Joshua Junior High: Inquiry-based Instruction Supported by Technology

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U.S.A Exemplary Technology-Supported-Schooling Case Studies Project

April 2001

Overview

Joshua Junior High is a school where teachers are skillfully integrating curriculum and technology, and students are excited about learning. Carl is a grade 7 student in Mr. Miller s social studies class. He is working with his partner Leonard, doing a research project on feudalism and American slavery. In this unit students have a variety of tasks to complete. They have to compare and contrast feudalism and American slavery, examine cause and effect relationships, evaluate and interpret primary and secondary historical sources, and then summarize their research findings into a PowerPoint presentation. Carl commented that he likes doing PowerPoint. But both Carl and Leonard know that in order to get a good grade on their Power-Point presentation they will need to work as a team, researching information on the Internet, analyze data, organize it, and then decide which ideas and information to present on their slides.

In another section of the building in Ms. Erickson s grade seven science class students were just beginning their study of obesity in adolescence. As the class began, several students eagerly raised their hands to pose a question to Ms. Erickson. Ms Erickson acknowledged each student who had a question, yet never gave a direct answer to them. Instead, she re-directed each student s question asking, How do you think we can find an answer to that question? Students appeared to enjoy being encouraged to seek out their own answers to questions. To assist them in their quest for answers, they turned to the Internet as a readily accessible tool to assist them in their quest for answers.

Later in an interview Ms. Erickson was effusive in her support for technology use in support of instruction:

If you want to see your children, your students actively engaged without any input from you, or let me say with only minimal input from you, and learning still happening, you want to do this. You want to do this. It s not about you, it s not about me. It s all about them. When you see them, I mean they have an I got it kind of look. You know, so, if you want to see animation...and you want to see activity, and

you want to see engagement...then you have to do this....I wouldn t teach any other way now. I mean, I would if I absolutely had to. But I just really hope that there never comes a time when I m without a technology classroom. I see the difference in the kids (AT 0606).

Teachers in Joshua technology rich classrooms integrate curriculum and technology to support improvement in students academic performance. The district and school s vision for using technology to improve student achievement began with the district s current superintendent. Since his arrival seven years ago, the district leaders have directed resources to support a commitment to improve teaching and learning in Joshua, including re-allocating substantial dollars ICT and support personnel to integrate technology into teaching and learning.
Joshua is a first tier suburb of St. Louis; its only junior high school is medium sized, enrolling 500 students in grades 7 and 8. Approximately 85% of the school s students receive free or reduced lunch and like many major metropolitan cities, its students fit virtually all of the descriptors that are associated with at-risk populations. In spite of these challenges, the district has successfully implemented a reform plan centered on providing teachers with extensive technology training and support. In part, this has resulted in a 2:1 student to computer ratio and has provided students with a technology-rich learning environment. The curriculum goals addressed in the innovation were diverse. They included, improving student performance, changing teaching styles and strategies, improving students attendance, improving students behaviors, and improving teachers attitudes and morale. Students in the technology-rich classrooms have posted gains on the standardized tests. Joshua school district clearly has a vision for how technology and curriculum integration can effect improvement in overall student academic performance.

The Past

Joshua Junior High, a school with a predominately African-American student population (95%) has experienced similar challenges that many schools that are located in urban areas face. Many of the students families are low income; 80% of the students receive free and reduced lunch. Many of students academic performance is below grade level. The current superintendent arrived at Joshua School District with a goal to improve overall student academic performance; in that work he considered technology an integral tool. He saw it as a lever for changing aspects of teaching and aiding learning, We felt like it would accomplish some of the changes and reforms in teaching styles and strategies and student performance (AT 0601).
The district began their technology and curriculum integration reform with pilots in two elementary classrooms (at grade five and six). Two teachers were selected to complete extensive professional development training through a statewide technology initiative, the Multimedia Interactive Networked Technologies, or MINTs. MINTs was funded by a $2.7 million grant from Southwestern Bell. In six school districts in St. Louis County thirteen classrooms were set up with high capacity bandwidth (10-Mbps connections that could be increased incrementally up to 145Mbps). The networked teachers workstations had the capability to project work on an electronic interactive white board via a multimedia projector. The MINTs classrooms were also provided with 15 networked workstations for students use. And in each classroom a scanner, a printer, a digital camera and quality desktop video equipment were provided for teacher and student use.
The objectives of the original MINTs program were to prepare teachers to integrate technology into their curriculum and instruction, provide a high-speed Internet connection, eliminate technology barriers, and affect improvement in teaching and learning. The two Joshua School District teachers who completed the MINTs training were very successful in transferring their technology training into

the classroom. They expanded and enriched their instructional practices through an integrated use of the Internet into the curriculum, and their students showed overall improvement in academic performance. Superintendent Ramsey was pleased enough with what he saw that decided to dedicate district resources in order to fund training and advanced technology classrooms for six additional teachers in the district:

We saw from there it was doing the kinds of things we thought would happen. It would improve student performance, change teaching styles and strategies, improve attendance, improve behavior of kids---[now] they wanted to be there. It improved teacher attitude and morale....And from there we decided we would expand after looking at test data also. We expanded into 18 classrooms, which actually last year was the first year for 18 classrooms. We saw the same kinds of initial improvements, and then we expanded again this year to 30. We re training for next year to go into probably 45 or so (AT 0601).

