Integrating Technology into the Curriculum to Support Standards-Based Achievement in a Middle School

Case study report by Robert Kozma and Carlos Espinoza
U.S.A Exemplary Technology-Supported-Schooling Case Studies Project

March 2001

Overview

Jackie is a 6th grader in Pat Davenport s language arts class at Mountain Middle School. She is writing a poem about wintry weather on a poetry website and submitting it for online publication. Among other things, Megan is working on Language Arts Standard 2.1, Sixth grade students will generate and develop ideas for a variety of writing and speaking purposes. In Elizabeth Small s 6th-grade science class, Nick and Kelly are working with their teammates on using information that they get off of the

Internet and graphics and word processing software packages to create a newspaper called The Tundra Times containing articles, cartoons, and games on the climate, animals, and plants in Alaska. They are working on Science Standard 1.323, Utilize the niche concept to explain the relationship of organisms in their ecosystems. Thomas is an 8th-grade student in Denise Murphy s social studies class who is using the Internet to find court cases and newspaper articles to analyze the meaning of the freedom of speech clause in the 1st Amendment of the Bill of Rights. He is putting together a poster that explains how the 1st Amendment affects his classmates as citizens of the United States. This addresses Civics Standard 1.4: Students know the distinctive characteristics of the political culture of the United States. All of these students and their teachers are using technology to support standards-based achievement at Mountain Middle School. This innovation results from the convergence of two significant traditions at Mountain: The development of a curriculum based on student proficiencies and the use of technology to support student achievement.

Mountain Middle School is in the community of Frontier, in Avoylles County, just south of Denver, Colorado. By all accounts, Frontier is an above average suburban community. While the median US household income in 1990 (the most recent figures) was $30,000, the household income in Frontier was $34,000. While 13% of the US population is below the poverty level, only 7% of the population in Frontier is below this level. While 20.3% of the US population over 25 years old has a bachelor s degree or higher, 42.5% of the people in Avoylles County do. Of the 17,300 people in Avoylles County, 16,800 are white. Of these, 650 are of Hispanic origin.

Mountain includes grades 6-8 and has an enrollment of 1,338 students with 133 teachers and 185 staff. Mountain is an above average school even in an above average school district. Mountain s s teachers have an average of 19 years of teaching experience, compared to 14 for the District, as a whole. While 75% of Mountain s teachers have degrees in their teaching subject, 53% of the District s teachers do. Many of Mountain s teachers have advanced degrees; several of them majored in educational technology. Mountain s teachers receive and average salary of $48,500 per year, compared to $48,000 for the District and $40,400 for the State. As for students, while 8th-grade students in the Clear Ridge School District scored at the 72nd percentile in math and the 71st in reading on the Iowa Tests of Basic Skills (the national norm, of course, is 50), Mountain 8th-graders scored at the 77th and 76th percentiles, respectively. While 58% of the state 7th-graders and 72% of the District 7th-graders scored at or above proficiency in reading on the Colorado Student Assessment Program (CSAP), 83% of the Mountain 7th-graders scored at or above proficiency. Only 70 students out of the 1,338 at Mountain are classified as at risk of failure . The attendance rate for the 1999-2000 school year was 96%. Mountain is an ESL (English as a Second Language) magnet school and about 15% of the students in one of the observed classes were non-native English speakers.

Mountain Middle School is down the street from the new Denver Future Center and a large number of the parents in this community are professionals, many in the high tech industry. The technology coordinator estimated that 85-90% of the students have computers at home; many have 2 or 3 home computers. Of these students, approximately 75-80% have Internet access at home and most have their own email accounts.

Mountain Middle School benefits from a considerable amount of parental support. For example, many do volunteer tutoring in the Proficiency Center. And the Parent-Teacher Council raised $80,000 through magazine sales during the previous year to support the school. They are also strong supporters of technology in the school. From their fund-raising efforts, the PTC has made an annual line-item commitment in their budget of $20,000 a year for technology at Mountain.

Standards for student achievement are important in the Clear Ridge School District and Mountain Middle School. Both were involved in establishing proficiencies for students to meet, before the Colorado State Standards were formulated and long before the more recently mandated Colorado Student Assessment Program (CSAP) was adopted. Indeed, much of the state s work on standards was based on the early work at Clear Ridge and Mountain, according to administrators. This emphasis

continues at Mountain and there are special resources available to support the attainment of standards, such as the Performance Assessment Specialist and the Proficiency Center.

