly visible switchers, hubs and servers. You can actually see how it all works, but it looks great. Silicon Graphics designed it to look like a modem office setting.
Were creating an environment that has the same access to information that the real world uses and integrating that with an educational program, says Paul Accampo, the San Francisco-based HP network specialist who designed the schools computing environment. Thats the critical difference. Its a lot different than a high school simply saying We need computers and then continuing to operate in the same old ways.

HP got it, says Future High Schools director of external relations. It knew what we were trying to create and signed on early to support it. Large numbers of HP representatives came to offer advice, design the network and walk with us every step of the way. The technology is central to the way the students operate on a minute-by-minute basis. We cant afford to be down ever so we need top-tier equipment.
The state-of-the-art network designed by HP and configured by CompuCom originally included the HP NetServer LX Pro and LH systems, 145 HP Vectra VL PCs, HP LaserJet and DeskJet printers, HP ScanJet scanners and HP AdvanceStack hubs and switches.

HP truly has a showcase installation with eight product lines coming together to provide a complete solution for Future High, says Norm MacDonald, CCO Small Medium Business Web site manager. Education is becoming a priority market for many of our product lines and this school is an excellent demonstration of what could be a lucrative and rewarding business for us.

Providing a launching pad to propel students to top-flight colleges and high-tech careers wasn't the only idea behind the development of the information age high school.

Local Redwood Valley business leaders need a dynamic new workforce, says the director of Future High School. They want to expand and diversify the economy beyond wine and tourism. And existing businesses want to increase their productivity. With the growth of the economy at stake, local businesses are integrally involved in the development and continued success of the school. They provide grants for technology and technical support, develop software applications that match up with the academic needs of the school and provide internships for all of the students.

The dog ate my homework would never fly at this school. Assignments given and conducted via the network are fairly inedible. Besides, students at the avant-garde school are highly motivated to actually do the work.

The way the students operate is similar to fast-track employees at a well-run company. Strategic plans, storyboards, critical analysis of product and process and multimedia presentations are all part of the learning process.

Our environment is like an office. Every student gets assignments, takes notes and conducts research on the Internet. They even get their grades online.

Additionally, the students are getting infrastructure, Paul says. If they have to do a paper on Abraham Lincoln, the assignment will be to research information using the Web. The point is not to write a paper but to deliver a presentation using PowerPoint. Its just the way a business would research a topic and present it. Suddenly, you've got kids learning how to deliver a presentation using the same media that we do, and yet the topic is history.

As you're learning details about the Industrial Revolution, you can be as creative and in-depth as you want,
says one student who is entering her senior year. And students give you feedback. They might say, That PowerPoint slide doesn't work. It should be eye-catching but not distracting or disruptive. And the colors should be neutral. Its a challenge to present it well. Ive learned to speak with confidence. And I try to get the audience really into it.

Technology is the future, the student says. You can start off as a senior, making $45,000 if you're technically proficient. She runs a small but profitable Web design business in her spare time.

Providing a smooth segue so students could move into Information Age jobs and careers upon graduation may have been the original idea. But Future High School now also serves as a place for students to make a contribution as part-time employees with local businesses while they're still in school.

Local businesses wanted students to be prepared to use technology, manage their time well and be dependable and productive, says Future High Schools Director. They had some pretty basic criteria. Our students far exceeded expectations.

While another student was in his senior year, a local Internet service provider (ISP) hired him to run its IT department for $30,000 in a part-time job.

Tipper Gore (the wife of U.S. Vice President Al Gore) is among the 2,000 people a year who have toured the school, the Director says. She uses it as a model to show what education can and should be.

The technology is the scaffolding. Were giving students skills for the highest-wage jobs available, the Director adds. They're trained in the latest technologies such as designing and deploying secure money-gathering Web sites. But they're also learning all the leadership traits they need to excel. We give them interpersonal and business skills that allow them to work with people, manage their time, solve problems and market themselves.

Whether its being a software developer in the south of France or going to the best college in the United States, were preparing students to do absolutely anything they want to do. They get very excited about their futures. M

(Karen OLeary is a free-lance writer. Editor)

Page TWO

BOTTOM Teen tycoons generate serious cash flow—the CEO of the schools student-founded business, Dynamic Designs. Graphic design and Web-site hosting and design for local businesses are among its money-making ventures). Overseeing 13 students, he already has management savvy. To motivate people, you have to tie into what theyre really excited about. He and his team learn sales, marketing, billing and managing tips from local business leaders. The schools latest endeavor is a raffle for a luxury car and a weekend in Redwood Valley that Chris expects will create a sizable cash flow every semester.

TOP Each Future High School classroom is a modern office setting, where students (left photo seated right) research the Internet to help complete school assignments. Miles of networking cables circling the walls, feeding to the many visible network cradles (lower photo) and joining at hubs (below) connect the school.

PAGE THREE

TOP Making the most of their time and talent through technology, students of Future High School also ace on business and interpersonal skills.

BOTTOM Students learn early that if you can dream it, you can achieve it Project-based learning is great,
reports a student, left). We work in teams on everything and everyone does their part. She excels in American Studies using PowerPoint software. Students are graded on collaboration, technology literacy, curriculum and oral and written communication. In this environment, you learn that you can make anything happen, says another student (right). We have the drive, and the school provides the technology and the support we need to achieve whatever we set out to do. Besides co-founding a Web site business, she launched a debate club.