1.1 Research Questions

The Maine Learning Technology Initiative (MLTI) was developed at the initiative of the Maine State Legislature under Governor Angus King. The first pilot in the Spring of 2002 saw Apple iBook laptop computers distributed to nine pilot classrooms. The first full year of implementation beginning in September, 2002, saw the distribution of over 17,000 Apple iBook laptop computers to the state's seventh graders. The purpose of the project is to support student learning and prepare Maine students for success beyond high school.

This qualitative study focused on one classroom to examine assessment and learning in a one-to-one computer to student wireless, high-speed, laptop-computing environment. The purpose of the study is to describe what occurred in the first year of laptop use as well as inform recommendations for implementation and stimulate questions for further study. The research focused on the following key question: What does classroom assessment look like in a one-to-one, high-speed, wireless, laptop computing environment?

1.2 Context

Commissioner of Education, J. Duke Albanese reported in a July 2, 2002 news release that Maine has had a history of success. Using results from the National Assessment of Education Progress he reported:

2000 Grade 4 Science: Highest score of any state
2000 Grade 8 Science: Only 1 state scored higher than Maine
2000 Grade 4 Mathematics: Only 6 states scored higher than Maine
2000 Grade 8 Mathematics: Only 2 states scored higher than Maine
1998 Grade 4 Reading: Only 1 state scored higher than Maine
1998 Grade 8 Reading: Highest score of any state
1998 Grade 8 Writing: Only 1 state scored higher than Maine

Education is seen as a means for ensuring that Maine has the capacity to offer residents a promising future and the capacity to attract a quality work force and industry. The MLTI project is seen as a way to promote learning while building capacity towards a new future for Maine.

Several conditions enable Maine to undertake this initiative including: legislative support, expertise and experience with technology, high-speed access in every school, commitment of Maine educators to help their students excel, collaboration with the contractor (Apple and its partners), and commitment to long-term planning and success.

This study took place in a small community (less than 1000 residents) in eastern Maine. The nearest grocery store is a thirty minute drive away. Eastern Elementary School (not its real name) is a relatively new building, home to about 115 students who can begin school as young as four years old in a half day kindergarten and end nine or nine and a half years later as Grade 8 graduates. Depending on the student population at different grade levels, teaching staff may teach a single or combination class (two grades in one classroom). Other certified staff and classroom assistants provide support for student learning in the areas of music, art, physical education and special education. Guest teachers and consultants offer assistance from time to time.

Eastern Elementary School, along with eighteen other schools in Maine, was labeled a 'failing school' in July, 2002, by President Bush under the No Child Left Behind Act (NCLB). The designation was based on the school's results on the MEA (Maine Educational Assessment), a state test administered in Grades 4, 8, and 11.[1] The nine students in Grade 4 for the previous year had not shown enough improvement in performance over their predecessors. The principal notes, "It was like we were one of the 19 lowest schools in the state. There were 250 schools with *lower* scores. I went online and counted…it was [based on the] gain that you did or did not make over a period of three years, and you had to do it three consecutive years." The impact of being labelled a 'failing school' or a 'priority school' was felt deeply in this school community. The school principal told of one parent who called the school to apologize for her child. Part of NCLB is to encourage parents to move their children from 'failing' schools. In rural Maine this means your child goes to school in another community a distance away or is schooled at home.

Schools and people are far more than their labels. Eastern Elementary School is recognized in different ways as being wonderfully innovative and successful. It was chosen as one of nine exploratory sites for the Maine Learning Technology Initiative (MLTI) in spring of 2002. Every student in the Grade 7 and 8 combination class was given a laptop computer to use and wireless Internet access. The teacher in the Grade 7 and 8 classroom was selected to be a Regional Integration Mentor for the region in which

she works. News reports, a PBS special about technology and learning, as well as a letter from the State Governor, describe the wonderful learning in which students in Eastern Elementary are engaged. Eastern Elementary School was selected as one of nine demonstration sites throughout the state. Demonstration sites received their laptops in the Spring of 2002 and provided an initial pilot of the program.

1.2.1 Research Context

High-speed access means access to information (and the accompanying challenge to create knowledge). Laptops and wireless, high-speed offer ease of movement and little loss of physical space (as noted by McKenzie, 1998). High-speed access (e-mail, access to the web) means students can communicate and easily become part of a community beyond the classroom and school. “Portability combined with ownership means that students will have the same set of tools and products of work available to them throughout the school day.” Windschitl and Sahl (2002, p. 170). Students in the MLTI project have a protected online environment in which to work – they are denied access to inappropriate websites and decisions regarding e-mail privileges and home use are made school by school. In the beginning of the year there were frequent discussions in this classroom regarding the appropriate use of the laptop. It was clear that the laptop use was for learning related to the curriculum standards not merely entertainment.

Learning in a one-to-one computing environment with wireless, high-speed access is different from classrooms without ubiquitous technology, and technology-focused research findings cited in this study refer to studies where students have one-to-one wireless, high-speed access unless noted. This is because computers are used differently depending on whether or not they are in the classroom, or outside the classroom in a school lab setting. Their use also depends on the number of computers available (Becker and Ravitz, 2001). In a one-to-one computing environment, a broad range of students have the opportunity to acquire complex skills and knowledge through rich interactions enabled by technology (Thorpe, 2003).