The use of technology also has a long history in Clear Ridge and Mountain Middle School. Both the district and the school have significant budgets for hardware, software, support staff, and teacher professional development. The 1,300 students at Mountain have access to 300 computers (a ratio of 4.3 to 1 compared to a median of 6.0 to 1 nationally). Most of these are in the 5 computer laboratories, the media center, and special rooms, such as the Proficiency Center. However, about half of regular classrooms have 3-4 computers in them. Almost all of Mountain s computers (93%) are high-end multimedia computers and a large majority of them (83%) are networked and have fast access to the Internet. Teachers also have access to support, with both a full time technology coordinator and a hardware specialist. They can also request the purchase of specialized software to support their teaching. All the teachers have email accounts and all the students have personal file folders for their work that they can access from anywhere in the school.

Over the past 5 years, the emphases on standards and technology have converged at Mountain and Clear Ridge. The 1995 District Technology Plan targeted student achievement through the use of technology. But the 2000 District Plan was much more explicit in its emphasis on the achievement of standards and performance on the standards-based state test. Goal 1 of the 2000 District Plan specifically is to enhance student achievement and learning by engaging students in curriculum-integrated technology use rich in standards, thinking, and application of skills . Goal 2 is to use technology to support increased performance on the CSAP and school report cards .

Correspondingly, in Mountain Middle School s 2000-2001 Technology Plan, their target is to use technology to achieve an 80% proficiency rate for 8th-graders in language arts, science, and mathematics.

Students, teachers, parents, and the school, more generally, have benefited from the use of technology at Mountain Middle School to support standards-based student achievement and from the resources that are provided. Students say that it would be a lot harder for them to get the information they need to do their schoolwork. The teachers at Mountain have acquired many technology skills and regularly use word processors, spreadsheets, email, and presentation software in their own professional work, as well as their instruction. Parents benefit from the technological skills that their students bring home with them and the knowledge that their children are doing great things with computers, to quote one parent. According to the Director of Middle Schools at Clear Ridge, the impact that technology has had is to allow the school to remain in the mainstream of what this community s about and what our world s about .

The Past

The interest in integrating technology into the curriculum has a 12 year old history at Mountain Middle School, according to the Director of Middle Schools and former principal at Mountain. According to him, Mountain Middle School was unique holding a shared belief that technology is not a skill within itself but that it should be integrated within the context of curriculum to support student achievement. The Director of Middle Schools strongly believes in the ability of technology to support student achievement and promoted this among teachers and parents while he was principal at Mountain. When there, the Director was one of the first people in the state who appointed a fully released person to integrate technology into the curriculum. The staff and the culture that the Director of Middle Schools fostered at Mountain continues and has been expanded by the current principal.

About 7 years ago, the Clear Ridge School District hired a District Technology Coordinator. Prior to that, each school was responsible for developing its own technology plan. The District Technology Coordinator was brought in to coordinate facilitates across schools in the district and to develop a district-wide technology plan. The initial plan, written in 1995 with the help of administrators, teachers,

parents, and students from across the district, focused on the integration of technology into the curriculum and use of technology to support student achievement. The new 2000-2001 plan has a tighter focus on the integration of technology into the curriculum and its use to support standards-based achievement, particularly achievement on the standards-based state assessment.

Clear Ridge s involvement in the standards movement also has a long history. This predates the Colorado State Standards and the more recent CSAP (Colorado Student Assessment Program). Ten years ago, discussions within the District and Mountain Middle School were focused on identifying the outcomes or proficiencies that were desired of students and on figuring out how to support their achievement, according to the Director of Middle Schools who was Mountain s principal at the time. As part of this focus, groups of teachers across Clear Ridge schools worked together to develop standards in almost every one of their academic and enhanced core or elective areas. The Director of Middle Schools said there was little resistance to this movement, either in the school district or at Mountain. Both Mountain s former and current principals put the locus of what little resistance there was on the few teachers who were so far along in their careers that they did not have the energy or interest to change. Otherwise, teachers throughout the District and Mountain Middle School have come to embrace this approach to curriculum.