The district planned the technology purchases and professional development so that it more or less replicated the experience that the two teachers in the pilot study had. The district s long-term goal is to integrate technology and curriculum beginning at grade three and extending to all core subjects (social studies, science, English and mathematics) at the secondary level (grades seven to twelve). They are reallocating a substantial amount of district funds for wiring, hardware, software, staff training and support in order to carry this out, as well as applying for e-rate funds from the federal government. During the first year the professional development opportunity was offered (beginning January of 1999 and extending up to the beginning of that school year) teams of two or more teachers were invited to attend the district supported technology professional development. At Joshua Junior High three grade seven teachers, two from social studies and one from science, were the first teachers to begin the technology professional development training. The following year three eighth grade teachers, again two social studies and one science teacher, attended the training for the 2000-2001 school year. This voluntary, unpaid professional development commitment required teachers to attend weekly meetings over a period of about nine months. A team of five staff members provided the district s technology support. Three staff members attended to the technical support for hardware and software problems. The other two members of the technology staff are the original teachers to complete the MINTs training, and now on special assignment as Technology Integration Specialists, provided the initial curriculum-focused technology training to all teachers and the on-going support for technology integration. Technology Integration Specialist Sally Kinsey described that the first part of their year-long professional development program emphasizes the operation of hardware and software and the latter part emphasizes an inquiry-based approach to its integration:

Our staff of five go in and get the teachers comfortable handling the machines, the PowerPoint, the Office 2000 Suite. The second half of the year is when we train the teachers, Now you can browse and you know how to use Word, how do you actually use it in your classroom as an inquiry-based format? We take them to sites that are educational, sites that we have them look at the different aspects of what is inquiry-based versus what is a worksheet, just reading information. We also show them different sites that they can go into to write lesson plans if they choose to, our server spaces, things that will help them as teachers....We require our teachers to write three inquiry-based interactive internet lessons, and along with that they can take one of those lessons and create a PowerPoint to present it to their classroom....we require the teachers to develop an instructional web page lesson.

But also basically driving home the idea of what s inquiry-based, changing their philosophy about education...saying now that there s a tech room, these things are totally different: You become a facilitator. You re not in charge of the information. They [the students] are in charge and actively involved in finding the information themselves. You re there to facilitate. So it s kind of getting them to rethink everything they learned in schools....We want to make sure the teachers are using it effectively.

That they re not using it for a worksheet, and they re not using it just to read and answer questions. That they re really truly understanding that in order for a student to be an active learner that they have to be involved, they have to make decisions....because that s where we found our biggest gains come from when the students take control of their learning and their engagement. (AT 0603)

Only teachers who have completed the technology professional development are considered for an advanced technology classroom. An advanced technology classroom consists of 15 networked student stations with Internet access, a networked teacher workstation, an electronic interactive white board, multimedia projector, classroom printer, scanner, TV monitor and VCR. Teachers and students use Microsoft Office 2000, including Word to create and print documents, PowerPoint to present information, and Excel to create tables and graphs. Publisher is used to publish newsletters, brochures, and signs. And Netscape is used to research information on a multitude of topics. The two full-time Technology Integration Specialists are available to provide technology support to teachers and assist them in curriculum technology integration.

The technology classrooms at the secondary level (grades 7 to 12) are implemented in targeted core subject areas; therefore, all teachers who enroll in and complete the training are not assured of getting a technology rich classroom the next school year. The after-school-for-a-year training for the teachers is unpaid. So clearly, the teachers who come to the professional development are committed to learning about technology use and its integration. The six teachers from Joshua Junior with such classrooms expressed gratitude for what they had received.

The district recognized that technical and instructional support was essential to the success of their work and made a commitment to provide high quality technology support. The Joshua District Technology Director recognized the importance of his department s work in providing these elements, ¼There are two things that [must] go on. The teachers have to be ready for this, and the technology has to be ready. If either one of those pieces fail the thing falls apart. (AT 0603).¼ The teachers at Joshua concurred that the support provided to them was excellent, as did the Principal,

I don t think you could get any more technical support in any aspect than what we have here....Any time there s a problem with the computer, we call them over there, and if they re not there we leave a message, usually within by the end of the working day they ve gotten back with you,...Most of the time, nine times out of ten, that same day they re over here. I don t think you could beat that. (AT 0602)

The Joshua School District has accomplished a lot with a little. With little external support, they have made substantial investments in overall school improvement, technology hardware and support, and professional development with little external support. In all of the advanced technology classrooms there is a 2:1 student to computer ratio, comprehensive technology support, and teachers who have completed extensive preparation on how to integrate technology into the curriculum. The Joshua School District stands as a lighthouse to other schools, showing how technology can be integrated into the curriculum to provide rich learning experiences for students who have typically been identified as low-achieving and how to make a difference in technology access and equity.

The Present

While our visit was to Joshua Junior High School only, the technology staff described that much of what we saw is taking place was also happening in the rest of the schools in the district. The technology integration underway is definitely led from the district level, and is a very focused approach with a planned expansion. In the district, including at Joshua Junior High, their stated purpose for technology integration is to raise student achievement; their pedagogical approach for doing so is to focus on technology as a support to Inquiry-based instruction. Developing these capabilities in students

helps them on the Missouri Show Me Standards, the students progress on which the school, and district, is judged. In implementation, the district has targeted particular curriculum areas for technology classrooms, focused on a particular instructional approach and role for the teachers, and encouraged teachers to assess students in a manner consistent with the state standards.

When the Joshua School District expanded the use of technology beyond the first two MINTs classrooms at the fifth and sixth grade levels, they did it in a way that allowed the students in the original MINTs classrooms to continue on in the technology classrooms as they advanced through their next grade levels. In the junior high, they targeted three core subject areas for technology integration, social studies, science and English. Teachers in these content areas were asked to attend the training during the year before they would receive a technology classroom.