A researcher in any study brings a set of assumptions and beliefs that serve to filter the research data collection and findings. Further, the relationship the researcher has with the people on-site also shapes the data that are available as well as the researcher’s interpretation of those data. Length of time in the research setting helps to get past the ‘we’re on our best behavior’ syndrome that can impact studies particularly those done over a short period of time. Length of time also leads to the people getting to know the researcher, who she is, and what she values. In this setting I felt known and valued as a person, as a parent, as a writer, and as a teacher. The people in this community met my family, met me shopping and going to church. They noticed me walking and offered me an orange hunting vest so I wouldn’t accidentally get shot when hunting season began. While it is difficult for the reader to come to know the researcher the way the participants in this study did, the assumptions I hold regarding learning, assessment, and technology can be found summarized in Appendix A.

1.3 Key Decisions

Research reports require decisions that influence the final results. Three key decisions made in this study were to focus on classroom assessment, to locate the research at Eastern Elementary School, and to do a qualitative research study.

1.3.1 Why Focus on Assessment?

It is often said that assessment drives instruction. Bette Manchester, Director of Special Projects[2] for the Department of Education is responsible for MLTI. She expressed concern early in the project that if classroom assessment did not change that over time technology (even with one-to-one, high-speed, wireless access) would fail to change teaching, learning, and assessment so that it better supported the learning of all middle years students. Assessment influences what is taught, how it is taught, and what is valued.

Learning used to mean memorizing. Assessment, limited to pencil and paper, makes sense given that definition. However, today learning is defined differently. Today’s curriculum standards means learning is, “thinking, problem-solving, constructing, transforming, investigating, creating, analyzing, making choices, organizing, deciding, explaining,

talking, communicating, sharing, representing, predicting, interpreting, assessing, reflecting, taking responsibility, exploring, asking and answering, recording, predicting, gaining new knowledge and applying that knowledge to different situations" (Cameron et al, 1997, p. 6). This kind of learning is more possible with one-to-one, high-speed, wireless computing. Assessment that addresses all kinds of learning looks different – paper and pencil tests are not enough.

Classroom assessment that supports student learning is influenced by the way learning is organized. Therefore, assessment in a one-to-one computing environment is going to be different. It is important that assessment practices be described fully before developing theories that can be tested.

A study such as this is grounded in practice and aims to describe that practice. This is different than a study that seeks to prove or disprove a particular theory or model. The purpose of this study is to support the conversation of researchers and practitioners concerning how assessment supports learning in a one-to-one computing environment. Collecting evidence over time and combining observational data, survey data, and interview data, along with examining the physical evidence of student and teacher work, permits the data to be triangulated, enhancing the validity of the results (Lincoln and Guba, 1985). This is not an action research study where an assessment 'expert' mentored a teacher towards 'best practices'. While acknowledging that a researcher always influences the research and the researched, the focus of this study was to record what happened and try to make sense of it. The purpose was to answer the question, 'What's going on here?'

Classroom assessment may change in a one-to-one computing environment with high-speed, wireless access for reasons including the following:

- Assessment is dependent on learning. When the learning environment changes, assessment must change to ensure it is able to 'measure' or assess the learning in its new form.
- Assessment is dependent on how learners show what they know. If students change some of the ways they show their learning, then assessment needs to change or new learning will not be seen or recorded.
- If what is to be learned changes, then assessment needs to change to account for new learning.
- Assessment is also influenced by beliefs and understandings of best practices. Learning about new research, theories, and new classroom practices can also change classroom assessment.

While this project involves students learning more about technology, the technology learning was not viewed as an end in itself. Students were to use the tools to better meet the standards expressed in their curriculum, the *Maine Learning Results*, and the Guiding Principles.[3]

1.3.2 Why Eastern Elementary School?

Maine is primarily a rural state with a depressed economy. "I'm told this is the second poorest county in the United States. If MLTI can work here, it can work anywhere." said Bette Manchester, Director of Special Projects, Department of Education, as she decided to place this study in Eastern Maine. The school selected was the only one in this county that had piloted the laptops in the spring in the 7th and 8th grade combination class. The principal and teacher agreed to give the researcher full access. The teacher was not familiar with my work, however, Bette Manchester felt that my credibility in the area of assessment, and my familiarity with the challenges Maine classroom teachers face as they seek to align assessment with the *Maine Learning Results*, was seen as an asset for this research project.[4]

1.3.3 Why a Qualitative Study?

Classroom assessment has not been the primary focus for existing studies of one-to-one, wireless, laptop initiatives.[5] If researchers continue to ask questions based on learning and assessment models that reflect learning and assessment in classrooms with less than one-to-one, wireless, laptop technology, they may fail to observe the differences. Qualitative studies are more amenable to exploratory inquiry, and, therefore, more appropriate to the earlier stages of innovation and related knowledge acquisition. Qualitative studies permit researchers to ask questions such as, 'What is going on here?' Using such open ended questions allows for the generation of new theories. New theories are needed when significant change occurs. One-to-one computing is potentially just such a significant change. Research,

such as this project, can help identify questions and new theories that can then be researched more extensively using both qualitative and quantitative research techniques.

