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Technology and School Reform:
A View from Both Sides of the Tracks

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Abstract

A discourse of reform claims that schools must be transformed to take full advantage of computers, while a competing discourse of inequality warns that technology-enhanced reform is taking place only in wealthy schools, dooming poor and minority students to the wrong side of a digital divide. A qualitative study at an elite private school and an impoverished public school explored the relationship between technology, reform, and equality. The reforms introduced at the two schools appeared similar, but underlying differences in resources and expectations served to reinforce patterns by which the two schools channel students into different social futures.

As educators cope with the task of integrating information technology into the schools, two main discourses have appeared: the discourse of reform and the discourse of inequality. The discourse of reform suggests that schools must transform themselves in order to make effective use of computers. As an educator in Hawai'i (Note 1) commented,

The analogy that I have to give is that there is television and there is radio

and there is in person. And you would never take a radio program and try to put it on television and expect it to work without modifying for the media. And what we've done is we've taken education curriculum that is a person-to-person curriculum and tried to put it on this medium called the Internet and that doesn't work. And so one of the things we're doing...is trying to work with teachers and with students to say, "What is the appropriate use of the Internet" you know, if it's not to just recreate school as we think school is, how do you do it?

The discourse of reform draws on research from both education (e.g., Cuban, 1986; Sandholtz, Ringstaff, & Dwyer, 1997; Warschauer, 1998, 1999) and industry (e.g., Kling & Zmuidzinas, 1994; Zuboff, 1988) demonstrating that the infusion of new technologies produces little results if underlying relations do not change. The root of the problem is seen in the mismatch between industrial models of schooling and post-industrial organization of society (Cummins & Sayers, 1990; Hodas, 1993; Lemke, 1998); the solution is seen not just in the diffusion of technology in the schools, but rather through creating new models of interactive, autonomous, student-centered learning which allow students to use technology in a process of critical collaborative inquiry (Cummins & Sayers, 1995). As Sandholtz, Ringstaff, and Dwyer (1997) explain, "the benefits of technology integration are best realized when learning is not just the process of transferring facts from one person to another, but when the teacher's goal is to empower students as thinkers and problem solvers" (p. 176).

Though the model of a learner-centered environment is not new, it is believed that technology provides the impetus which will finally allow this dream to be realized. According to one optimistic (but not atypical) prediction, the introduction of more computers in the schools will help bring about eight major shifts in education, including changes from "whole class to small group instruction," "from lecture and recitation to coaching", "from a competitive to a cooperative social structure", and "from all students learning the same things to different students learning different things" (Starr, 1996, n.p.)

While the discourse of reform is hopeful, the discourse of inequality is troubling. From this perspective, increased use of technology in the schools is bound to heighten distinctions among students based on class, language, and race. As a teacher in Hawai'i explained,

The problem that I see with this change is it's going to create two classes of schools: those schools that can afford the technology and those schools cannot afford the technology. And the rich schools will get richer and we're going to create a greater divergence between our best educated students and our poorest educated students. You cannot change it now. It's out of the box, and it's just going to get bigger and bigger and bigger.

The discourse of inequality draws on its own body of research demonstrating that low-income and minority students either have less access to new technologies or are more likely to use them for rote learning activities rather than for cognitively demanding activity (Market Data Retrieval, 1997; Novak, Hoffman, & Project 2000 Vanderbilt University, 1998; Wenglinsky, 1998) Inequality falls in at least three areas:

- Home access: Wealthy families are seven times as likely as poor families to own a

home computer, and white families are more than twice as likely as Black families to own one. The percentage gap in both of these areas increased from 1994-1997. Black and Hispanic families trail (non-Hispanic) white families in computer ownership by a substantial margin even within the same income groups(Novak, et al., 1998).

- School access: More than 78% of public schools in low- poverty communities had Internet access in 1997 compared to less than 59% of public schools in communities with high poverty rates. And public schools with over 50% minority enrollments had an average of 8.4 students per computer, while schools with fewer than 5% minority enrollment had 6.6 computers per student (Market Data Retrieval, 1997).
- Use within schools: African-American students and Hispanic students are more likely to use computers for drill and practice, whereas white and Asian students are more likely to use them for simulations or applications; the same differences appear between poor students and wealthier students (Wenglinsky, 1998).

Putting the discourses of reform and inequality together, two scenarios emerge. The dream scenario is that the information age will help bring about the kinds of educational change that reformers have pushed for all century, with schools becoming sites of critical collaborative inquiry and autonomous constructivist learning as individuals and groups work with new technologies to solve authentic problems under the guidance of a facilitative teacher (see, for example, Lemke, 1998). The nightmare scenario is that this type of educational transformation will occur only in elite private schools and in some upper-middle class suburbs, with the urban and rural poor attending schools that either lack computers or use them in the most traditional and ineffective ways.

The truth of course will probably lie somewhere in-between. Not all wealthy schools will use computers well, and not all poorer schools will use them badly. Nevertheless, there are a number of factors that make the nightmare scenario all too likely, including the depth of already-existing inequality in U.S. schools (Kozol, 1991), the heightening economic polarization in the U.S. in recent years (Mishel, Bernstein, & Schmitt, 1996), and a hundred-year history in which learner-centered reforms have almost always been implemented more readily among privileged students than among poor ones (Cuban, 1993).