Currently, there are six technology classrooms at Joshua Junior High School. The first three, put into place during year 1999-00, were seventh grade teachers classrooms, two from social studies and one from science. This school year brought three more, for the eighth grade teachers in social studies and science. (It is notable that the school district provided funding for two of these but the junior high school principal was so enthusiastic about the impact of the advanced technology classrooms that he earmarked all the profits from the school s soft drink machines to fund a third classroom.) This year, the school s two seventh grade teachers in communication arts (English) are in training and are likely to receive a technology classroom next year; the eighth grade teachers of English expect that they will be encouraged to take the training and get a technology classroom in the following year. The Superintendent indicated that after the current planned expansion they will review their progress and plans for the future; at this point they do not anticipate expanding to mathematics or elective areas at the junior high.

The focus of the innovation is inquiry-based instruction supported by technology. During their year of training teachers are taught to operate the technology and then presented with an instructional approach the district calls inquiry-based. In this approach the Internet is used as a resource correlated to the curriculum, and tool software is for students to make products that organize their work and express what they have learned. The district s Technology Integration Specialists, Sally Kinsey and Celia Manning, explained that they emphasized to the teachers in training that the inquiry approach would require new approaches by and roles for teachers:

It s the first thing we talk about, because they have to know it [the technology classroom] is going to change the way they teach and the way they direct their classroom. You re not the dictator in front of the classroom with authority and knowledge...your kids direct their learning and they become engaged in it themselves. And you stand there and you are their partner, you re their facilitator; a community of learners is what you become. And the teacher s no longer the know-it-all...and your ego has to kind of take a back seat. [it is about]changing their philosophy about education...and saying now that there is a tech room, these things are totally different. You become a facilitator. You re not in charge of the information. They are in charge and actively involved in finding the information themselves. You re there to facilitate. So it s kind of getting them to rethink everything they learned in schools (AT 0604).

The idea of teacher as facilitator, students as producers of work, and the technology as a tool is one often described by technology enthusiasts. When the first teachers at Joshua Junior High to receive advanced technology classrooms were introduced to it they described it as an abstract concept that did not help them know what, specifically, they should do with technology. Mr. Miller, a Joshua Junior High seventh grade social studies teacher, explained that while he had understood their description of an inquiry-based instructional approach, it was something that gradually sunk in and took on new meaning as he had a chance to try it out. He described that after having such a classroom for one and half school years he had become comfortable with technology and come to understand inquiry-based instruction as a concrete concept:

You are actually seeing the evolution of a teacher from a survival basis to a comfort level, [who is]

now ready to take the technology and impose my will on it, more so than it imposing its will on me....What promoted more of an evolution [of my understanding] was me asking myself how to get more student participation in the lesson as opposed to [their] reacting more to what I give them...and seeing the computer, the tool that it is, that they could do that [participation] and do it reasonably well....[Now I] Give the student a task to complete, not too much in direction but enough in direction to where they have to do a lot of the problem solving in order to answer the main question, and bring things up in their own minds as to how best to go about tackling this, or sifting through hoards of information (AT 0610).

His description of inquiry-based instruction was similar to what the other teachers in advanced technology classrooms described as the approach to instruction that they were working to put into practice.

All six of the teachers described that this inquiry-based, technology-integrated instruction was correlated to the curriculum and standards for the State. Mr. Miller described that during planning time, the standards were pretty much our blueprint. We wanted to match up our lesson goals and objectives to the Show Me Standards for our grade range, which is 5-8...[so] we can prepare the students for the MAP [the Missouri performance-based test] (AT 0608). He went on to describe how they also keyed their curriculum to the key information areas in the Terra Nova, the norm-referenced standardized test given to seventh graders.

Because the State curriculum standards were new, as were the computers and inquiry-based instructional approach, and the social studies and science teachers were encouraged to make regular use of their computer resources, it required a substantial investment of time on their part to plan for regular integrated instruction. The instructors have now aligned their lessons for the entire school year with Missouri Show Me Standards and integrated technology use in each unit. They follow a district template to organize lessons, which includes a section for technology web site sources and the Missouri State Standard that each lesson addresses. While the teachers were guided to educational resource sites, the already created resources still required revision and adaptation. Mr. Miller described it as a huge search to find appropriate topic and reading level materials and that a myriad of things that went into the planning process before it was actually ever presented to the students (AT 0608). Seventh grade social studies teacher Mr. Clark provided a familiar metaphor to describe the work: As a teacher you have to do your homework. You have to go into those sites. You can t just say, Hey, today we re gonna get on the Internet (AT 0610).

To support teachers in this work, at the district level when new curriculum adoptions are underway, they now include Internet and software resources that are keyed to the State s curriculum standards and tests. District Technology Integration Specialist Kinsey describes how, over the last two years they have been rewriting their science curriculum, and that the end product will include both a binder of the curriculum, and then an appendix of technology lessons that they [science teachers] can use at any different part of the science curriculum. So even non-tech teachers [teachers without advanced technology classrooms] can actually get into the labs and use some of these lessons....we re rewriting it with the MAP in mind (AT 0604).