1.4 Timeline

The first stage of this study took place between September, 2002, and June, 2003, with follow-up work at the site and with participants from September, 2003, to February, 2004, for the purposes of verifying findings. The adults and students quoted in this study were given the opportunity to verify all quotes at that time. Once data was verified by participants, final analysis took place. Data collection conducted between September, 2003, and June, 2004, is not included in this report except where noted. This is a report of the first full year of implementation. The second year data and insights are not included. That said, it should be noted that preliminary data collection for Year Two indicates students' and adults' learning and assessment in this setting, supported with one-to-one technology, is continuing to evolve.

1.5 Support for MLTI in Eastern Elementary School

The laptop work in this classroom exists within a larger project in the State of Maine referred to as MLTI. The combination 7th/8th grade classroom teacher at Eastern Elementary School directly involved in the laptop project noted that there was a lot of support from MLTI and the school technology coordinator (also the school principal) with regards to technology issues. The MLTI project includes extensive educator support state wide.[6]

This school's implementation team includes the principal, the grade 5/6 classroom teacher (also the lead teacher identified for the MLTI project), and the Grade 7/8 classroom teacher. They all attended training sessions offered both in the summer and when school was in session. They also met with other Regional Integration Mentors and continued to learn and problem-solve with each other and with students.

The classroom teacher responsible for the combination 7th/8th grade class has taught for a total of 10 years, nine years at the high school level (life and physical sciences) and one year in middle school immediately prior to this study. Part of MLTI's implementation plan included professional development. The classroom teacher estimates she had 14 days of professional development between Spring, 2002, and June, 2003, including summer in-service days.

This teacher is also a regional integration mentor for other classroom teachers involved in the MLTI in her geographic area. She acts as a resource and a support. This is primarily done through e-mail and phone conversations because she is teaching full-time. In addition to attending all the in-service opportunities that are available to teachers as part of the laptop project, she also attends additional sessions and networks in a deliberate fashion with other teachers in her area (estimated by the teacher to be an additional ten days between Spring, 2002, and June, 2003).

This classroom teacher is part of a new community that reaches beyond her classroom. The principal is also significantly involved in the laptop project as the technology coordinator for the school. The principal has access to professional development opportunities offered as part of the MLTI initiative in both her roles. The grade 5/6 teacher is the lead teacher in the school for the MLTI project. She, too, attends many professional development opportunities with regard to the laptops. Other staff working with students, such as classroom assistants and special education staff, do not have as many opportunities to learn with regards to the laptop.

1.6 Data Collection

The first year of this study was conducted over one school year (2002-2003) during which school was in session for 175 days. It included the lead researcher being present in the classroom for 43 days between September and December and ten days in May. The researcher was also connected by e-mail to students and teacher as well as by telephone with the adults in the school. There were numerous off-site meetings with the teacher, the lead teacher in the school and the school principal. In addition, the classroom assistant agreed to act as a researcher's assistant and took observational notes for approximately 120 days from November 25, 2002 to May 9, 2003. Data analyzed includes:

- 53 days of structured and unstructured observation notes (each were 1–5 typed pages)

- 221 pages of unstructured observation notes (research assistant)
- 15 hours of audio tape interviews, transcribed
- E-mails from Eastern Elementary School participants and e-mail 'interviews'
- 60 pounds of student evidence of learning, consisting of all student work that would fit in a flat envelope
- 50 CD-ROM's containing student work from the classroom that serves as evidence of learning
- 9.0 GB hard drive storage of students' digital work product from the classroom that serves as evidence of learning

1.7 Record of Research Proceedings

Grounded theory follows from the data rather than preceding it. Glaser and Strauss (1967, p. 3) indicated that grounded theory, "fit(s) the situation being researched." Grounded theory is "discovered empirically rather than expounded apriori…grounded theory can play the role of conventional theory for any subsequent study" (Lincoln and Guba, 1985, p. 206).

Lincoln and Guba (1985) explain that, in a naturalistic inquiry, the naturalist starts with a focus and theory emerges from the inquiry. The inquirer samples in ways that maximize the scope and range of information obtained. Sampling is "not representative but contingent and serial – each element sampled depends on the characteristics of the preceding elements…." The inquirer sorts salient elements and targets in on them, becoming more refined and knowledgeable through the process. The data analysis is open-ended and inductive. The form of the data cannot be known in advance so data cannot be specified prior to beginning the study. The issue using the best means to "make sense" of the data that will, at first, facilitate the continuing unfolding of the inquiring and lead to a "maximal understanding….of the phenomenon being studied…" (p. 224-225).

The research is undertaken with a posture of "not knowing what is not known." There are several phases to the research inquiry – determining what is important, finding out about it, and checking the findings in accordance with trustworthiness procedures. There is continuous feedback and feedforward (Lincoln and Guba, 1985, p. 235). This is a qualitative, descriptive study of one classroom over the period of one year in a one-to-one, high-speed, wireless computing classroom environment. The research design includes prolonged engagement, persistent observation, and triangulation – three attributes identified by Lincoln and Guba (1985) as leading to credible findings.