But just because one master narrative might ring truer does not mean that it is true. As Bryson and de Castell (1998) point out, the "normativizing" (p. 76) of any one particular account of educational technology as *the* account imposes premature closure on what may be accomplished, thus discounting and restricting the human agency which can actually bring about transformative educational results. Classroom research, and particularly qualitative research which attempts to understand classroom practices from the perspective of the participants, can help bridge the gap between story and reality.

To further explore the relationship between technology, reform, and equality, I carried out a qualitative study in two schools in the state of Hawai'i from 1997-1998. The first, Leina High, is a public school in one of the poorest neighborhoods of O'ahu. The second, Kaunani, is one of the most elite college preparatory schools in the nation. However, this study was not meant to be a simple comparison of "rich good school vs. poor bad school". Both Leina and Kaunani have reputations for excellent use of new technologies, and that is why I selected these two schools for investigation. Through the study, I was hoping to learn more about good uses of new technology in radically

different sociocultural circumstances as a way of discovering both the possibilities of reform as well as some of its limitations.

I conducted the study using an interpretive qualitative approach based on classroom observations, interviews, and analysis of texts. I chose the two schools based on interviews and informal discussions with school district administrators and teachers as to their opinions of the best schools in O'ahu in integrating technology and instruction. From the suggestions offered, I chose these two schools based on their distinct socioeconomic populations. I then visited the two schools on approximately a weekly basis over a six-month period in the 1997-1998 school year. During my visits, I interviewed school administrators, technology coordinators, counselors, department chairs, classroom teachers, and students on their thoughts regarding integration of technology in education. In the majority of cases I tape recorded and transcribed the interviews. In situations where spontaneous discussions arose that were not possible to record, I took notes during or immediately after the discussions. From my discussions with administrators, department chairs, and teachers, I sought the names of teachers who had a reputation for outstanding use of information technology in their teaching. I observed these teachers' classes during my visits to the schools. During these observations, I interacted with students and spoke to them about their experiences. I sometimes helped students while they were working at computers. I took notes during my observations, or, if I was busy helping students, immediately thereafter. Finally, I was provided by teachers and administrators with school reports and documents, and also had access to papers, reports, newsletters, and World Wide Web sites produced by students.

In the remainder of this article, I will share what I learned at these two schools, and then explore the similarities and differences of the reform process.

Leina High

Leina High is a sprawling school of low bungalows in a semi- rural corner of O'ahu. The neighboring community of Leina is one of the few remaining areas on O'ahu with a large percentage of Native Hawaiians. It is also one of the most economically depressed areas in the state. Fewer than 10% of the adults living in the area have completed bachelor's degrees, and per capita income in the area is less than $10,000 per year.

Leina High's character is shaped by that of the neighboring community. Half the students are Native Hawaiians and many of the rest are Samoan and Filipino immigrants. Most qualify for free or reduced- cost lunch programs. Some live in homeless encampments on nearby beaches. Twice as many students are performing below grade level as is the national norm, and only one-sixth as many are performing above grade level. Of those who are able to graduate, the majority seek work, join the military, or study part-time at nearby community colleges. Only 11% of seniors claim that they plan to enter directly into a four-year college or university; no statistics are available on how many actually do. Information in this and the preceding paragraph was provided in a personal interview with the school principal (November 13, 1997) and in school documents which she provided.

To better meet the challenges the school faces, Leina administrators have launched an aggressive reform campaign in recent years. At the centerpiece of the reform plan is a school-to-work plan to better prepare students for success in Hawaii's competitive economy. As part of the planned reforms, students in the future will select a career pathway such as arts and communications, business and management, health

services, human services, or natural resources, and then take a number of related courses in that particular pathway while also participating in extra- curricular activities such as visits to local workplaces.

Another important goal of reform at Leina is for better integration of technology into the school's programs. The school's technology committee has laid out an ambitious five-year plan to ensure that the school's infrastructure will allow teachers and students to access a wide variety of technologies, that teachers will have the training to competently integrate technology into their curricula, and that students will have multiple opportunities to become technology literate for their chosen career pathways. Based on these plans, Leina High won an award for having the best technology vision in its school district.

From my visits I could see that implementation of the plan was clearly in its early stages. Though the library had assembled a fair amount of electronic resources, in several visits I never saw more than one or two students using them. Outside the library, computers were relatively scarce, with a total of some 200 computers for Leina's 2200 students. And only a few buildings on campus were wired for the Internet. Susan Bello, the school's educational technology coordinator, explained to me why the wiring was going slowly:

> Due to lack of funds, we had to get volunteers to dig the ditches to lay the cable. So we've had teachers, parents, community members out helping dig. But it's been really slow going since the buildings are spread out, and there's only a few inches of soil before you get to solid coral.

Other problems have to do with the existing infrastructure of the buildings. The classrooms, which were built in 1957 and have not been rewired, are unable to handle the power and electricity requirements of modern computer equipment.

In spite of these challenges, a number of teachers at Leina are making efforts to integrate computers into their teaching, and some have had great successes. When speaking to Susan and other teachers and administrators at Leina, I was pointed to three programs which had made strides in this area: the communications program, marine sciences program, and Hawaiian studies program.