Along with an inquiry based approach to instruction and curriculum aligned with the State s curriculum standards and tests, teachers have been asked to implement a different assessment approach. To assess the students increasingly project-based learning activities teachers were taught to use rubrics, scoring guides that describe what the teacher wants to see in that product. They share the rubric with students ahead of time in order to help them understand what they must produce. This more descriptive approach to assessment is very compatible with the project approach, where students are expected to demonstrate what they have learned through their work with the technology. Elizabeth Benson, an eighth grade social studies teacher, indicated that asking students to produce work and telling them ahead of time what she wants to see has been a change that she thinks helps the students to produce better work:

When they begin their projects, to assist them I use a rubric...or a scoring guide. And I ll let them know what the scoring guide is about....So they can...look at the scoring guide and say, I need this, I need that, and I need that. I m [now] more detailed in what they need to do....I think it has helped them to see where their errors are.... So that has been a change in the way I teach and the way that they are evaluated. (AT 0605)

Jenny Erickson, the seventh grade science teacher, indicated that as she incorporated the inquiry-based approach into her teaching that she also adjusted her methods for assessing students learning: Now I use more constructed response type items, more performance items that my students do. Before technology, my tests were 100% multiple choice. So I ve progressed a whole lot (AT 0606). She described how experience taught her that technology could potentially undermine student learning if the assignment and assessment wasn t structured correctly, Because I don t want them just to regurgitate to me what it says. They are very good at cutting and pasting. And if I ll allow them to, that s all they will do. So, I found that out....I had to move to the level of, OK, give me a project. Give me something to show me what you ve learned. (AT 0606).

Teacher Practices and Outcomes

Because they were all chosen to receive an advanced technology classroom and trained together, among these six Joshua Junior High teachers there were some similarities in their integration practices and outcomes. Their facing similar goals led them to collaborate together and share. They were also overwhelmingly positive about the opportunity they had been provided.

The teachers in advanced technology classrooms had taught from three to over 25 years but nearly all had limited experience using technology, either personally or professionally, when they entered the year of training. While the district technology leadership wanted to target particular curricular areas for the advanced technology classrooms, they did make it clear that they would choose who would receive one. So these six teachers had some other attributes in common. The Superintendent told us that they looked for particular qualities in teachers that they thought would help teachers deal with the inevitable ups and downs involved in technology integration:

The right kinds of teachers, to me, are the ones who have always demonstrated a real willingness to work hard. They don t have to know anything about technology. [they must be] Willing to work, arrive early, work hard, stay late, and their interest is in improving student performance....They cannot be concrete sequential people, because concrete sequential people need to know all the answers to all the questions before they start. Well, what about this? What happens if this breaks down? What happens here? You can t do that in this environment. You have to have enough confidence and enough flexibility and enough creativity. So you look for those creative people who are willing to go out on this ledge, who know that there s training there, who know that there s help there, but they don t have all the answers....They re certainly not the ones who just want to stick with the textbook....I use the phrase: Many are called, but few are chosen. You get a sense of how they are when they go through the training whether or not they fit in those categories (AT 0601).

In the classrooms the teachers use a variety of software, including word processing, spreadsheets, presentation software (PowerPoint), and the Internet. Because of the students fingertip access to the Internet and their limited, and in some cases outdated, textbooks, there is a big emphasis on teachers developing Internet integrated curriculum in support of inquiry based instruction. Teachers spend substantial time searching out relevant information on sites on the Web to integrate into units that are appropriate for the age and reading level of the students.

The teachers described that in their classrooms they seek a new role for themselves and their students, where they are no longer fully in charge of the information and students are actively involved in

determining and finding the relevant information and making sense of it. The teachers still feel very much in charge of their class and are often at the center of the interactions there, like when starting class or at the beginning of projects and providing direct instruction. While the students are working on inquiry-oriented assignments and projects they circulate throughout the room, answering students questions. At times they stop and provide nudges to pairs of students who are not working together well, or who gotten off the task. If they encounter a number of students who are having problems, they may stop the class and redirect their attention, or provide additional clarification. If one pair of students locates an especially relevant Website or shares an insight to the work at hand, the teacher may ask them to share it with the class. Through these frequent interactions they signal to the students that the role of teacher and student is fluent, that sometimes an adolescent can be the teacher and the adult the learner. In general, the advanced technology classroom teachers work to provide enough direction so students stay focused, but make students be the decision-maker and problem-solver whenever they can. A seventh grade social studies teacher described himself now as providing more freedom for the student. More opportunity for them to showcase what they have to offer, what they can bring to bear (AT 0608).

The use of the Internet resources in class always requires that teachers fulfill the role of monitor, to ensure that students do not go to inappropriate sites. If students do, or act disrespectful to the equipment, most teachers remove that student from the computer and give him or her book work assignments for a period of several days to several weeks.

Once they have taken part in the technology staff development the teachers tend to continue to collaborate when creating their technology enhanced curriculum. The pairs of social studies teachers at seventh and eighth grade had strong collaborations. They re-wrote their social studies curriculum incorporating Missouri Standards and Web sites. This was a challenging task and required substantial planning and working together on their part. The advanced technology classroom teachers in this building often consult the one another about technology problems or issues.

These six Joshua Junior High teachers were very positive about their new tools and pedagogy. One teacher commented, I wouldn t teach any other way now. I mean I would if I absolutely had too. But, I just really hope that there never comes a time when I m without a technology classroom (AT 0606). Other teachers expressed similar positive sentiments. One indicated that he was committed to always looking to improve, always looking to get more out of less: less time, more product, less waste, more seeing that the student benefits out of more self direction with instruction (AT 0608). Mr. Clark, an eighth grade social studies teacher with twenty-five years of experience, described a total shift in his point of view that has resulted from his experience with the district training and an advanced technology classroom.

I once thought that if the classroom s quiet, kids learn; but that s not always the case. I guess I m from the old school, and that s the way I taught. But I realized, after using technology [that] it s important for students to be able to communicate with another student in the classroom. I think students learn more if you re doing that....I was a traditional teacher for 23 years. Standing in front of the class, disseminating facts to students and requiring them to take notes and follow that with a quiz or a test, but I don t believe that was the best way that students learn.... I can t imagine teaching without the technology... I can t imagine using the strategies I use in my classroom today without having computers. Well, I couldn t do it (AT 0610).