In subsequent years, the State of Colorado also adopted the standards-based approach to curriculum, based in part on the early work of Clear Ridge. The Colorado Department of Education has developed detailed, model standards and grade level expectations for reading and writing, mathematics, science, history, geography, and foreign languages, among other areas. More recently the State has adoption the Colorado Student Assessment Program that is articulated with the State s standards. The phased in program of annual assessment started in the 1998-99 school year with tests of 7th-grade reading and writing. The tests have scaled up by grade level each year so that by 2002, the 8th grade will be tested on all the subjects: reading, writing, mathematics, and science.

The Present

The importance of student achievement permeates the culture in the Clear Ridge School District and Mountain Middle School. This value is embedded in the very titles of the positions, buildings, and programs throughout the District. While some districts have Assistant Superintendents for Curriculum and Instruction and some schools have Technology Coordinators , Clear Ridge has an Assistant Superintendent of Performance Improvement and the staff members responsible for educational technology at Mountain and other Clear Ridge Schools are called Student Achievement Specialists . What in some school districts is called the Resource Center is called the Student Achievement Resource Center in Clear Ridge.

The Director of Middle Schools commented that:

Clear Ridge as a school district and the parent community are very concerned with high student performance, student achievement. They re committed to the importance of education and that the children should do well.

The district is interested in standards-based curriculum, primarily because of this commitment to student achievement. As the middle school director put it:

We as a district took and embraced the concept of standards early on. We believed that was what really would drive student achievement forward in a positive way.

The district s interest in technology is also founded on their commitment to student achievement. The middle school director continued:

When we write our proposals, our yearly goals, around what we expect to accomplish with technology, it has always been aligned with student achievement, and then as standards became that definition of

student achievement, that was the alignment.

This culture of achievement is also very strong at Mountain Middle School and the Principal is very much a leader in creating this culture. For the last year-and-a-half, she has met once a week with the Building Council a team of teachers, administrators, classified staff, and parents to come up with a shared vision statement.

The first component of this vision is the expectation that students will master and excel in the core academic program. More specifically, the expectation is that the curriculum will be differentiated in a way that addresses the needs of a diverse population of students, that technology will be integrated to enhance curriculum and instruction, and the instructional program will promote growth and achievement of <u>all</u> students. These expectations are reinforced through the hiring, evaluation, and professional development practices in the school. For example, the Principal relayed a story about a candidate for a teaching position at Mountain who commented that standards-based education was just a buzz word . She said:

He didn t have a shot because he didn t match the culture of what this building is all about and where we want it to be.

Teacher evaluations also include an analysis of the proficiencies that teachers target and their integration of technology into the lesson. Their performance evaluation is based on the application of their knowledge to increase student achievement.

At the same time, both the Principal and the school district put their money where their mouth is . A rich variety of resources are provided to the teachers to improve their pedagogical and technological skills, all in service of student performance and achievement. For example, the Performance Assessment Specialist, meets with teachers to incorporate standards into their instructional units. This specialist works with teachers, individually and in professional development workshops, to review their lessons and think through the standards that they want the students to accomplish. She also analyzes the CSAP test results to identify students strengths and weakness to derive implications for teachers lesson planning. She and the Principal had just sent out notes to 450 8th-graders reviewing their CSAP scores, telling them where they were doing well and where they needed to work harder.

Through a combination of expectations and resources, the use of standards has been widely adopted by teachers. One teacher commented:

You re expected to do it, to do a lot of work to be able to do it, and it s expected to happen, and it happens.

Another teacher commented:

If you look in my plan book, everyday has the standard that I meet in that day and I circle it in highlighter just to know that that s the standard I m going to meet that day.

Yet another:

It s hard to answer the question How do you address the standards? . I guess because it s so much a part of us I don t know what to say to really answer the question.

Technology is a big part of the resource mix at Clear Ridge and Mountain Middle School that support standards and student achievement. For example, the District provides each school with $40 per pupil for technology. But this funding is not an entitlement. Schools have to put together an annual technology plan and articulate it with the district plan. Specifically, they have to identify the learning goals for their students for that year and describe how they will use technology to meet those goals. The technology plan from Mountain Middle School specifies that 80% of the 8th grade students will score as proficient or advanced in the areas of language arts, math, and science. It identifies specific