Communications

The communications program at Leina dates back tp 1994 when two social studies teachers teamed up to teach an introductory mass media course, focusing on both video production and computer multimedia production. This single course has since expanded into an ambitious program of more than 400 students integrating video production, radio production, Web site design, computer animation, journalism, and yearbook production. The majority of the students in the program take an introduction course co-taught by two teachers and a teaching assistant; students in the course choose to specialize in either video production, radio production, or Web site design. More advanced students take courses in video or multimedia journalism and work to produce video and Web documentaries, multimedia computer animations, and a television news program shown on a local cable station. The program has won numerous state, national, and international awards, including a top price in an international Internet fair for a student-produced World Wide Web site on the Leina Coast, providing multimedia information on the region's history and ecosystem.

During my own visits to the mass media class, students were working on developing Web pages for Leina sports teams and clubs. More advanced students were working independently on more sophisticated Web sites (including a written report and video of a recent surfing competition) and developing complex computer animation. Students were working in a highly independent fashion, with the teacher providing individual or small group support and guidance.

Marine sciences

Another innovate program which has attempted to make use of new computer technologies is in marine sciences. Students in the interdisciplinary marine sciences class engage in collaborative project work related to different aspects of the subject, including growing and selling their own commercial seaweed, and preparing for and participating in sailing voyages around Hawai'i. Computer work centers around producing a newsletter about their projects, based on their own collaborative writing and editing as well as research they conduct on the World Wide Web. Students work in terms to discuss and select stories. They then write an outline and at least three drafts of their article, with it peer reviewed by a student editor. Students receive extra points of their work is published in the newsletter.

The teacher, May Wong, explained how the rationale behind the newsletter:

> My big thing is I want the students to be computer literate. Cause I really feel that's real important in today's word. So I require that all the students come in either before school, after school or during recess to get computer time. And every newsletter that's once a month. They have to have at least three times to use the computer outside of class time. Now, they cannot use the computer during class time and get this. And they can do it for anything. They can come here during English class and say, "Can I type an English paper, and they'll still get computer time?" Cause my big thing, are they comfortable, are they literate on the computer. I don't care if they're doing my work or not.

During my own visits while students were working on the newsletter, they worked to make plans in groups, word process their papers, or seek information from the Web about current events. They were just beginning to use the Web, and their searches were quite cursory, reflecting a quick desire to grab a likely story for the newsletter rather than an informed search, analysis, or critique of online information.

Hawaiian Studies

A third program that is starting to make use of new technologies is Hawaiian Studies, an interdisciplinary program incorporating Hawaiian language and culture, anthropology and history, and physical agriscience. Students in the program also engage in fieldwork, including a weekly visit to a Hawaiian cultural center where they help plant traditional Hawaiian crops such as taro. Use of new technologies in the program has been mostly dedicated to student documentation of the program and its projects. This includes a student- produced newsletter using desk-top publishing and student-produced videos and Web pages on the Hawaiian studies program. The teacher is planning on getting the students involved in an international environmental data-sharing Internet

project, but students had not yet begun the project during the time of my visits.

Unlike the Marine sciences program, which has a dozen computers, the Hawaiian studies classroom only has two, one of which is in disrepair. From my visits it appeared that work on the computer was largely controlled by a small group of students who were most comfortable with it. These students help produce the newsletter and Web page and will enter the data in the future Internet project.

Overall, relatively few students were using computers at Leina. Though the library had a new computer laboratory available for classes or individuals, the computers were rarely in use during my visits there. There were no other drop-in laboratories for students at the school, and there were relatively few computers in classroom. A few teachers, as reported above, are starting to integrate computers into the classroom for production of newsletters and informational Web sites, and some of the students in the media program are learning sophisticated multimedia production techniques.

Kaunani School

Many people would consider Kaunani (K-12) School to be the polar opposite of Leina. Kaunani is one of the most expensive private schools in Hawai'i and one of the top-ranked college preparatory schools in the United States. Approximately 97% of its graduates go on directly to four-year colleges and universities, with many going to elite private colleges on the U.S. mainland.

Kaunani has strict admissions policies, requiring a battery of tests for all applicants. In addition to paying some $10,000 per year, potential Kaunani students (even applicants to kindergarten) must test two full years above grade level. The ethnic mix is also quite different at Kaunani than Leina; most Kaunani students are of European, Japanese, or Chinese ancestry, with relatively few Hawaiians, Samoans, or Filipinos.

Though Kaunani already has the reputation as the best school in the state, it is working to improve in a number of areas. According to a recent five-year plan, Kaunani seeks to strengthen its emphasis on critical thinking skills; collaborative and autonomous learning; global education; and ethics, spirituality, and community service.

Like Leina, Kaunani is placing great emphasis on technology, but Kaunani has much greater financial means to implement its plans. While Leina has a technology coordinator for the school, working in the back of the library, Kaunani has an entire department devoted to this effort, with a coordinator, a large staff, and its own multi-room building. Kaunani has been able to wire the entire school (using union labor, not volunteers) and has some 1000 computers available for its 3,700 students (a ration of 3.7 students to computer as compared to 11.0 students to computer at Leina). Most impressive of all though are plans for a new $64 million science and technology center, the construction of which is currently underway. The center will include a large lecture hall with multimedia presentation capacity and one Internet connection for every two seats; numerous laboratory and classrooms fully equipped with networked computers and other technological equipment; a math science resource center for students; a science workshop for hands-on interactive demonstrations and themed exhibits; and high-tech faculty conference rooms and work rooms to promote interdisciplinary teacher collaboration.