Student Practices and Outcomes

In many ways, the student body at Joshua Junior High is rather homogenous. One way they differ from students at most other schools is that they are regularly using technology in support of their learning social studies and science and they are taking on new student roles in the classroom. In addition, they report having developed new skills and improved their self-esteem; and according to information from

the district, their achievement levels on the State Missouri Assessment Program (MAP) and Terra Nova tests have risen.

All the students in the school are involved in the advanced technology classrooms through their grade seven and eight social studies and science classes. The entire student body is from mostly low socio-economic background, as indicated by the fact that between 80 and 85% of the students qualify for free or reduced lunch.

In the advanced technology classrooms students are regularly given an overall question to guide their work. They then use ICT to look for information and to represent what they have found out about it. An example we saw while we were there was define and compare two forms of servitude [the feudal system and slavery] from two different regions and time periods (0600 Site documents). To do this, students were working at the computers on their desktop, mostly in pairs, looking for information on the Internet. They took notes on particular sheets the teacher had made for them to use. The students spent between two and three class periods looking for information. By circulating around as they worked, the teacher judged they had gathered sufficient information. Their next task was to make a Venn diagram on the computer, which they then used to organize their answers to the question. After organizing the information they had found into the diagram, they were to write up their findings in PowerPoint presentation.

The students were clear that their job was to find the relevant information, put it into their own words, and then process it to represent what they found out. They were encouraged by the teachers to form their own questions as they went along, following their hunches and interests about the topic and translating these into key words for search engines. The students enjoyed this approach and nearly all of them found it easier to find relevant information on the Internet compared to using a textbook. They told us that it was easier because it returned the information faster to them but that they still had to read it and determine if it was pertinent to their topic or not.

In addition to the benefit of the search engines finding and returning to the students the information they wanted, they found word processors a big help to them as they composed their thoughts and edited their work. In a focus group several student elaborated on how they thought the computer aided their writing, assuring us that it helped them learn to do this for themselves, and did not serve as a crutch to their not having to learn to revise and edit:

Student 1: I think the best thing you can learn on computers [for writing] is grammar, because the computer is always fixing your grammar. And a lot of times you get on the paper, you write like you see on a computer.

Interviewer: If the computer shows you what is wrong, you can fix it; but then does that help you learn how to do it right yourself for the next time?

Student 2: It makes you check your own work. We check ours now on paper, we check our friends, have our friends check our papers...

Student 3: And it [the word processing program] gives you different words. You click on it, and it can give you all the words [i.e. synonyms] and you can think about it (AT 0607).

There was one aspect of working on the computers in class that the students sometimes saw as a drawback and at other times as a benefit, it was that they nearly always worked with a partner on the computer. In the advanced technology classrooms the student to computer ratio was 2:1. The classroom furniture they used were long rows of tables with the CPUs mounted underneath the table surface and a flat screen monitor on top of the table. Students pulled up individual chairs that were spaced so as to seat two to a monitor. Thus, when it was time to work on the computer, the students nearly always did so together, unless students were absent or there was an odd number of students in a classroom. The teachers and students alike agreed that this had students interacting about the subject under study more often, and that this was beneficial. When students work together, often they take on different responsibilities: students who were more advanced in technology often helped students who were less

skilled; they were checking with each other about Web resource information; they delegated to each other how projects were to be completed. One of the advanced technology classroom teachers explained what she saw as the changes in their roles, and the resulting benefits:

Well, I think their roles have changed because they are more responsible....they work more now with each other. They collaborate more on projects....They ll have a group project that they have to do...every person has a responsibility for the final project. I think the most key thing is to know that they can depend on other people....That they don t have to know all that it is OK not to know all the answers. That anybody can help them. And then the other thing that they ve also done, is that they look for the people, they know have the specific skills that they need...they have sense enough now to know to go to those people....As we go through a different area, they pick up on who can do what better, [for example,]Kim is very good at graphing, so I want Kim in my group (AT 0606).

However, sometimes problems arise when the more skilled students feel as they are teemed up with a less skilled student who doesn t listen to their advice about how to operate the computer. Or, when using the Internet, sometimes students disagree as to where to navigate to, or which key words to use. Most pairs of students indicated that they took turns being in control of the keyboard and mouse in order to alleviate these conflicts.

Often, students receive more freedom to move about technology classrooms to talk to other group members. Hence, they were responsible for demonstrating appropriate classroom behavior when not being directly supervised. The seventh grade science teacher commented that this was something she encouraged for her students, but that she had to get used to it.

I have to be very careful when I see a student get up and move on the other side of the room to find out from someone else what they are doing or how they are doing or how they are processing. Because I used to be a sit-in-your-seat-teacher, and don t move out of that chair (AT 0606).

The students indicated that they thought it was important for them to have regular access to ICT because the Internet provided them with more up-to-date information than did their books, as well as providing a variety of perspectives. Another student added that he thought that the Internet provided more in-depth information than was available in his textbooks.

Computers [and the Internet], they ve just got, they ve got more information....You ve got like a topic, then you ve got like four pages or a page or something to read. In a book, you ve got that topic, and you ve got about three sentences to read (AT 0607).

He went on to explain that he thought that that Web pages forced students to read differently, requiring a more in-depth review, since it was not guaranteed that an answer or fact they sought was even on that web page.

