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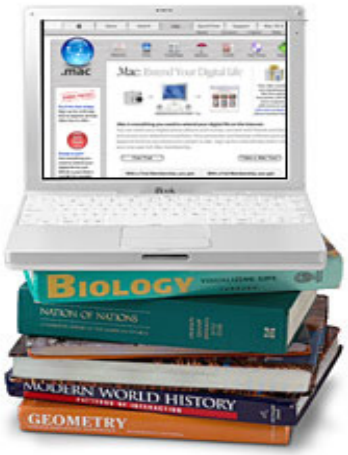

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Use of Laptop Computers and Classroom Assessment:
Are Teachers Making the Connections?

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I. Introduction

In 2002-2003 all students and teachers in seventh grade classrooms received a wireless laptop computer. The heavy emphasis on computer technology reflected concerns among business and state government leaders that information technology was likely to play a much larger role in the state's future economy. In the first year approximately 17,000 seventh graders and their teachers from over 240 schools had new, wireless laptop computers. In the first full-year of implementation the Maine Learning Technology Initiative (MLTI) several evaluation studies were commissioned. But what does the implementation of laptop computers look like up close? This study focuses on the findings from a study of three teachers based on classroom observations and informal interviews. All of the teachers have used the laptop computer technology over the past year. The specific purpose of the study is to examine the use of laptop computers by teachers' to support classroom assessment strategies.

The laptop initiative provides an opportunity to examine a wide range of teachers' classroom practices, and classroom assessment is an area of current emphasis in the state of Maine. As in other states leaders in the state of Maine are using multiple strategies to support a standards-based system of school and student accountability. The significance of the study is to link the effects on teacher practices with classroom assessment practices. The study is limited, a small case study, focusing on classroom examples of students' work and student achievement. There is no possibility to calculate large-scale effects on students' achievement, but the everyday use of laptop computers is critical to support a positive, constructive assessment environment. Laptop computers are visible in every classroom, sometimes throwing a soft glow into each student's face, other times tucked under textbooks and notebooks. In a matter

of months laptop computers have become a ubiquitous presence in the seventh grade classrooms. How have teachers used these powerful learning tools to enhance classroom assessment?

Although conducted by a single researcher the results of the study were shared with teachers, graduate students and fellow researchers in the University of Southern Maine's College of Education and Human Development In addition, the observations were compared with the results from the large-scale survey of teachers, students and administrators conducted during the 2002-2003 school year to triangulate findings and strengthen inferences.

This study is presented in four parts:

1. A description of the study's location and a brief description of each teacher and his or her classroom
2. A summary of participant-observer findings and implications for classroom assessment
3. A comparison of participant-observer findings state-wide survey results relevant to classroom assessment
4. Concluding remarks

The most important questions focus on the teachers' use of laptop computers for classroom assessment. For example, do teachers use laptop computers to assess specific achievement targets? Are teachers designing selected response tests using laptop computers? Are teachers using laptop computers for performance assessment? Are teachers using laptop computers for communications with students? With parents?

From the outset the premise of MLTI was that computer literacy for all middle school students would produce a variety of effects, from increasing students' attitudes towards instruction and learning, generating students' interest in learning, and improving student achievement. Putting laptop computers in the hands of all seventh-grade teachers and students addressed the economic disparity between the instructional resources in schools and classrooms in Maine. The Maine Learning Results have expectations for use of computers by students, but no explicit targets for teachers' competencies. The

assumption was that all students could benefit from the equitable infusion of technology. Also, computer-enhanced teaching and learning would result in students better prepared for the changing workplace. The general benefits sound promising, but have yet to be verified. In this study I investigated the effects of having computers on classroom assessment. In this regard, the study begins as descriptive, and concludes with questions about possible changes and innovations specific to classroom assessment.

II. Methods

The methods for the case study of Mountain River Middle School were qualitative, combining observations with interviews. There were three on-site visits to Mountain River Middle School from December, 2002 to April, 2003. In December 2002, I met with one of the school's teams led by Jake, a science teacher and the school-wide coordinator for the MLTI program. In addition to visiting his classroom I also spent a class period with Karen's classroom observing English Language Arts. On two subsequent visits I observed Jake and Karen, but was able to observe Jen, the mathematics teacher, on one occasion. Also, I sat in on a team meeting, which included the special education teacher as well.

The study is located in a school district in the western mountains of Maine, referred to as Mountain River Middle School. The middle school has a population of approximately 420 students. The school sits on a hill overlooking the river valley. The hill was graded to make way for a sprawling one-story building. On the far side of the valley sits a large pulp mill, clearly the largest employer in the town. The architecture of the school is a one story building.

I have worked in this particular school district as a testing and assessment consultant for their local assessment system for the past four years and have even taught a graduate course in classroom assessment in the district. Through this work I have established rapport with teachers and the administrators. In particular I worked closely with the curriculum coordinator on numerous projects concerning the development of testing and assessment

in the school district. For example, I developed a survey with the curriculum coordinator and the district assessment team to examine perceptions and attitudes towards district and classroom assessment and have reported on changes in classroom assessment (Beaudry, 2003). The school district is a part of the Western Maine Partnership that organizes and offers professional development opportunities, but has access to graduate education programs through interactive television and the Internet, or the tried-and-true distance learning delivery system, driving.