Use of computer technologies for teaching, though also at a relatively early stage, is more common at Kaunani. I will examine briefly four programs in which computers are being used: high school English and social studies, high school foreign language, high school science, and elementary school science.

English and Social Studies

English and social studies teachers are trying to use computers to help their students develop literacies in new media as well as to use the online world for academic collaboration and research. One English teacher taught a special online writing course during summer. Students in participated in the course while also engaging in summer travel (one student was on holiday in the Netherlands). Activities included computer-mediated discussions of readings, the posting of student essays on the Web, and the development of an online writing center with links to and reviews of sites related to writing and technology. The same teacher is planning a new regular course which will integrate global education and ethics by having Kaunani students connect with students in other countries to analyze and reflect on ethical themes in world literature.

A social studies and literature teacher are jointly teaching an interdisciplinary course on American studies in which all students have been assigned laptop computers for the school year. Students use the laptops to take notes in class, to write their papers, to discuss topics via e-mail, and to develop and show multimedia presentations on their research.

Foreign Language

Foreign language teachers at Kaunani have been at the forefront of using new technologies for global interaction and education. For example, several of the Japanese teachers at the school have integrated e-mail and the Internet into their teaching. One Japanese teacher is having her students produce a Japanese-language radio program for a local station. To help prepare the program, the students are working in teams to survey Japanese correspondents via e-mail. They then, using both e-mail and live video-conferencing, further discuss with their Japanese correspondents the topics and content of their radio scripts. The teacher is planning a project next year where students will select several Japanese characters on display at a local cultural center. They will then research the historical meaning of characters and combine that with current interpretations based on e-mail interviews with students in Japan. The goal is to compare the language and culture of contemporary Japanese society with that of the Japanese who came to Hawai'i 100 years ago.

Science

Computers are being used extensively in honors physics and advanced placement (A.P.) biology programs. (Approximately half of Kaunani students take honors and/or A.P. classes). In physics class, students perform computer-based simulations of motion experiments one day, and then the next day they perform the actual experiments in laboratories of sophisticated equipment (e.g., frictionless air tubes). The computer-based simulations allow them to try out a broader range of hypotheses related to motion and collision of multiple objects traveling in multiple directions at multiple velocities. In biology class, the students use special hand-held devices for probing the temperature, acidity, absorption spectra and other features of plant life in the classroom and in nearby ponds. Students then download data from these devices to personal computers, where special software allows them to graph and compare data in order in order to interpret it.

Elementary School Science

Use of computers for science begins at elementary school at Kaunani. Fifth grade students learn to write computer programs for a Logo-Lego system. Unlike earlier Logo systems, in which these programs were used to manipulate a drawing of a turtle on the screen, this new Logo-Lego system can be physically connected by wires to the students' own constructions made up of plastic Lego building blocks. Students thus first build small cars and traffic lights, and the use the computer programs they write to make the cars go and stop per the change of traffic signal.

Overall, there was a substantial presence of computers and computing at Kaunani. There were several large wired computer laboratories available to classes or individual students on a drop-in basis, and the use of these labs was quite heavy. In the labs and on their home computers, students frequently searched the Internet to get information for school papers. Several teachers had begun to integrate computers into their academic programs in areas related to writing, foreign language collaboration, and scientific research and analysis.

Common Elements of Reform

As seen from these above examples, there are many common elements of successful classroom use of technology which are evident at both Leina and Kaunani. These elements, which I will briefly discuss, include interdisciplinary and team teaching, collaborative/apprenticeship learning, flexible scheduling, and support for teacher initiative and involvement.

Interdisciplinary and Team Teaching

Almost all the cases of excellent technology use that I observed in these classes are attempting in some way to break out of traditional classroom disciplines. In some cases this involves an individual teacher designing a project with many disciplines in mind, such as the elementary school teacher planning a Logo-Lego project which incorporates math, physics, computer programming, and engineering concepts for elementary school students; or a Japanese teacher planning a lesson which incorporates language, culture, and history. In other cases, the courses themselves are interdisciplinary by design, such as the marine sciences course at Kaunani. And in many cases, teachers have found ways to form partnership or team teaching relationships with those from other disciplines. For example, the computer component of A.P. biology was set up through cooperation with a mathematics teacher; in the future, the two teachers plan to establish a paired A.P. biology and A.P. calculus course. The video production and computer production teachers at Leina have joined for a combined Mass Media course, and they coordinate together with the teachers in business, journalism, and yearbook production. Similarly, these interdisciplinary programs coordinate with each other at a meta level, with students from the Hawaiian studies or Marine sciences programs who are also in the mass media program working on projects which combine their interests (e.g., a Web site or video about marine sciences).