The book, you can get like four pages of it, and it will be like one thing in those pages that we are looking for. So what the kids do, they don t read it, they just run through it, look for that one word and read around there, and they ve got their answer. But with a computer, you can t do that....You have to look down a whole big special page, and they [the students] are just having to read....You have to read faster, too. (AT 0607).

A different student commented that he thought word processors made it easier for him to write better, and improve the appearance of his products.

Honestly, computers help me write a lot better because before, whenever we used to write on paper, I used to never indent or anything. I used to have grammar errors. And then, when I got onto the computer, it helped me a lot better with writing. And I like writing now. It s easier to make it look good, be right, correct (AT 0607).

According to the teachers and students alike, the advanced technology classrooms support several other positive outcomes. Students are staying after to school to work on assignments; they are willing to

attend Saturday school so they can access technology to complete their work; attendance is up; and students were excited about learning. Mr. Clark noted that he saw better behavior in his classes now, Another plus would be, I don t have the behavior problems that I once had, because kids come to class now with the willingness to learn. And they know if they misbehave they re off the computer. Most of them don t want that (AT0610). In addition, students report that they are interested in becoming computer technicians, programmers, and other professional roles as one result of their positive experience with computers. The exchange below quotes the responses from the five students who were in a focus group. Their responses to the prompt Is there anything else you want to tell us? suggest that, at least in the short term, their experiences and successes in the advanced technology classrooms has improved their self-esteem.

Student 1: How do I feel to be in a technology classroom? It makes you feel special.
Student 2: I think computers make you feel a lot better cause if you don t know one subject, like math, and your teacher may secretly think that you re an idiot. But when you go into a technology class, you find out, and you know how to do PowerPoints and know how to write better and you look stuff up and the teacher probably doesn t [know how]. And the teacher will tell that other teacher that you re good at it [technology], and then they won t think you was a numbskull.
Student 3: Computers help me out a lot because now I ask my mom to help me with my homework but she doesn t know how to help me because she says she s too old, that she hasn t been in school that long, so she can t do it. So I m teaching her stuff.
Student 4: It s fun to teach your parents different things.
Student 5: Yeah, cause then they gotta listen to you.
Student 4: That s like the only time in life your parents have to listen to you, when you teach them.
Student 5: Sometimes it s not fun teaching parents, you know, cause then they don t wanna listen (AT 0607).

Problems and Solutions

The students, teachers, and administrators reported few problems with ICT implementation and integration. Of course, more teachers would have like to receive an advanced technology classroom than were going to be accommodated, but everyone seemed to accept the fact that expansion was limited because of funding. The teachers were conscious of the fact that students could gain access to inappropriate materials on Web sites but had also accepted the responsibility for monitoring that this didn t happen.

The Technology Director reported one concern. Recently, the spouse of one teacher in an advanced technology classroom was transferred in the middle of the school year and the teacher left the district. They were unsure what to do when a trained teacher leaves the district in mid-year, or close to the start of the year. The district leaders were reluctant to put an untrained teacher into the room, or to move a trained teacher out of his or her classroom to the advanced technology classroom.

We (the researchers) were concerned that teachers were not compensated for the time they spent in the yearlong professional development experience. But again, the staff members did not treat this as an issue. Instead, they were pleased to have the training available to them and just hoped to get an advanced technology classroom.

The focus group of seventh and eighth grade students expressed some frustrations about differences they recognized between their classes and uses of technology in previous years and in the junior high. The group concurred with one student s assessment that we really don t get enough time to like, just free ourselves and go on the Internet and just explore as much as we want to (AT 0607). They also indicted that they thought that the periods in the junior high were too short (they are 50 minutes long), that just after you got going on some research and a task, it was time to go to the next period.

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 there where true reform is found, technology served only as an additional resource and not as a catalyst, that the forces that drove the improvement also drove the application of technology to specific educational problems.

Evidence in support of rival hypothesis:

The evidence indicate that there was more support for the rival hypothesis, and the need to improve students academic performance was the catalyst for the current uses of technology; therefore, technology served as an additional resource to accomplish this end. The majority of students at Joshua were not achieving academically. The superintendent commented,
The reason I knew it was something I wanted to do was because Joshua was having significant problems with improving student performance...You don t do technology by itself. It s just a tool, it s a pretty powerful tool. So we did it. We are doing a lot of things at Joshua to have real systemic reform and improvement in our student performance (AT 601).

Joshua has focused their reform efforts on its complex student achievement issues. In describing the issues Joshua face the superintendent stated the following,
The initial improvements, though, are phenomenal when you think about it from the school district that was so low achieving. All the achievement issues between black children and white children and all the achievement issues with poverty, high concentration of free and reduced lunch---most of them free. Over 50% of the kids are in single parent homes, most mothers and grandmothers and the high mobility rate. [We] have all of the at risk factors and all of them to a high degree. And to make this kind of improvement in one year that we made to get people to grade level or even in many cases way beyond grade level is just phenomenal, and then to continue that on. So, we re going to see what it s going to do over a two or three or four year period (AT 0601).

Evidence in support of hypothesis 1

Joshua Middle School teachers who taught in the technology-rich classrooms used various technologies during instruction. Within the context of their curriculum technology integration focus the World Wide Web played an integral role. Joshua teachers and district technology staff worked closely together to integrate Web resources into core subjects. Thus, it influenced some of the specific assignments and projects they undertook.

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 rival hypothesis is that technology functions differently from traditional innovations and that therefore different diffusion patterns occur.
These hypotheses are hard to address because there is some evidence in support of both of them. The diffusion pattern was, in general, purposefully planned, but left room for volunteers to step forward.