technological and professional development solutions that address these goals and ways the accomplishment of these goals will be evaluated. As a consequence of district, school, and parental funding, Mountain is rich with technological and professional resources. Last year, Mountain had over $74,000 to spend on technology, between funds from the District, the School s budget, and PTC contributions. Among the technological resources at Mountain Middle School are 300 computers (for the most part networked, multimedia computers), distributed in 2 large computer laboratories for core courses, 3 labs for specialized courses, the media center, other special rooms, and teachers classrooms. The computer labs (each containing 30 computers) are available for scheduled use. They are also available for student drop-in, when they are not in use (which is not very often) or for individual student use of the few computers that might be available, even when the labs are being used by classes. The computers are well supplied with software. Most of the software (an estimated 75%) that is used by teachers and students is tool-based software, such as presentation software, spreadsheets, word processors, and Internet browsers. The rest is content specific software, such as Geometer s Sketch Pad and River Deep . Other technologies are also used, such as probeware in science and hand-held calculators in math. Over 80% of the computers in the building are networked and Internet accessible, so students can work at just about any station in the school and store their work in their personal folder on the school server.

But the technology resources at Mountain are not just the abundant amount hardware and software. Even more important are the people and the values they project. Again, the Principal is a leader in this area. She is a strong supporter of technology. She promotes its use in teacher meetings and uses it extensively in her presentations to teachers and parents. Several teachers pointed out the importance of the example this has set for them.

The Student Achievement Specialist (called the Computer Coordinator in other schools) is also a very important resource. She is a full-time staff person available to help teachers and students use these facilities in the service of student performance. Among the Student Achievement Specialist s responsibilities are to purchase hardware and software, provide professional development that integrates technology into the curriculum, and work with teachers to find technological strategies that address the goals of specific lessons. She also chairs a group of teachers and staff who write the building technology plan. The Student Achievement Specialist is supported by a full-time Technology Assistant . The assistant is responsible for maintaining the hardware and the network.

Prior to the class sessions that were included in the observations for this site visits, the Student Achievement Specialist worked with the teachers to select appropriate software and to make sure that they were comfortable with its use. She and the assistant were continuously in the computer laboratories supporting both the teachers and students, as well as trouble shooting software and hardware problems. During the class, the Student Achievement Specialist demonstrated the use of the software, either in front of the whole class or by circulating among the students, responding to their technical questions while the teacher responded to substantive questions.

The Student Achievement Specialist is also in charge of teacher professional development related to technology. She uses a 3-tiered approach, developed by The District Technology Director and the district s technology coordinators. Some of her workshops are at Tier 1 , basic hardware and software operation. But most of her workshops and her primary mission in the school center on Tier 2 , integration of technology into the curriculum. Beyond this, there is Tier 3 , a system of teacher peer-coaching that the Student Achievement Specialist directs. The importance of her contribution was emphasized by both the Director of Middle Schools and Mountain s Principal. When asked why Mountain was out in front in its use of technology, the Director of Middle Schools said, It s the Student Achievement Specialist. The Principal stated, I think if she went away, if we decided not to fund that position anymore, I think the sustainability would be gone. As one teacher put it, We have wonderful computer support people, [the Student Achievement Specialist and her assistant] are just the best. I ve worked in three different schools in this district and they re top notch. Another teacher said

the Student Achievement Specialist is amazing.

The direct connection between these resources and the instructional practices of teachers and students was apparent during the site visit. While observing classes both within the computer labs and other classrooms the following technology-based practices were observed or described:

- Students in a 6th-grade language arts class used the Internet to explore and evaluate various poetry websites and write their own poems for Internet publication.

- Students in a 6th-grade science class used the Internet to gather information on the Alaskan Tundra ecosystem and used a variety of productivity tools to create a product, such as a newspaper, mural, or research proposal.

- Students in an 8th-grade social studies class used the Internet to study court cases pertaining to one of the Bill of Rights that they selected, search for newspaper articles that pertained to this amendment, and construct a poster that explained how the amendment affects the lives of their classmates.

- Students in an 8th-grade used Blackboard , an intra-net collaboration environment, to share, read, and comment on each other s papers.

- Students in an 8th-grade math class used Geometer s Sketch Pad to construct geometrical shapes and dynamically explore their properties.

- An 8th-grade student used a video camera and video editing software to make a report on tennis for a project in his inquiry class.

The Student Achievement Specialist estimated that over 80% of the teachers use technology in their instruction on a regular basis. And the Principal estimates that only 15% are not as far along in their use of technology as she would like.