Collaborative Apprenticeship Learning

In addition to breaking down traditional boundaries among disciplines and among teachers, successful technology-enhanced programs at both Leina and Kaunani are also breaking down traditional teacher- student roles. Virtually all the computer projects I saw at either school were based on social constructivist principles of learning, with students working in groups to define and carry out projects. For example, in the Web production program at Kaunani was organized more like a semester- long workshop than a traditional teacher-centered class. Students came and went immediately to their computers, which were spread out in clusters around the class. The teacher occasionally offered explicit instruction to the whole class, but students paid (or didn't pay) attention based on their own particular interest in the topic of discussion. Students worked in teams and were encouraged to pursue areas of their own interest, with some students focusing on researching and writing texts, others focused on advanced Web production techniques, and others focused on artistic areas such as multimedia animation. Students sought help as they needed it from each other or the teacher. Grades in the course were based either on the students' or on occasional performance assessments, in which students were required to create Web pages with certain features. The teacher acted as a coach and guide, bringing in new instructional videos and books for students to use, giving them individual or small group guidance on their work, letting them know (and helping them prepare for) upcoming competitions, inviting students to accompany him to either attend advanced workshops or give basic and intermediate workshops to others, and providing students moral support and encouragement. For example, he would frequently remind them of the successful national awards won by previous students, and would also tell them that Leina High is "the Kaunani of Web design," just like people might say that their city is the Paris of Asia, or Africa, or the Middle East. In essence the teacher is a master Web page designer who is working hard to continuously upgrade his knowledge of the most sophisticated new technologies, ranging from "VRML" (Virtual Reality Modeling Language) to "Claymation" (clay animation). Students are his apprentices; they begin by working under his guidance on simple projects such as the design of a Web page about a sports team at Kaunani. Those who show a serious interest continue to more substantial efforts, such as the previously mentioned virtual tour of the Leina coast.

The biology course at Kaunani indicated a similar collaborative apprenticeship approach. In this course, students were apprenticing to be biologists rather than Web designers. Though portions of the course were devoted to lecture, other portions were devoted to engagement in the practice of biological research using computer technology as a tool in the same way a scientist might. Students worked in groups to carry out and interpret their experiences, achieving results, which according to the teacher, were potentially publishable in scientific journals. The teacher wandered around the classroom and guided the students in everything from the gathering of data to its interpretation to the formation of overall conclusions.

Flexible Scheduling

At both schools, an interdisciplinary approach and collaborative apprenticeship learning were facilitated by flexible scheduling—of a somewhat simple form at Leina, and a more complex form at Kaunani.

At Leina, Mondays, Tuesdays, and Fridays were organized according to a traditional six-period high school program. However, Wednesdays and Thursdays were based on double periods, with students having three two-hour classes on Wednesday (first, third, and fifth periods) and three two-hour classes on Thursday (second, fourth,

and sixth periods). These double-periods were essential for carrying out the kind of in-depth project that apprenticeship learning often involves. Students in video production wandered campus to carry out filming and interviewing. Students in marine sciences tended to their seaweed. Students in Hawaiian Studies combined two two-hour slots and worked at the nearby Hawaiian cultural center.

At Kaunani, the reorganization of scheduling has been more dramatic. School is organized according to six-day cycles, rather than five-day weeks (e.g., cycle 1 is M-T-W-Th-F-M, cycle 2 is T-W-Th-F-M-T). Teachers are assigned a certain number of contact hours per day, which they can divide up however they please. For example, English teachers are assigned 85 student-contact hours a day. They can teach, if they want, five one-hour classes of 17 students, or one one-hour lecture of 85 students, or some combination. Most teachers put together a schedule which includes a combination of larger lectures, smaller discussion groups, and possibly small but lengthier laboratory sessions. This approach, while obviously much more complex and difficult to set up, is even more advantageous than the Leina setting for implementing technology-enhanced project work, as teachers can create the combination of laboratory, discussion, lecture, or other sessions that are most appropriate for the type of course they are teaching. For example, the American Studies course met twice per cycle for one-hour classes of 27 students, twice per cycle in one-hour discussion seminars of 13 or 14 students, and once per cycle for a two-hour sessions of 60 students for lectures or films. The biology and physics classes both combine longer sessions of smaller groups in the labs and computer rooms, with larger shorter lectures.

Teacher Initiative and Involvement

As Larry Cuban (1986) has documented, new and supposedly revolutionary technologies have been imposed from above for a century, with poor results. Central district and school administrators have a history of urging or demanding use of radio, television, film, and now computers, with little involvement from classroom teachers in making school-wide decisions about technological implementation.

Both Leina High and Kaunani School have avoided this problem. On the contrary, both schools seem to be exemplary in involving teachers in shaping the direction of the school, and in particular encouraging their initiatives regarding technology.

Leina High is a designated School Community Based Management (SCBM) site and thus receives extra support from the Hawai'i Department of Education for teacher and community involvement in decision-making, including the potential of receiving special waiver days (in which students are dismissed from school for teacher planning). Leina has used these days to the maximum over the last three years to involve teachers in developing the five-year plan for the school. Teachers I spoke with were quite familiar with the details of the plan, and couched their own teaching goals and visions in accord with the plan's language.

Teachers at Leina have also been quite involved in shaping policies regarding technology. The technology plan has arisen through grassroots teacher involvement, and teachers have been given release time to work out its implementation. In addition, grassroots teacher initiatives are respected and appreciated, especially when they involve crossing disciplinary boundaries. As the principal told me,

> We've been encouraging teachers to informally hook up with each other. Do interdisciplinary projects. Do things together. Get out of your own four

walls or your own content area and try doing something different with a teacher from another department. So we've been encouraging this kind of behavior among the staff...And so technology, with [the media] program, they've been deliberately expanding and trying to encompass more areas into what they do. And with the Hawaiian Studies program the technology really just supports what they're doing in terms of having the kids learn about agriculture. From agriculture all the way to architecture and archaeology. And then with the marine sciences program also they're doing a , they're now integrating what they're doing in marine sciences with social studies. History as well as modern day Hawaii. So that's the direction. The direction is toward integration and towards creating career pathways and so we expect to see more people jumping in and doing that kind of thing.