Evidence in support of the rival hypothesis:

The Superintendent and his technology staff members did have a particular diffusion pattern in mind for expanding the number of advanced technology classrooms. They targeted particular grade levels and subject areas. This is a factor that would make it unlikely that the traditional diffusion model would be present. One teacher with an advanced technology classroom described in a laughing, but sarcastic, tone that he was volunteered to attend. The other teachers with advanced technology classroom conveyed that they had wanted to be in the training but indicated that they didn t remember if they mostly chose to attend, or were strongly encouraged to do so.

Evidence in support of hypothesis 2:

However, the technology leaders also made it clear that not everyone who volunteered to attend the training wouldn t automatically get an advanced technology classroom nor would they automatically put a teacher in one who they didn t feel was well suited for successful inquiry-based, technology-supported teaching. Instead, the year of the professional development allowed the technology staff to see who worked well with ICT and showed promise for adapting to this instructional approach. Because the district technology leaders ultimately decided who got the advanced technology classroom, this somewhat supports the traditional diffusion pattern. The leaders indicated that they were looking for teachers who showed some characteristics of innovators and early adopters, such as willingness to work hard, interested in improving student performance, not concrete sequential, confident, flexible, and creative. The Superintendent summed this up, describing:
We wouldn t put pressure on you to take one of those classes. Not at all. We wouldn t want you to feel like you had pressure. But we would look for those people who demonstrated those kinds of attitudes, the skills. And knowing the technology is the least important attitude and skill. That all can be learned (AT 0601).

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.
The evidence indicates that there is support for both hypothesis 3 and its rival.

Evidence in support of hypothesis 3:

At Joshua successful implementation of ICT is dependent upon staff competence in the integration of ICT in the instruction and learning. As part of Joshua technology staff development model teachers are required to complete an entire year of technology training *prior to getting* a technology classroom. Joshua core subject teachers with technology classrooms have completed the required year- long technology professional development During the technology staff development, teachers learned how to use the computer s software and how to integrate technology into the curriculum. The superintendent explained that he saw Joshua teachers continually creating and updating their own electronic curriculum.
And teachers are constantly creating their electronic curriculum for doing exactly what the education community s wanted for years, is for teachers to constantly up date their curriculum (AT 0601).

Evidence in support of the rival hypothesis:

There is also evidence to support the rival hypothesis that the school technological infrastructure and student ICT competence rather than staff competence determine ICT implementation outcomes. Joshua highly competent technology staff includes both technology and curriculum specialists that provide dependable technical assistance and on-going technology curriculum integration in-service sessions. The superintendent stated,
First of all, make sure that all of the resources are there---when I say resources what I mean is making sure that we have the technical support, and let it trickle all the way down to the tech teachers. We have to make sure that we have innovative teachers. ...Also we have a technical support staff, who again, I give all my praises too, and when we have problems and challenges here in the building, we need them here to kind of hold our hand through whatever dilemma we re going through. (AT 0602).

When commenting about students computer skills one of the first teachers to receive technology training through the MINTs project made the following comment,
And they [students] loved the idea that I didn t have a clue what I was doing most of the time,... and I d have my book and say [to them] okay, this weekend I learned this, and we re all in this together now (AT 0604).

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.
The free and reduced lunch rate in the district is between 80% and 85% at this school, indicating that a majority of the students in the district and school are from families with low incomes. Thus we can t address this hypothesis because all students are low income. When asked, teachers commented that they did not feel that either low income or (relatively speaking) higher income students benefited differently from ICT access. Except that the teachers commented that while they noticed the number of students who have access to ICT at home increasing, for many students the school s resources were their only access to ICT.

Hypothesis 5:

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

Evidence in support of hypothesis 5:

The teachers anecdotal evidence suggests that they have raised their expectations of students and their work. The superintendent, his technology staff, and the principal of Joshua Junior High all agreed that prior to the Superintendent s arrival the students at-risk factors seemed to create for the staff an implicit excuse for students not achieving academically. Superintendent Ramsey was very clear that he made no excuses and that technology was to be a part of the district s overall approach to improving student performance. Ramsey explained this while recounting his history with a successful pilot program prior to coming into the district, and his approach to improvement once he arrived in the

district.
It [technology] would accomplish some of the changes and reforms in teaching styles and strategies and student performance that new technology was capable of....When I came here to Joshua, I knew that it was something that I wanted to do. The reason I knew it was something I wanted to do was because Joshua was having significant problems with improving student performance....So I knew what we wanted to do when I came here. I knew the environment. I didn t know everything we wanted to do, but I knew that technology was gonna be a powerful component in all of it....it was never, ever about the kids. I think that s an important point, too. I don t think I ve changed much in that. It was never about whether or not children in poverty or black children could learn. It s not as if somebody said no, they can t learn. It was never as if the achievement gap had to be there. It was always about whether or not we could change the profession, change the adults. And this tool was a powerful tool. I felt from the very beginning this was gonna be very powerful, what we were doing. (AT 0601)

Evidence in support of the rival hypothesis:

No evidence in support of the rival hypothesis.

The Future

The technology integration effort in the Joshua School District, and its junior high, appears to be highly sustainable. The leadership is strong, the funding source is steady, and the district has fostered the staff expertise necessary to support these efforts.
The Joshua School District s superintendent has a clear vision for technology use and expansion in the district and this is important to Joshua success. Here, Superintendent Steward shares his insights as to what is need to sustain technology integration and implementation:
I think it s a leadership question and an attitude question.....So I don t think it s a big cost issue just to begin with. We re fortunate. We have e-rate, and that s helpful to us, too. But we were spending $5,000 or 6,000 a kid with getting virtually no results, then for changing year round spending about another $100 to $200 a child and getting significant results---the educational community ought to figure this one out. But they don t. The sustainability of it [a district s re-allocation of resources for technology] really does require that all superintendents change the way they do things (AT 0601).