Teachers, students, and parents that were interviewed all expressed high expectations and positive attitudes about the use of technology in support of student achievement at Mountain. Teachers commented that:

It s valued by all teachers in all areas of curriculum to go to the computer lab to do something.

Another said:

I don t think I would dare plan a year s worth of curriculum without integrating technology. In this school that would just not be okay anymore.

Students said that their schoolwork would be a lot harder without computers. One parent commented that:

I m seeing my daughter come out with incredible papers and um, you know, it s because she s able to use that resource [i.e., technology].

Another parent mentioned that her chronically sick daughter has been able to stay connected to her teacher through the use of email; It has allowed her to stay on top of things.

There are other resources available to teachers and students; as with technology, they are in service of student achievement. For example, the Proficiency Center is a facility in which one-on-one help is provided to students who have been identified as being deficient in one or more areas of the Colorado Standards. Parent volunteers often work with these students around structured activities that address the standards. Technology also plays an important role here. For example, one of the programs, Excel at Algebra allows the resource staff to set where they want students to start and then students can work through at their own pace. The River Deep program works the same way. A diagnostic test places students into the program wherever their skill level might need to be built in math and science. Mountain is also a magnet school for the ESL (English as a Second Language) students in the district

(they constituted 15% of the students in one of the classes we observed). These students get additional help with their language; again, technology plays an important role. The school s Principal described a project in which the two ESL teachers worked with their students put together a PowerPoint slide presentation and introduce themselves to their parents for parents night. She observed, the pride in the kids, the pride in the parents...it was great.

The shared vision, expectations, and culture that have been built at Mountain and the staff and material resources that have been provided to their teachers has created a special kind of school and culture, one oriented around the use of technology to support standards-based student achievement. One parent summed up her attitudes about the school:

My kids are totally different students as a result of being here. And I feel really privileged that I m able to [have my children] attend this school.

Hypotheses

Hypothesis 1.

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

Evidence in support of hypothesis 1.

By definition, technology plays a subordinate role at Clear Ridge and Mountain. The Principal and the Student Achievement Specialist characterized the innovation at Mountain as the integration of technology into the curriculum to support student achievement of standards. If statements like they couldn t have done it without technology or that wouldn t have happened without technology are the criteria for evidence for a strong role for the role of technology, there is little evidence that technology has played a strong role in driving changes in curriculum or instruction at Mountain.

The strongest comments about the role of technology in bringing about change were rather modest in claim. For example, when discussing the role of technology in the Proficiency Center, the Principal commented on the ability of the software to differentiate the instruction around the needs of individual students:

A teacher can t have thirty different individual lessons happening in the classroom at the same time. So that s one of the beauties that I really see [in using technology].

Or an 8th-grade teacher said:

Our kids write so much more because they have technology to use in their writing.

Perhaps the strongest comment came from the Student Achievement Specialist, the technology coordinator, who said:

Technology can make things possible that nothing else can writing for a larger audience. The creation of a web site so that other people can read what you re doing. . . . Using spreadsheets to solve problems.

But even here, the Student Achievement Specialist subordinates her statement: That will increase student achievement of a standard.

Evidence in support of the rival hypothesis.

More often, the comments made by administrators, staff, teachers, and even students suggested that technology was an added resource an important resource, but just one more in an arsenal of resources that supported standards-based student achievement. The Principal commented that, It s really enhancing the teaching of the standards . . . rather than just replacing something that they could already do in their classroom. She went on to say:

It s just a different view of doing that, and so I think technology, if the teacher has that end in mind, then the technology can be just one of the tools to enhance them getting there.

The direction of impact is one of standards changing the use of technology, rather than the other way around. The District Technology Director, commented on the District s technology plan:

This plan also talks a lot about how [we] are going to be able to do the things that we know are right with kids for learning. Use technology to do that and within that embed the standards . . . and move toward where we need to be . . .

Similarly, the Student Achievement Specialist stated:

Instead of what do you want to do and what program do you want to use , it s more what standards are you trying to address through this lesson , so it s changed the way that we plan

The statements most often made by teachers were that:

- the use of technology enhances the curriculum
- it s an alternative way for kids to express themselves
- it can be used to do research in a slightly different way
- technology is always one of the choices for students.