Recently the teachers in the communications program were pulled out of their classes for four straight days to plan the future of their program, and the role of technology within it, while substitute teachers taught their classes. The media teacher complimented the role of the principal:

I credit her the most as far as our successes. She is real action oriented. She's visionary. And she's very, very supportive of what we do. She's been very supportive. She's given us the leeway. And I think as a result of her support we've been successful. We've been able to try and move things. Cause without a principal that says, sure, try a recording studio, or, sure, try a radio station, sure, you want a digital camera; - I needed money to get a digital camera - she doesn't really understand what it is but she understands that we want to stay on top of the new technology.

The support for teacher involvement and initiative at Kaunani is equally impressive. The school just thoroughly reviewed its policies and goals as part of a review by the Western Association of Schools and Colleges. All faculty and staff participated in meetings to help clarify the school's purpose, as well as hundreds of students, parents, and alumni. Teachers are also given substantial support to integrate new technologies, including release time from the college for innovative practices, special funds for purchase of equipment, and support for taking of classes. The social studies teacher making use of laptop computers is doing so with a school grant (both for equipment and release time) and is also taking a course on distance education with funding from the school. And a special interdisciplinary committee of the faculty is meeting on a regular basis to discuss uses of the Internet and distance education, again with release time from the school for these purposes. Teachers who engage in such projects are also expected to produce reports for the rest of the faculty based on their experiences.

Different Resources, Different Expectations

As seen above, there were many substantial areas of overlap between the reform process in these two diverse schools. At the same time, though, there are also important areas of difference. I will group them into two general areas, related to resources and expectations.

Resources

When looking at resources at the two schools, it is important to start from the differential access to technology that students have at home. At Kaunani, in one social studies class I surveyed every single student had a home computer, and the majority had 2, 3 or 4 computers at home with one or more Internet accounts. My informal polling of students indicated that it was rare of find a student at Leina who had home access to a modern computer—most either lacked a computer or had part-time access to a very old machine. As a librarian at Leina explained to me,

> We have to provide technology because they don't have it at home. The only
> exposure to technology they have is at school. Most don't even have
> push-button phones, or indeed any workable phone line at all. Often when
> we call their phones are out of order or disconnected. People are struggling
> at home to pay their phone bills.

Unfortunately, this differential access between Kaunani and Leina students is further multiplied at school. Classes at Leina are held in dilapidated bungalows with poor infrastructure to support modern technologies. The Hawaiian Studies class, for example, has a dial-up connection to the Internet as the building lacks the electrical facilities to support a hard-wired connection. Leina's Web production teacher—one of the most honored teachers in the state, with awards of recognition from the Mayor, Governor, House of Representatives, and State Senate—has only eight computers in his classroom, so students must double or triple up on a machine. In contrast, Kaunani already has a fully wired school and a high computer-student ratio, and it is in the midst of building one of the most modern and well-equipped school science and technology centers in the country. Dozens of high-paid construction workers labor away day-by- day at Kaunani, while technological improvements Leina depends in part on the sweat of unpaid volunteers.

Differences extend to the support given for teachers as well. Leina High does its best with limited resources, but it has only so much to offer. Teachers who want extra funding have to write grant proposals on their own time. Kaunani has its own financial support staff on campus which seeks grants for the school; the money is then made available to teachers for the asking. And while teachers at Leina teach six classes a day of up to 35 students, Kaunani teachers face an average of 85-100 students a day (based on 17-20 students per period for five periods) in a schedule totally at their own control. Smaller class sizes and fewer classes mean that teachers can spend more time preparing for their classes, including thinking about how to integrate technology, and can devote more personal attention to individual students as they uses computers in the classroom.

Expectations

The second major difference has to do with the goals, visions, and expectations of the schools. While the processes of reform are in many ways similar in the two schools—include interdisciplinary and team teaching, collaborative/apprenticeship learning, flexible scheduling, and high levels of teacher initiative and involvement—the goals toward which the reform is geared differ dramatically in the two schools.

Leina High's reform process, including the uses of technology, is geared toward

better preparing students for the workforce. Teachers work to help students develop the types of technological literacy and human relations skills that might be needed in the workplace, without great emphasis on academic content. To illustrate how this takes place, I will briefly examine two programs, the communications program and the marine sciences program. The strong majority of students in the communications program take either radio production or video production. In both of these classes, most students focus principally on learning technical skills, such as how to videotape or how to edit a radio program. Likewise, for the minority of students who take Web production, most of the work is focused on the technical aspects of Web page production. (In contrast, at Kaunani, students also are involved in producing the school's Web pages, but they do this as part-time paid work, rather than as part of their academic course load).

In the marine sciences program, much of the work the students do has little relationship to science. The teacher spends a good deal of time with the students discussing the meaning of inspirational quotations, or reading stories from the popular book, *Chicken Soup for the Soul*, and even had students write their own stories for a classroom version of the book (Portuguese Soup for the Soul). Work at the computers serves a similar communitarian purpose; the newsletter the students produce has little hard scientific information in it and instead focuses on the students personal experiences (e.g., "Students sail on the voyage of a lifetime," "Dear Journal". (The Hawaiian studies newsletter also featured similar personal stories, introducing the teachers and students, discussing attendance policy, and announcing a calendar of upcoming events.)