As indicated above, the superintendent was in full support of bringing technology into the districts classrooms and invested funding in order to do so. But because Joshua is not a wealthy school district, this was largely a re-allocation of funds that was supplemented by the e-rate funds from the federal government. Jim Collins, Director of Technology and Brian Scott, Assistant to the Superintendent for Telecommunications and Technology Development, described to us the different strategies the district used in order to save money:
Jim: ...one of the things that s kept us in terms of economy is doing as much as we can in house....[for hardware purchases] I will often do a market survey. Brian will get on-line and look at what s available at what price, we ll compare those things, and then we ll choose a vendor to make a bid, rather than go with an RFP [request for proposals]....[we] call a vendor at the end of the third quarter when we know that they re looking for revenue....If I get a price from them, and I say, I won t accept that ...[which] has given us a lot more for the dollar than we would ve gotten otherwise (AT 0603).
To further control costs and ease the number of people required for technology support, they allow only the use of software adopted as a district standard. They discourage the use of propriety software because they feel it is problematic to maintain. They went on to describe how they selected standard tables over specialized computer tables to further reduce costs. The district s Technology Director explained the extent of their self-reliance:

As far as networking and basically we do everything in house...we put everything from the cable, [for example] the maintenance department runs the power, everything is done within the district as much as possible (AT 0603).

This self-reliance has also built up considerable expertise over a wide range of skills. Together, the highly technology competent team members and technology-trained educators, in consultation with the Superintendent, make the majority of district s technology-related decisions. This supports the sustainability of the technology use in the district because the necessary expertise is available for their future efforts. The technology department is adequately staffed and well qualified. The district has grown its instructional expertise in a manner similar to its development of in-house technical support. The original two teachers who participated in the pilot MINTs project are now the Technology Integration Specialists for the district.
The district has a comprehensive plan for allocation of funds and resources for technology expansion; the Superintendent projected that there will be 45 advanced technology classrooms next year. Lessons that are learned from each year s gradual expansion of technology classrooms are taken under consideration for the next expansion.
It is evident to us that the clear vision and leadership, strong technical support, extensive technology training, and staff commitment provide the necessary factors to maintain technology use in the Joshua School District and its planned expansion.

Appendix A: Methods

Description of the amounts and types of data collected
Interviews Conducted
With teachers (approximately 45- 60 minutes each)

- One grade seven science teacher,
- Two grade seven social studies teachers,
- Two grade eight science teachers,
- Two grade eight social studies teachers,
- Two grade eight English teachers,
- One specialist teacher
- Teacher focus group (comprised of three teachers)

With students (approximately 50 minutes)

- Student focus group (comprised of six seven and eight grade students)

with parents

- One parent telephone interview

With building administrator (approximately 1 hour)

- Principal

With district office administrators (approximately 50 60 minutes each)

- Superintendent of schools
- Director of Technology

- Assistant to Superintendent for Telecommunications and Technology Development
- Two instructional technology specialists

Observations Conducted of classrooms (approximately 45 50 minutes each)

- Two grade seven social studies classes (also videotaped)
- One grade seven science class (also videotaped

Site Documents Collected

- MINTS Project
- Technology Plan 2000 2003
- Achievement Data Report
- Staff Development Plan

Appendix B. ICT Survey: Case #600, 15 Teachers

How comfortable are you with using a computer to:

	very comfort-able	comfort-able	somewhat comfort-able	not comfort-able
	%	%	%	%
Write a paper	87%	13%	0%	0%
Create, maintain web pages	0%	20%	27%	53%
Send & receive e-mail	73%	13%	7%	7%
Programming	0%	0%	0%	100%
Draw picture or diagram	27%	27%	27%	20%
Present information	47%	7%	20%	27%

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

	1+ times weekly	1+ times monthly	a few times	never
	%	%	%	%
Use WWW	36%	0%	21%	43%
Create web pages	0%	0%	0%	100%
Send & receive e-mail	13%	0%	7%	80%
Use word processing	20%	0%	33%	47%
Use computer for games	0%	0%	20%	80%
Use a graphics program	0%	7%	20%	73%
Join on-line forum or chat	0%	0%	0%	100%
Use presentation program	0%	13%	13%	73%
Use instructional program	0%	14%	7%	79%

Rate your ability to use a computer

	good	fair	poor
	%	%	%
Ability to use computer	71%	21%	7%

Experiences last year

	yes	no
	%	%
Graded student computer use	31%	69%
Made Web site for my class(es)	15%	85%
Involved in virtual, on-line course	15%	85%
Students collaborated via Web	0%	100%

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

		no restrictions	some restriction	Only certain sites
Students' web restrictions	Count	1	3	5
	%	11%	33%	56%

Computer use in classes last year

	All	Most	Some	Very little	None
	%	%	%	%	%
% of classes devoted to computer use	42%	8%	8%	0%	42%
% of computer use done individually	0%	33%	0%	8%	58%

Computer use at home

	1+times weekly	1+times monthly	a few times	never
	%	%	%	%
Amount of computer use at home	54%	15%	15%	15%

Collaboration with other teachers via WWW

	yes	no
	%	%
Using ICT for collaboration	23%	77%

E-mail messages sent daily

	1-5	none
	%	%
Daily e-mail messages sent	46%	54%

Computer Expertise Index

	none	1	2	3	4	5
	%	%	%	%	%	%
Number of computer activities done	23%	23%	15%	15%	8%	15%