Teacher attitudes were best summed up by one 6th-grade teacher who said:

Technology, I kind of feel, is a way to enhance my curriculum, because that s a conflict, I think does curriculum drive your instruction or does technology drive your instruction? and of course, this being a standards-based school, I have to say my curriculum does.

Technology is important at Clear Ridge and Mountain Middle School, but it plays a supportive role and it is taken for granted in this community of frequent computer users. The Middle School Director, made an interesting comment on this topic. He said:

I don t view it [technology] as a change agent that we ve introduced children to technology and then it s infused into the community. I just think that we reflect the community; the school reflects the community that it s part of.

Hypothesis 2.

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

Evidence in support of hypothesis 2.

Traditional notions of diffusion posits that the spread of innovations follow natural lines of communication within a system, often influenced by an opinion leader. The distribution of innovation users often forms a bell-shaped curve, with a small number of early adopters and hand full of laggards and a large group in between.

There is little evidence for this pattern at Mountain Middle School. Perhaps the greatest evidence against it is the highly-skewed distribution of technology use at Mountain. According to the school s Student Achievement Specialist, 80% of the teachers are regular technology users and according to the

school s Principal, only 15% are not using technology as much as she would like. This is very different than the normal distribution predicted by the traditional theory of innovation diffusion. As described by the Principal, it is more like a situation where a whole staff can kind of hold hands and jump into the fray together, and where everybody s taking risks, and where everybody s learning together . She goes on to say, I think those are probably the most powerful staff development times I ve seen, when a whole building changes. At Mountain, it is more like a cultural change than the diffusion of an innovation.

Evidence in support of the rival hypothesis.

Rather than the result of a natural process of communication, the integration of technology into the curriculum in support of standards-based achievement seems to have resulted from a systemic plan to change not just the practices at Mountain but the entire culture. While the Principal often acted as an opinion leader in modeling the use of technology, she more often engaged many people in a collaborative learning process. As she put it: I think sometimes it s leadership that helps them get there by saying if we all do this together , with me being one of the learners. A centerpiece of this collaborative process was the Shared Vision statement that she put together with staff, teachers, and parents over a year-and-a-half period. Technology was an important part of this statement. She commented on the shared vision statement:
It almost becomes your Bible, your mantra for your building, because it s what you fall back on when people are being resistant. But we all agreed to this, we all said we were going to integrate technology.

Hand-in-hand with this collaborative process, there has been a widespread expectation that technology will be used and teachers have been provided with extensive resources to enable that. These resources include a large number of computers, a range of software packages, and staff support for teacher professional development and to assist with the use of technology. One teacher reported:
It s just the way teachers feel now about using technology because there s someone in a position to help them and to have them . . . and when you come in, she s always there and can help troubleshoot stuff. . . . So I think that support is very important.

As a result of this collaborative process and material and human resources, there has been a large-scale, near-unanimous integration of technology into teaching.

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 ICT s 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 the rival hypothesis.

With 300 computers, Mountain has a 4.3 to 1 student to computer ratio. Of these, 93% are multimedia computers and 83% are networked for email and the World Wide Web. In addition, Mountain has laser printers, color printers, scanners, devices for digital image and video processing, a CD-writer, and several video projectors. They also have an extensive software collection. Most computers have word processor, spreadsheet, and graphics software. In addition, they have mathematical programs, tutorial programs, drill and practice programs, simulations, educational games, presentation software, and music and video composition software.

Evidence in support of hypothesis 3.

Clearly, Mountain Middle School has a technological infrastructure that any school would envy. But it is its extensive human infrastructure that accounts for Mountain s success. As the District Director of Middle Schools put it:

So we re really trying to stop and say, So, what makes it work at this school? and a lot of it is the person. . . . You need a fix it person and then a person who really looks at integration of technology into the instructional process. I think it s pretty crucial.

Mountain has both a full time Student Achievement Specialist (like a technology coordinator) and a technology assistant. The technology assistant is the fix it person. The Student Achievement Specialist (technology coordinator), provides a systematic teacher professional development program that includes instruction on how to use computers and various software packages, how to integrate technology into the curriculum, and peer-coaching. She also provides one-on-one support to teachers as they plan their lessons and implement them in the computer labs. The Student Achievement Specialist is a key to successful implementation at Mountain. According to the Middle Schools Director s assessment of the Student Achievement Specialist:

She is someone who can see the instructional implications of what technology can do. She also has a winning personality. She is someone who people like, they trust, she s bright, she helps people see connections where they would never have seen them before. She s a crucial piece of this.