III. Site Visits: Observations and Interviews

The three teachers on whom I focused were all willing participants in the study. In this section I use the results of observations and interviews to depict each of the teachers in her/his classroom setting. They were all enthusiastic when they talked about the laptop computers, but showed a varying degree of utilization when it came to classroom instruction and assessment. Over the course of the site visits, each teacher had opportunities to demonstrate the use of laptop computers for instruction and to answer questions about their experiences.

A critical question for the study was the use of laptop computers to facilitate and improve communications. As of March, 2003 the electronic mail function for the laptop computers was not available to teachers and students in this middle school. There were numerous reasons for the lack of service, and at the top of the list were concerns of the school district's technology office of the capacity of the system. That is, the computer system had limitations, and unchecked use would over-burden the computer system. Therefore, use of the electronic mail was limited to teachers. Students were not allowed to communicate with teachers, and were not permitted to send email to other students. In essence, the use of electronic file sharing, the use of attachments, discussion boards, list-serve's were all postponed. Students and teachers were forced to use their laptop computers as simple input-output devices, and were

unable to take advantage of the computer as a part of a communications network.

A. Jake: Science, Visual Learning, and Testing

Jake is not only the team leader; he is the overall coordinator of the Laptop Initiative at MVMS. He's an experienced science teacher with great passion for education. His classroom looks like a creative mess, every surface piled with graded and un-graded quizzes, lab reports, books (e.g., *50 Inventions Made By Accident*) and students' fledgling, scientific drawings. The lab benches in the front are loaded with stuff, finished posters and tri-fold displays, notebooks, machines. It's a place fertile with imagination and scientific puzzles, even if it appears cluttered and in disarray. At my last visit there was a large 3 x 6 foot elongated, rectangular trough. The open box was lined with black plastic, and it sat at an angle, tilted from one end. Dirt, sand and fine pebbles formed an area of striated deposits, and the lower third of the box was filled with water. "We just finished an experiment with glaciers." Jake explained. "It was a demonstration of how ice melts and leaves deposits." It was evidence of the science approach of combining in-class experimentation with demonstration. With so many varieties of snow and ice available Jake was incorporating materials at hand into his instruction.

Jake combined the attributes of a scientist, tinkering with ideas and a visual learner. In every instance I observed his teaching he spoke about some aspect or demonstrated an instructional approach based heavily on visual learning. As I mentioned earlier he talked everyone through a line drawing of types of rocks (a volcano) and the cross-sectional layers of the earth.

The lecture and demonstration about types of rocks was in mid-December. All of the students sat at individual desks, with a handout of procedures and computers sitting open. They observed the lecture-demonstration by Jake, a drawing using computer software. He opened a file with a completed drawing of a mountain covered with lava. He went through the procedure for constructing a likeness of the drawing. During the modeled

diagram, he provided clever names to personalize/humanize scientific terms. I watched student's screens fill up with graphic images similar to Jake's model drawing. At that point in the lesson he spent very little time tending to individual students, but he fielded questions at the front of the room. Students wanted to know how to draw a curved line. Jake directed his responses to his computer "Click here, point there." The students were playful in their questions as well, asking if they could use a fill pattern made up of ducks for the drawing. Jake responded with good-natured banter, "Sure you can, as long as the drawing is accurate." It appeared that the students were busy making drawings, motivated to complete the task.

As I continued to ask about classroom assessment he immediately shifted gears to a recent assessment, a test. He wanted to see whether his visual approach to teaching the earth's layers had produced a corresponding success on a quiz about the type of rocks. Although I never saw the results he expressed disappointment. He had connected classroom assessment, the pencil-and-paper test, with instruction in visual/graphics using laptop computers. But did he make a connection that students could follow? That is, if he was instructing with a visual-graphic representation of the earth's layers and testing with individual, multiple-choice test questions, did the assessment method match the assessment achievement target?

He was open to my inquiries, and disclosed his own observations, findings and questions very readily. For instance, I mentioned the issues around the Road Trip activity. There was initial optimism about the image of students seeing learning as a journey. But Jake conceded that the task was too open-ended, with many students taking significant detours, stopping altogether in some cases. Although he had a rubric, it seemed to answer some questions about the report but not enough to guide most students. As the Road Trip project progressed the task was modified to reflect their understanding and the level of completion, rather than teachers providing specific feedback and assessment for learning.