"...not knowing what is not known."

Data were triangulated; that is, gathered from at least three different sources - observations, products, and interviews with different people - over time. "Triangulation involves checking and cross-checking the accuracy of the data obtained from one source with data collected from other, different sources" (LeCompte & Schensul, 1999, p. 131).

The data collection is cyclical with initial stages being primarily observation and subsequent stages involving observation, interviews, evidence collection, and verification of data. This research project took place over a prolonged period so as to build trust, permit observations throughout the changing context and conditions of an evolving academic year, and to learn about the context for teaching, learning, and assessment in this one-to-one, high-speed, wireless computing classroom environment.

1.7.1 Phase One: Orientation and Overview (September, 2002, to November, 2002)

The object of this phase is to get enough information to follow up in detail. This phase builds the relationships and informs the inquirer as to the participants; their roles, the underlying meanings of actions, and the language of the setting.

When I arrived, I was introduced to people in and out of the school as 'the person who was in the school to do some research on laptops.' Over the first few weeks, students and staff met both my son and my husband and found out where I was staying (not hard in a small community).

I arrived at the classroom each day about 10:00 am and made daily classroom observations during Language Arts and Science instruction. Once

students went to Social Studies (about 2:00 pm) I either met with other staff members or went home to reflect on the day's data collection.

The focus of the fall was building relationships with students, staff members and people in the community. It was important that they knew and trusted me. Building relationships always takes the time it takes. My relationship with the students was facilitated by the presence of my 20 year old son who spent four weeks with me early in the project. The students were interested in him. He had just completed a diploma at the Vancouver Film School in New Media. He visited the class a couple of times and was able to answer some questions they had regarding the technology. At one point he showed them his portfolio, his website (www.mackenzieduncan.com) and got them started with iMovie.

I think that to young people, I am perceived to be old and uninteresting. My sense is that the only thing impressive about me as far as the students were concerned was that I could type fast, I was 'from away', and I had written books. Students saw me as a writing expert. Typing everyday did nothing to dispel that impression. I chose to use my laptop to record data (which looked the same as a student's laptop, although I used a word processing program with which I was comfortable) in order to be part of the group. This posed some problems – time to start up before being able to begin to record observations, needing a power cord when the battery ran low, and typing speed (I'm fast, but always want to be faster). With the students, I felt it was important to be 'like wallpaper'.

When I arrived, the classroom teacher introduced me to the class and I explained my purpose for being there. I asked students to keep all their evidence of learning. We talked about what evidence looked like – my definition was "everything you do or create". A couple of times I was asked as a writer to talk to the class about writing related issues. I tried not to get drawn in – this was not an action research project.

During my classroom observation time I sat at a student desk off to one side, at the back of the room, or wherever the students were working and learning together. I often stayed in the classroom during recess and lunch if students chose to stay in. I recorded what the teacher said and did and what the students were saying and doing. I tried to figure out what was going on without asking questions might cause people to infer that I had made a judgment of some kind.

"Evidence of learning is everything you do or create."

During this first research data collection period, I limited my interactions with individual students, the classroom teacher, and the classroom assistant, to necessary questions related to the technology, the work assigned, or general information about the school or the community. The classroom teacher was interested in talking, but had little time to do so. When we were able to talk, it was about a range of issues related to teaching, learning, assessment, and living in the area. I tried to listen more than talk. The classroom teacher has a young family, which meant after-school time was limited and frequently not available for us to meet or talk. I deliberately did not interview the classroom teacher until November (after about seven weeks of observation), when I felt I understood a little more of what was going on with regards to assessment in the classroom and we had a relationship that could withstand my questioning her regarding assessment, evaluation, and the decisions she made day-by-day. For example, she was reluctant to let me photocopy her grade book. No one else from outside the school had ever looked at it.

Students began to initiate conversations with me after about four weeks in the classroom. By the second week of November, I was able to interview some students. Most students who agreed to be interviewed were still very nervous. Prior to my leaving in November, I asked students to sort their evidence of learning into subject areas and put it into large envelopes. I also asked them to burn CD-ROM's as back-up. In November, I worked directly with the 7th grade students and videotaped some younger students reading, talking about their learning, or showing their work. This was related to the Local Assessment System work I was doing with the primary teachers. It also gave me an opportunity to work in a more in-depth way with some of the students in the class prior to leaving the site. I felt that, in order to sustain my connection with the students, I needed to have a solid relationship. I left a CD-ROM burner in the classroom, two digital still cameras, and two video cameras, so students

could collect a wider range of evidence of learning of themselves, each other, and other students in the school.