As mentioned earlier, the teachers agree with this assessment. The Principal summed it up: I think if [she] went away, if we decided not to fund that position anymore, I think the sustainability would be gone.

But ultimately, the successful implementation at Mountain is dependent not just on the staff support but the response of teachers to the expectations that are set at Mountain and to the support with which they were provided. As documented above, the response of the teachers has been quite impressive. One 6th-grade teacher characterized the teaching staff at Mountain:

We re hard workers, we re driven to excel. We always want to be on the latest of what s new with technology. We re all well-rounded individuals and we have a drive to succeed and that rubs off on the kids as well. . . . We re competitive but in a way where there s no problem sharing ideas and sharing activities.

Parents agree with this assessment. One said:

I think the teachers and staff commitment is just remarkable. It s, it s like nothing I ve ever seen before.

Another commented:

The teachers and staff here are willing to move around. They re willing to be flexible and they just constantly reevaluate what s good for the kids. I mean that s great.

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 the rival hypothesis.

There is very little direct evidence in this case to address this hypothesis. As documented above, Mountain Middle School and the Clear Ridge District are above average . They have a demanding and supportive administration, a strong and committed teaching staff, high achieving students, and supportive parents. They have an envious supply of hardware, software, and other resources. All of these factors, indirect as they are, would suggest that if anything, these students will do even better, as a result of their access to technology and the gap between these kids and others will widen.

Even within this enriched environment, the Student Achievement Specialist expressed a haunting concern:

I m concerned about equity of access. Because I think that even though you look around and you think Oh wow, you guys have all these labs, we also have a really big school. . . And I have some concerns about that that not all kids leave Mountain Middle School with the same experience.

Evidence in support of hypothesis 4.

There is, on the other hand, some evidence to the contrary. First, the Middle Schools Director expressed a commitment to use technology to address the needs of a broad range of students. Whether it s students who are very high achievers or students who are needing support, special education students, students with multiple handicaps all accessing technology. Because again the expectation is that technology needs to be present for all of them.

The Principal also saw a great potential for technology to address the individual needs of children. She saw this as a particular advantage for students in the Proficiency Center. One of the parents commented on the capability of the school to address the needs of her son, but more from the perspective of proficiencies than technology:

All through his whole education here, he was helped to get to the level that he needed to be at in order to, um, be successful . . . they, they started him very early in sixth grade and, and it s a path, it s a future path. . . . Without those proficiencies, um...we d be looking at a totally different picture.

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.

Everything about the Mountain Middle School case points to the use of technology to support high standards. The argument is aptly summarized by the District Technology Director:

And so the focus of the [technology] plan is how do we take technology and really give it a tight purpose toward the ends of student achievement.

Evidence in support of the rival hypothesis.

Only one bit of evidence suggests that academic skills might actually decrease because of the use of technology. At one point during the interview with the Student Achievement Specialist, she commented:

I m also concerned about how easy it is for them to get information and pass it off as their own. I think that s a real challenge for us is to, to make sure that whatever they do, it s not just finding the

information, it s what they re going to do with it. . . . I mean there s daily, five or six times, I see kids copy something, you know, from the Internet and boom, paste it right into their document and you just go it s not your work .

But even the way that the Student Achievement Specialist qualified this statement indicates that she is constantly guarding against this practice and it is not tolerated.

Projection to the Future

There are three components to future developments for Mountain Middle School, as articulated by the respondents in this case study:

- teachers will engage in backward planning when analyzing standards..
- technology will be used to help teachers analyze student proficiencies and engage in backward planning.
- wireless technology will be used to increase classroom access to technology.

While teachers at Mountain are immersed in the culture of student achievement at Mountain, there is a sense in which they are doing things the way they always have. As the Principal put it, they re teaching to the standards but doing it in the same way, just that forward planning. She describes backward planning:
I think standards-based education works backwards to that. It says, here s what I want kids to know now, or I ve built my assessment based on what kids need to know to meet the standards, now how do I build my lesson to get them there? It s just a different view of doing that, and so I think technology, if the teacher has that end in mind, then the technology can be just one of the tools to enhance them getting there.