Both the communications teacher and the marine sciences teacher both explained to me their hidden curriculum—the purpose behind what they do in the classroom. Carla, the communications teacher explained that:

> We have to make it relevant, because when they leave us, we want to be
> able to say that they not only, you know maybe as we're teaching teamwork,
> cooperation, respect for themselves and others. We just so happen to be
> teaching that through video production. Through computers. Through radio.
> And when they leave that, when they leave us we want them to learn how
> important it is to have teamwork, cooperation, and respect for themselves
> and others and property. Because no matter what they do, right, whether it's
> in a job or a relationship, they have to have that. And hopefully at least that
> they're taking with them. And they have some kind of a skill that's going to
> be able to get them a job. Whether it be media or anything, you never know
> what they're going to grab on.

The marine sciences teacher explained to me her very similar approach, also stressing respect and cooperation:.

> There's four things that I expect the students to learn.... Number one I expect
> them to learn respect. How to be respectful. Number two, responsibility.
> Number three, to work cooperatively in a team situation. And number four
> is to be seekers of information. If I can teach you those four things by the
> time you graduate I will feel like I've done my job. And I said, you notice,
> there's nothing to do with science. 'Cause to me the science portion will
> come as a part of being responsible and useful seekers of information....As
> far as I'm concerned they cannot learn the science and they cannot learn the
> material if they're doing all of the above.

She later explained to me why she didn't feel it was important to emphasize scientific concepts in her marine sciences program:

> I've been doing this for about six, seven years now, seven years of so. And the really interesting thing is about two or three years ago this whole school-to-work thing came out. And they went to big companies, and they asked these employers, they said, when our students graduate from high school what do you want them to know? And the employers all came up and said, We don't care what they studied, we want a student who's respectful, who's responsible, who can work together with other people and want to learn and want to learn, we can train them. We don't care. We don't need them to be honors students and all that. We can train them on the job. Give us kids who know how to be respectful, responsible, team players. And so it's right in line with what we've been doing and I feel really good about that...cause this is what employers want.

For both teachers, the central element is not the content, but the attitudes that students learn from the class. And the attitudes which are most important are the respect and cooperation—how to be a good team member—which employers value.

Both of these teachers are trying to further strengthen the school-to- work component of the program in another way too, by integrating a strong business component into their teaching. The marine sciences teacher is seeking to develop a team-teaching relationship with a business teacher, so that the students can better market their seaweed. She also hopes to have students track the progress of local stocks on the World Wide Web as part of their education for future marketing, sales, and investment.

The communications program has already brought a business teacher to help teach sales, marketing, and accounting. As she explained:

> We want to be looked at as a production company. So say, when you come into this class you're not coming to class, you're coming to work. Each of you have a job to do. And we want to start, because this type of class takes so much money to, repair and maintenance, and, you know we want to get air conditioners and this and that. We need to start raising our own money. So we want to start selling our services. For the last four years we've been doing it for free. And we still want to do it for free to a certain extent. Especially to the community as community service. But, we also need to start generating our own income. So we want to start selling videos. If somebody wants, let's say, a wedding video, we want to be able to do that. Somebody wants a little documentary on their project, or, for the radio people want, they want a little 15 second radio, commercial on their business, or you know if they want to come and record themselves we want to be able to generate funding through that. Our kids have done numerous Web sites. And you know that costs money if you go on the outside. But we've been doing it for free. And we can make money doing them. We won't charge them an arm and a leg, but we'll charge them something. And the kids need to know how do you go about doing that. How do you market? How do you sell your product? What do you sell. What do you charge? You know, business fundamentals.

I did not have a chance to interview or observe all the teachers in the school. Yet these teachers have been identified by colleagues, students, and the administration as the most exemplary that Leina has to offer. And from my observations of their classes and interviews with students in their classes, that is not surprising. They are both highly engaged, committed professionals who devote untold hours and boundless energy to providing new opportunities for their students. And their energy is devoted to reshaping students' attitudes, and providing the skills and acumen, to better compete in the job market, with the use of new technologies serving these purposes as well.

In some cases, the Leina teachers themselves are anxious to raise standards but find the challenge overwhelming. Last semester, for example, May was teaching a combined beginning-advanced class with some 45 students. Her original plan was to have the 30 beginning students work on introductory projects, while the 15 advanced students (all in their second or third year of video production) worked on more challenging news programs and documentaries. But coordinating different levels of so many students in the same semester became overwhelming, especially with limited amounts of video equipment. Most of her time and energy thus was devoted to the beginning students, and she was not able to get the advanced students working on the projects until much later in the school year.