1.7.2 Phase Two: Data Collection (December, 2002, to April, 2003)

Research during this period consisted of the observations of a research assistant, e-mail correspondence with students and adults in the research setting, and students collecting evidence of their own learning. During this time period my interaction with students from the site was to respond to any e-mails students sent me. I received 95 e-mails from students and responded to all of them. They included iMovies, pictures, audio-greetings, text greetings, work asking for feedback, self-assessments, slide shows, and questions focusing on a number of topics including my work away; their writing; my son, Mackenzie; and sick kittens. When I was on-line with middlemaine.org, students would e-mail to ask where I was and what was I doing. During this time, I also worked with the classroom teacher twice at gatherings of middle school teachers where we talked and exchanged ideas about assessment practices. I was in contact with the classroom teacher, classroom assistant and the principal by telephone, and e-mail and had some face-to-face contact at meetings in the state.

1.7.3 Phase Three: Focused Exploration Data Collection (May, 2003)

The object of this phase is to focus more fully on the information that emerged in Phases One and Two through interviews and observations. As data is gathered and themes emerge, provisional insights are noted. These can be pursued as subsequent data are collected. When the data are being analyzed, it is done at the meaning level. The categories build as data that go together are put together and data which form new categories are checked with participants so as to come to a better understanding of their meaning. The principle of negotiated outcomes requires that the agreement be sought “at the end of the inquiry but whenever possible *throughout* the inquiry, not only for the sake of establishing credibility but to assure that one is on safe ground in unfolding the next step of the emergent design” (Lincoln and Guba, 1985, p. 358).

This period in the research involved on-site observations with a purpose of seeing what had changed and what was similar and to get to know everyone again. Once students and adults appeared comfortable with me, I began to interview students and the adults about what they had noticed. A sample interview follows:

***

Researcher: Is your learning any better?
Student: It seems like we’re learning at a faster pace.
Researcher: You learn at a faster pace. So you think you’ve learned more this year than you did last year?
Student: ‘Cause most of our subjects we can, the quickness of our typing we got most of our assignments typed and then passed in and then we go onto another one.
Researcher: Do you think you’ve handed in more work this year?
Student: Yeah.
Researcher: Do you think when you work more you learn more?
Student: Yeah, I think you get adapted to it. If you do more stuff, like, basketball or something you play more of it. You get used to it.
Researcher: If you play more basketball, do you become a better basketball player?
Student: Yeah.
Researcher: So if you get more work done you tend to be a better student?
Student: Yeah.
Researcher: What evidence have you improved in most with the laptop?
Student: Probably writing. I never used to. Probably reading too. ‘Cause I like reading on my laptop. I don’t like looking at a book.

***

There was an initial round of interviews with students most willing to talk with me. Based on my observations and initial interviews with several students, I created a brief e-mail questionnaire that was sent to students section-by-section over four days (see Appendix D) and began to focus interview questions more tightly on the emerging themes related to assessment and learning: learning, information and feedback, collecting evidence of learning, and showing proof of learning.
I interviewed students who were willing to meet with

me and, eventually, met with students who were more reluctant – meeting with two or three students together helped some students feel comfortable. Interviews with students were conducted for short periods of time (10–20 minutes) with follow-up questions on subsequent days. All students were interviewed at least once, with some students being interviewed more than once. Some students were interviewed with their collections of evidence so they could show pieces of work. Students had very similar things to say about their experience. I heard the same thing from students over and over again. The report reflects this repetition, so readers have a sense of the students' common interpretation of their experience.

At this time, I again interviewed the classroom teacher and the classroom assistant. I also interviewed the principal, a guest teacher, a reporter from the local paper, and the grade 5/6 teacher. All interviews were audio-taped with the exception of the classroom teacher who agreed to show student work to a video camera while we talked.

Prior to leaving, I asked students to give me any evidence of learning they and their parents were comfortable giving me. I left a box for them to give me any more evidence, should more become available after I left. I shipped home four boxes of student evidence. I also downloaded files from their hard drive onto a Firewire drive so it would be available to me for later analysis.

1.7.4 Phase Four: Date Analysis and Review (July, 2003, to January, 2004)

The guiding method of data analysis is the method of constant comparison: what is observed, what is said, what is done. Once the data collection is complete, then data are again sorted. This permits a fresh look at all the data and ensures that categories that appear to be emerging are, in fact, fully present. Once the categories emerge they are checked for internal homogeneity and external heterogeneity (Lincoln and Guba, 1985, p.349). The categories are then grouped so as to illuminate the relationships between and among them. Learning, teaching and assessment are very complex. Each perspective helps one to see and understand a little more. A report is necessarily linear. However, even though the report is focused on assessment, teaching and learning are an integral part, and so they are also a part of this report.
The timeline for this work was as follows:

July, 2003, to October, 2003:

- Interview tapes were transcribed.
- Transcribed interviews were returned to the classroom teacher, the classroom assistant, and the principal for verification.
- Students' evidence was weighed and tabulated.
- Student e-mail responses were tabulated and analyzed.
- Both sets of observation notes were reviewed and filed.
- Literature review for technology and assessment (1998-2003) was conducted (See Appendix C for technology literature reviewed).
- Initial data sort took place using transcribed interviews and observation notes.

October, 2003, to January, 2004:

- Research related to technology implementation was reviewed and analyzed (Note: I made a deliberate decision not to read the technology research prior to this study as I felt it might prevent me from answering the research question that guided this work – 'What's going on?').
- Current assessment research was reviewed (1998-2003).
- Fall writing prompt results were collected for current 8th grade (previous 7th grade students).