The next step in the Principal s plan is to move teachers to using backward planning . With this approach, teachers begin with a standard and a way to assess it. This gives them a means to determine what students know and do not know. They then can provide students with the instruction they need in order to achieve. Moving teachers toward backward planning is a major goal for next year for the Principal and the Performance Assessment Specialist who is developing teacher workshops around this theme.
Both the Director of Middle Schools and the District Technology Coordinator see an important role for technology in this development, the second development for the future at Mountain and Clear Ridge. When commenting on future developments in Clear Ridge, the Director of Middle Schools said:
I m also seeing a great deal of technology being used in data analysis, and the blending of enabling teachers to interpret data; to understand the instructional importance of that data, towards student achievement; to begin to ask questions of that data, as far as how they would plan for instructing students; is impacting instruction. . . . I see teachers using more technology to inform instruction and then, with that informed base, doing a better job of determining how technology can then be used in the instructional experience.

The third development for the future at Mountain is wireless technology in the classroom. With the money provided by the PTC, the Principal and the Student Achievement Specialist plan on purchasing a portable I-Book rechargeable lab on Airport wireless network. The additional resources will reduce the access problems to equipment in the computer labs and mean that teachers can use computers in their own classrooms. Both the Principal and the Student Achievement Specialist feel that this capability will increase the integration of computers into the classroom work.

Appendix A: Methods

Research Team: 2 researchers
Time Frame: 5 consecutive school days

Data Collected:
Interviews (30-90 minutes unless stated otherwise):

- School principal
- School Technology coordinator (2 hours)
- District Director for technology
- 4 8th grade teachers
- 4 6th grade teachers
- Proficiency Center Teacher
- Library/Media Specialist

Focus Groups (30-60 minutes):

- 4 teachers
- 4 8th-grade students
- 4 parents of 8th-grade students

Observations (45-60 minutes):

- 6th grade class in computer lab (2 observations)
- 8th grade class in computer lab (2 observations)
- 6th grade class in classroom (2 observations)

Appendix B: Teacher ICT Practices Survey Results

(Site 500, 39 teachers)

How comfortable are you with using a computer to:

	very comfort-able	comfort-able	somewhat comfort-able	not comfort-able
	%	%	%	%
Write a paper	100%	0%	0%	0%
Create, maintain web pages	13%	5%	31%	51%
Send & receive e-mail	90%	10%	0%	0%
Programming	0%	5%	8%	87%
Draw picture or diagram	18%	26%	38%	18%
Present information	23%	13%	36%	28%

For work you assigned last year, how often did your students:

	1+ times weekly	1+ times monthly	a few times	never
	%	%	%	%
Use WWW	10%	33%	41%	15%
Create web pages	0%	0%	23%	77%
Send & receive e-mail	5%	8%	26%	61%
Use word processing	36%	36%	26%	3%
Use computer for games	5%	13%	46%	36%
Use a graphics program	3%	26%	41%	31%
Join on-line forum or chat	0%	0%	10%	90%
Use presentation program	3%	3%	38%	56%
Use instructional program	8%	3%	59%	31%

Experiences last year

	yes	no	4
	%	%	%
Graded student computer use	55%	39%	5%
Made Web site for my classes	29%	66%	5%
Involved in virtual, online course	18%	76%	5%
Students collaborated via Web	5%	89%	5%

Rate your ability to use a computer

	good	fair
	%	%
Ability to use compute	54%	46%

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

		no restrictions	some restriction	Only certain sites
Students web restrictions	Count	6	16	5
	%	22%	59%	19%

Computer use in classes last year

	All	Most	Some	Very little
	%	%	%	%
% of classes devoted to computer use	38%	41%	22%	0%
% of computer use done individually	16%	59%	22%	3%

Computer use at home

	1+times weekly	1+times monthly	a few times	never
	%	%	%	%
Amount of computer use at home	39%	29%	29%	3%

Collaboration with other teachers via WWW

	yes	no
	%	%
Using ICT for collaboration	51%	49%

E-mail messages sent daily

	12+	6-11	1-5
	%	%	%
Daily e-mail messages sent	21%	31%	49%

Computer Expertise Index

	none	1	2	3	4	5
	%	%	%	%	%	%
Number of computer activities done	26%	15%	23%	13%	13%	10%

Appendix C: Supporting Evidence

None to include