At Kaunani, expectations, policies, and teaching and learning conditions differ dramatically. The school is designed to produce the academic and professional leaders of tomorrow. Discussions of school reform are framed by the goal of helping students meet the requirements and expectations of the most prestigious universities. As for technology, teachers seek to use it for academic rather than communitarian purposes (for an interesting discussion of the differential impact of a communitarian climate and an academic climate, see Phillips, 1997) This is seen, for example, in the Japanese classrooms, where students' use long-distance exchange for analysis of complex cultural and linguistic issues. Or in the biology classes, where students use computers to perform the same types of analysis and research that a university research might perform, rather than to produce a newsletter (and where the teacher is teaming with a calculus teacher, not a business teacher). The biology teacher at Kaunani explained his own rationale for using computers, which is quite different from the perspective of the science teacher at Leina:

We've been working over the years on our biology program, particularly our advanced biology program, to give students the type of experience that they need to prepare them for college work...I had been a research scientist at Berkeley and Stanford as a graduate student. So I have a very strong background in research, which I loved. And I try to share that love of research with my students. And since I was pretty much lab oriented and biochemistry oriented I did what I knew and tried to implement those kinds of experiments. When the advanced placement biology program became formalized they gave us a lab. And at first that was very frustrating but we gradually were able to do all the labs they asked us to do and still implement our own program and add to it and to the best of our ability we maintained a strong program that we feel prepares students for college level work. And it became obvious as we, over the last ten years, the computers were becoming one of the most important scientific tools available. And, so we wanted to implement the computers into the program. And the way we did this was we brought two computers of own, our own personal computers

from home, we purchased the software ourselves and we demonstrated to the administration of this school that we could use the computers in the classroom in a productive and effective way. Once we'd proved that we could use them they were willing to fund it. And so we had cooperation from the parent/faculty association and the administration. And they funded our computer program. And we realized that this was an important scientific direction for our students to go.

Perhaps most interesting to me was my observation of the fifth-grade students work on the Logo-Lego project and my discussions with the teacher of that project. Similarly to the teachers at Leina, this teacher told me his own "hidden curriculum" behind the teaching.

I'm teaching a lot of other things besides math and science. Probably the most important think is project management, making complex things happen in a certain amount of time. I'll say, O.K., based on these commands that we know how they control the machines, now do this in the next hour. And they have to work in teams. Or, I'll make an extension based on what they know, and then there are multiple solutions, so there's all different ways to do it. But they have to do it within an hour. Getting to operate under those conditions I think that's important.

It was noteworthy that both Leina and Kaunani teachers stressed the importance of participating in teams. But whereas Leina students were expected to learn things such as responsibility to the group and respect for other, Kaunani students—even those as young as in the fifth grade—were expected to learn how to manage complex systems.

Conclusions

This study examined the process of school reform and technology implementation in two diverse schools, an elite private school and a school in a low socio-economic status neighborhood. Interestingly, the process of reform in the two schools showed a good deal of similarity. Both schools encourage interdisciplinary and team teaching, collaborative/apprenticeship learning, flexible scheduling, and active teacher initiative and involvement in shaping the use of new technologies. In some ways, Kaunani's reforms in these areas were more dramatic, as seen in the total modular scheduling at Kaunani as compared to the double-period days at Leina. But Leina nevertheless implemented similar reforms within the school's more limited means. The study thus provides a positive example of how a low-SES school can engage in the types of reform that are seen as necessary to make effective use of technology (see for example Sandholtz, et al., 1997; Means, 1998) and which are believed to rarely occur outside of elite private schools or public schools in well-to- do suburbs (Cuban, 1993).

But in spite of the above, it is also the case that Kaunani continues to socialize students into academia, and Leina socializes students into the workforce, a difference made explicit by the emphasis on school-to-work at Leina. And the students from Leina, who enter high school far behind their Kaunani counterparts in technological literacy due in part to limited access to home computers, are likely to fall much further behind from the respective high school education students receive in the two schools. Kaunani

students have more school computers at their access and are more likely to use them for scholarly experimentation and research than are students at Leina.

Studies have shown that students in low SES neighborhood schools frequently used computers for exercises and drills in basic skills (e.g., Wenglinsky, 1998). That is not what I observed here. Perhaps the era of "drill and kill" may fade away, at least in secondary schools, to be replaced in low -SES schools by the development of attractive but limited- content Web pages or newsletters.

Leina's best-regarded teachers are building award-winning programs which are inspiring students and actively engaging them in the learning process. They are turning many lives around, and their best students are winning national and international awards for their media projects. These teachers' hard work has indeed made Leina "the Kaunani of Web page design". The types of collaborative apprenticeship project-based teaching they are engaged in, together with other reforms such as team teaching and flexible scheduling, have contributed to these positive results, and are worthy of emulation by other schools.

But Kaunani school itself remains "the Kaunani" of mathematics, physics, biology, history, literature, and foreign languages. And that in the end has a profound effect on the differing life opportunities for Leina and Kaunani students. To seriously diminish that difference, it will take more than team teaching or flexible scheduling or collaborative learning, but rather a challenge to the unequal allocation of resources and expectations to Leina High and Kaunani School and to the thousands of other Leinas and Kaunanis across the country.

In analyzing integration of technology into instruction, Cuban (1993) proclaimed that "Computer meets classroom: Classroom wins" (p. 185). The implication was that the traditional patterns of classroom organization are proving impermeable to change, even with the introduction of large numbers of computers into schools. This study suggests that even in those cases where the computer "beats" the classroom, it doesn't necessarily beat the system. Computers, Internet use, re-arranged classrooms, flexible schedules, and interactive instruction can all leave intact or even reinforce patterns by which schools channels students into different social futures.

This study thus provides support for both the discourse of reform and the discourse of inequality. Schools of diverse socio-economic circumstances can carry out the types of technology-enhanced reform that make education more interactive. But these reforms take place in a social context that will likely make education more unequal.

Note

The names of schools, administrators, teachers and students have all been either changed or deleted in this study.

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