Follow-up questions for clarification were exchanged with the classroom teacher, some of the students, the classroom assistant, and the principal. A survey was created both as a summary of data from the site and findings related to research regarding technology implementation. It was sent to the classroom teacher, the classroom assistant, and the principal for response (see Appendix E). The data sort continued, watching for data that did not fit earlier emerging categories. Data from interviews, observations, and notes were revisited and, again, sorted into groups using common key words and ideas. At this time the data analysis of student work was completed, the resulting quantitative data was recorded and analyzed, and a draft report of the findings was written for verification purposes by participants at Eastern Elementary School.

1.7.5 Phase Five: Verification and Review (February, 2004, to April, 2004)

Verification: The object of this phase is to take a provisional report back to the site and subject it to the scrutiny of the persons who have provided information. This is the best way to know if the reconstruction of the data is 'true'. The task includes ascertaining whether people said what they said (checking transcripts) and then finding out whether the reconstruction accurately represents its meaning. Additional information may be collected as this phase is conducted while member checks provide new data that affirm or illuminate new understandings of the meaning of the data (Lincoln and Guba, 1985). Appendix E, mentioned earlier, is an example of inviting additional data from participants.

In February, there was an on-site visit so that participants could review and verify a draft of the data grouped into like categories of meaning. Students and adults were invited to read the complete draft of the results so as to verify results and to ensure the results made sense in terms of their experience in the setting. Participants agreed that the data and the meaning conveyed by the data were representative and accurate.

Written Report: Naturalistic inquiry tends towards a reconstruction of the participant's meaning. Building on the reader's tacit knowledge, the report tries to present a holistic and life-like description. In this report I have tried to use the participant's words to convey meaning. I have done this only after the data was verified through observation, conversation, and by looking at the physical evidence. It is important that readers receive a measure of vicarious experience. The students' common interpretation of their experience was very powerful to me as a researcher. I have tried to convey that power by having students speak for themselves even though many are saying similar things. I have included some interview pieces so the reader gets a sense of the interplay between the participants and me. The students – in fact all the participants – were very frank with me. This is a measure of their trust in our relationship. They used informal language, which also helps to show how comfortable they were during our conversations. Informal language is another reason why the participants needed to review the transcripts and ensure the words represented accurately the meaning they intended to convey. The findings shared in this report try to provide the 'thick description' that is necessary for judgments of transferability (Lincoln and Guba, 1985).

I heard the same thing from students over and over again.

In March, 2004, a preliminary draft of the report received helpful comments from Bette Manchester, Seymour Papert, and David Silvernail. In April, 2004, a complete draft report received further helpful comments and advice from Kathy Busick, Paul LeMahieu, and Seymour Papert. The research report was finalized and published. Finally, draft reports were filed and research data kept in case further analysis is needed.

In summary, the findings of this report describe a classroom full of students (22) and their teacher (along with a classroom assistant) in a classroom with one-to-one, high-speed, wireless laptop computers over the period of one year. The students ranged in age from 12 years, 1 month to 13 years, 10 months when school began in September, 2002. This research project is meant to inform future research about assessment and learning in a one-to-one wireless laptop computing environment, provide recommendations for implementation, and guide future research about assessment and learning. The research study was not designed to produce results that can be generalized to other settings, although the learning may be transferable to similar settings (Lincoln and Guba, 1985). The findings are meant to inform the reader about one setting.

The findings are reported in the following sections:

2.0 The Learning Community: Access for All
3.0 The Learners: Preparing for Success
4.0 Feedback: Monitoring for Quality
5.0 Proof: Evidence of Learning
6.0 Evaluating and Reporting: Accounting for the Learning
7.0 Conclusions: Continuing the Learning
8.0 PostScript

Prior to reviewing the results of the study, here is a closer look at ninety minutes in this classroom.

1.8 A Closer Look

Eastern Elementary School is both different from other schools and yet the same. Talk to any teacher – students are changing and the job of teaching is changing. The complexity and the challenges of the work increase with every new group of students, every new mandate and every new headline. Being knowledgeable is important – not just about every subject area one teaches, but also craft knowledge – how does one keep a room full of growing adolescents engaged, working, and learning? Preparation is key – as a teacher with a class full of students, one can feel a part of a marathon race even though the race is being run alone. Teachers know that involving students in every aspect of learning and assessment is essential if the Guiding Principles and Learning Results are going to be met. It is easier said than done. In classrooms every minute is full of information and calls for decisions. This composite is a glimpse into this 7th and 8th grade classroom on a typical Monday morning and is based on observation notes from the site. As you read, think about what it takes to do this, and do it well, hour after hour, day after day, and week after week.

Good morning! The first group of students arrive with greetings for Mrs. J. as they go next door to put their packs and coats in their cubby. It is Monday morning and Mrs. J. has already been at work for almost two hours meeting with the principal concerning a student with special needs, checking in with her colleagues concerning the Local Assessment System that is being implemented this year, and getting materials ready for the students.

Students arrive on different buses at different times every morning or in the family vehicle. They check in with each other as they arrive. It is March. The days are brighter now as the weather – at least until last night's snowfall – promised an early spring. The energy in this room has the same promise. Students are ready to begin – they are getting out their laptops and checking in with classmates.

It is 8:37 a.m. The intercom system in the corner starts to make a noise. No one pays much attention. It is a temporary measure that doesn't work very well and it is hard to distinguish any words. Suddenly, everyone leaps to their feet, faces the flag, stands straight with hand across their hearts and recites the Pledge of Allegiance. They sit back down and continue getting themselves organized for the day. Mrs. J. is announcing the finalists for the district-wide Mathematics competition. She concludes, "Even those of you who missed a point or two still did really well."

Two students, who just finished making the school announcements from the principal's office, re-enter the classroom. Mrs. J. turns as they enter and asks, "Could you just read this piece? (pointing at the announcement sheet) We didn't hear…" The students repeat the announcement for the class.

The school board met recently to discuss building an addition onto the school. There is no extra money – however, the five year lease for this modular, two classroom building will be up soon, so a decision will have to be made. Modular buildings present a few inconveniences – going to the main building to use the restrooms, transporting a large water dispenser into the classroom every day, and not hearing announcements. There is a bonus though as a second classroom acts as a place where students can work. There is someone – student, classroom assistant, classroom teacher, guest teacher – making use of that second classroom for some reason most of the time.

Mrs. J. continues to begin the day. "Check your Spelling. It is on your e-mail or go to the school website and it is there. I put it there on Friday so you could do it on the weekend if you wanted to. Grade 8s, let's take a look at your Math." Students pull out their Mathematics work from Friday – some finished it at home.

While students are getting their materials ready, Mrs. J. says to the rest of the students, "Make sure your Spelling is there. Could someone please send it to Jason?" The 8th grade students, having pulled out their Mathematics work, are also picking up their spelling from middlemaine.org which houses their MLTI e-mail, a help desk, and access to all of the more than 16,000 students and teachers in the first year of the MLTI project.

The desks are gathered into groups of four or five students. Within a few minutes laptops are open on every desk as students pick up their e-mail from Mrs. J. so they have their Spelling lists for the week. Students get busy. Mrs. J. is watching to make sure students are getting online and finding their Spelling work in their mailbox. She always has her laptop

open. Her eyes return to its screen. The classroom is so quiet right now. Every minute seems to be used. Students are busy. There are 22 students present – 8 boys and 14 girls. This is the only Grade7/8 class in the school.

Classroom placement, a complicated process in a larger school, is easy here. 'How many do we have? Here is your class list.' Teachers teach the students who are assigned to their classroom. Classroom assistants are assigned to meet the needs of the students present in the classroom. The principal is always orchestrating the best delivery of service to students, given few resources.

In this classroom this year one student has an individual education plan and several others have been identified as needing additional support for learning. The teacher and the classroom assistant work together along with the special education teacher to provide for unique needs. Every year students seem to present more and different unique needs and human resources are stretched thin. The principal is always working on one grant or another to try and bring more financial resources into the school. It is difficult, especially as more and more funding comes with use of the funds so prescribed it is difficult to make effective use of them across grants and across the school in support of students.
The quiet ends. Mrs. J. says, "Grade 8s. Let's take a look at this page…" 8th grade students close laptops and open their Math texts. The Grade 7s continue working on laptops. They know they have time to work on their Spelling until it is their turn to focus on Mathematics with Mrs. J. 8th grade students are attending to Mrs. J. as she works at the white board. Attention can be hard to discern – the indicators in this case are students shifting their bodies to face the board and asking questions of Mrs. J. as she talks through one example at the white board…

Every step appears like a choreographed interplay between students and teacher. They have done this before – many times this year already. Students ask questions, volunteer to put examples on the board, and talk through problem areas. Students show no reluctance to show what they don't know – they seem eager to learn how to do this well.

The door opens and a student arrives late, accompanied by a gust of cold air and a few snowflakes. "Good morning," says Mrs. J. "We'll wait a second while you get your Math." More than one person was surprised by last night's snowfall – this student has missed the bus and arrived late.

After a pause Mrs. J. continues. "The next piece is the same thing only it is going to be a fraction…"

"Do you have problems with this? Some of you asked about this on Friday. Check back…" Mrs. J. continues to work through more problems, checking in with students, "Suzie, does that make sense?" and pausing to pass along advice from her teacher long ago to cross the Z so you don't get it confused with a number 2.

It is 8:53 a.m. Class has been in session for almost twenty minutes. Mrs. J. talks quietly with TJ, a 7th grade student who is working on his Spelling and then returns her focus to the 8th grade, "Who wants to put that one on the board…?" Keeley raises her hand and Mrs. J. hands her the marker…

Keeley is quietly coached by other students. She works at the board. Then Keeley goes back to her desk to check her book and continues to put the example on the board. It doesn't look like she has needed any of that quiet coaching.

Mrs. J. once more talks quietly with TJ as he works on his Spelling.

She turns her attention back to the example.
Mrs. J. "Is she right?"

The students respond, "Yup."
"It is the right process, right? If you put 45, do you get the right answer? Did you check? Before we go practice, let's try number 11."

Mrs. J. "Holly, will you read the word problem?"
Holly reads.

Mrs. J. "Part a. Jason, will you read that?"
Jason reads.

Mrs. J. "How much is the bike?"

Mrs. J. "How many weeks does he have to save for it?"

Mrs. J. "Do you need to know it is a bike?"
"No," say a few students.

Mrs. J. "Do you need to know the boy's name?"
"No."

Mrs. J. "We have two pieces of information. What is the question we have to solve?"

A student responds, "How much per week?"

Mrs. J. "Who thinks they can come up with a way to resolve it?"

Students respond verbally.

Mrs. J. responds, "How many people thought that might be it?"

Many students respond positively.

Mrs. J. "So do it."

Students are busy figuring and recording.
Mrs. J. "So he needs to save $18.05 each week for a total of…"
Students respond verbally.

Mrs. J. "Joe, will you read part b?"
Joe reads.

Mrs. J. "Can we make a prediction before we solve this?"

Students respond. As this lesson proceeds students continue to listen and be engaged. They are looking towards Mrs. J. and looking at the white board. The grade 7s continue to be busy with their Spelling work.

Mrs. J. is teaching. She is helping students think through the problem, interacting with students in a variety of ways.

"Anna, are you watching?"

Mrs. J. is making eye contact with students throughout the room. She checks in constantly.

It is 9:02 a.m. Class has been in session for less than thirty minutes.

Mrs. J. "If you can do this you will know where to put the number…"

More work on the board. "Is it true? Do the check."

Mrs. J. continues working with students checking for understanding.

What if I couldn't divide by x? What else could I do there? Mrs. J. shows another way to solve it. She says, "These are both correct. There are different ways to get at the correct answer. Was that word problem hard?"

Mrs. J. gives students their assignment, "You're going to do pages 155 - 156. Do the Extra Skills and, on your own, questions 12 - 23…" The 8th grade students get paper and get to work. Their laptops are not going to be useful for this Mathematics assignment.
Mrs. J. quietly asks her next teaching group to get ready, "Grade 7s."

One student, Aimee, moves up front to sit close to Mrs. J. and the white board.

Mrs. J. asks, "Anybody else in Grade 7 want to come up front?"

Chrissy joins Aimee at a table near the white board.

The lesson begins, "Last week we were figuring out how to make checks…"

Where to put your name…how to create a checking account…balancing a check book… what kind of Math did you do?

Students respond.

Mrs. J. repeats their responses, "Addition. Subtraction. Any percentages?

"What did we call it when we added?"
Students respond, "Deposit."

"What did we call it when we subtracted?"
Students respond, "Debit."

Mrs. J. keeps asking questions. Students keep responding with answers.

"When else would you need to take money?"
Sometimes she directs the question to a particular student. "Robbie, what does it cost to have a checking account? Aimee, how many checks can we write…?"
The lesson continues. It is 9:11 a.m. and Mrs.

J. continues to work through the lesson with the 7th grade students. Mrs. J is scanning the class continually, making eye contact with every student she is teaching. She poses a lot of questions to class. She waits for students to respond and follows up with questions like, "Jason, how did you figure it out?"

I start to track the asking and answering of questions Within minutes the teacher asks eighteen questions – all are responded to by at least one student and some as many as 12 students (the entire 7th grade class). There is a lot of chiming in. It seems to keep students involved and connected. Meanwhile, the Grade 8 students are all focused on their work.

The lesson has moved on to a conversation about negative numbers. Then, the teacher assigns work and students move back to their places. Some get up to retrieve some paper to work on.

It is 9:28 a.m. All students are working. Mrs. J. scans the classroom. She begins to move from student to student, checking in. For most students the stop is momentary. For others it is brief. She never stops long. She keeps moving from student to student and group of students to group of students.

She pauses and says out loud to the class, "Students in Grade 8. Who is still working on Math?"

Students respond verbally.

"Can you be done in the next 15 minutes or so? I'm just checking in. If you can get the Extra Skills questions done, we will go over them so we can make sure you are on track."

One student asks for help. Another is looking for a power cord. Mrs. J. notices and asks, "Do we have more battery issues or are we not plugging it in? Do you have lots of memory? Do you have an iMovie? Do you want to put it on CD-ROM?" Student shakes her head. "It is too long, Mrs. J."

Mrs. J. asks, "Can you export to QuickTime?"

"It isn't done."

The student begins to quietly discuss the problems and possible solutions with her neighbors.

The classroom is quiet again.

Students are working.

Mrs. J. is circulating and observing while students work.

It is now 9:34 a.m. Mrs. J. has checked in with every group – all 7th and 8th graders. The whole class is working quietly. There is very little talk amongst students. There have been no reminders to be quiet. This just seems to be the way work gets done here. This is what independent work looks like. Mrs. J. returns to her laptop. Students continue to work on either Mathematics or Spelling.

It is now 9:58 a.m. Students are finishing the first part of the morning's work. Some students have begun to talk about stocks. The teacher is checking in with some other students. There are two minutes until recess begins.