Jake continued to share units of instruction, but was not ready to share results of the Science Fair Project. The Buoyancy instructional unit is an example that uses web-based information for test items, mixing open and closed questions and buoyancy test, primarily closed, selected-response questions. The recommendations for improvement of test construction would be to: (1) identify content standards and performance indicators (goals and specific objections), (2) re-write important content as proposition(s), (3) align instruction with the assessment especially clear achievement targets though the use of a table of specifications, (4) match the types of questions to the Table of Spec's, (5) review the length of the test, reliability will increase with more items, (6) re-write items paying attention to item quality checklists (Stiggins, Dosterhoff, Linn & Gronlund) (e.g. matching, fill-ins, try some MCQ) and proper grammar, (7) clarify procedures for the test and points for items.

The Buoyancy web quest relies on the use of laptops, substituting the designated web sites for books and handouts. Both of the handouts are assessments, one formative, the web quest, and one summative, the test. The web quest is a case where the instruction and assessment blend, while the test is used only after instruction as an add-on activity. In both cases, it's necessary to apply the standards of high quality assessment (Stiggins, 2001). Applying the five standards is useful and necessary regardless of whether the test or assessment is delivered by Laptop or not.

B. Karen - Independent, group work on the Internet

One of the pervasive messages conveyed by Karen was classroom organization and discipline. The first time I observed her classroom the transition from room change to classroom instruction was brief, following the bell signaling the beginning of the period. Posted on the wall was a list of off-task behaviors and the consequences for use of the laptop computers. Her explicit attention to classroom discipline receded once she began her lesson, but it continued to provide a supportive environment to supervise group work.

During the first visit Karen handed out results from a spelling test and moved on to the task of the day with brief instructions to work on the web quest unit about the book, *The Light in the Forest*. Students filed over to the computer cart to pick up their laptops, and with little fanfare returned to their groups. The web quest amounted to a unit of instruction using Internet resources, in particular reading passages, diagrams and pictures. Students were not reading about the story or answering direct questions about plot or character, rather they were asked questions about the times and the setting of the story. Even though it was a web quest students had a worksheet full of questions. Karen spent time circulating through the classroom, and stopped to confer with students if they sought her assistance. I watched a boy looking at web sites but not writing anything. He was having trouble with definitions of key words. As I observed him I asked what he was doing, and he said he needed to understand some terms before going on with the worksheet. He did not go to a dictionary off the shelf, he did not consult any of the resources on his laptop, and he seemed reluctant to ask the teacher for help. What he did was to continue to browse the web, occasionally glance at his worksheet. Dressed in a white t-shirt and blue jeans, he appeared to be attending to his work with his laptop open. However, more often than not he was off task, browsing the web or just keeping his head down, in control of his learning environment, but not engaged and off task.

In a focus group interview Karen expressed concerns about the web quest activity and laptop computers in the classroom. The use of laptop computers was a liability in this instance, since there were some problems. One major issue was limitations on the server to allow all students to work simultaneously. With students doing a common task, some classes had no problems, while others risked falling behind if there were technological problems. There were problems with the local server, as well as with the web site that hosted the web quest activity. At times the web site was unavailable to anyone. What she realized was the need for a back-up strategy and materials. She was coming to grips with the fact that you needed at least two

instructional systems, one dependent on computer technology and the other on pencil, paper and tangible products.

The second time I observed Jen she led her students straight to the task. It was another instance of group work. She assigned 3-4 students to each group, and they were expected to work independently on a common task, to draw a life size picture of one of the characters of *The Witch of Blackbird Pond*. Desks were pushed back, and the students rolled out large pieces of white paper. Students sorted themselves into roles, lying down on the paper as a life-size silhouette, outlining, drawing, and coloring. The outlines of figures were easy to draw, but the details were challenging. Since there were on photographs or pictures in the book, Karen was looking for students to imagine what characters would look like. She did not provide any instruction or guidelines for illustration or drawing, and she did not have any references other than the book itself to show what characters looked like.

What was the role of the computer? It was relegated in this instance to a resource, a means to look up background information. In one group an enterprising student was looking for costumes on the web. He found his favorite search engine, *Google*, and was searching for 'Pilgrims.' The results of the search showed pages of text, but no pictures. Then he searched for 'Puritans' and one of the links on the site went to the movie starring Demi Moore, The Scarlet Letter. There were pictures but they were stylized costumes that lacked authenticity. They were made for Hollywood, and not for historical accuracy. The web pictures tended to highlight the particular actor and actress, with less attention to details of costume. What proved to be an interesting discussion focused on the differences and similarities between the Pilgrims and the Puritans. There were other questions to consider before the sketch artists could draw details like hat, shirt and collar, coat, pants, dress, apron, hair coverings, socks, and shoes.

Karen took an unusual step with one group. After they asked numerous questions she reached over and took a piece of paper. She carefully and quickly sketched a picture about 5 - 6 inches in height, a female with a head

covering, dark dress and a white apron. She did not fill in features on the face, but the overall sketch looked like a Puritan woman. There it was, the answer, or at least Karen had produced a template for the group.

As the period was in its last minutes I surveyed the room, and saw students in various poses of active engagement and levels of compliance. There were four groups, each with four or five students milling around life-size drawings. Each group had a sketch artist or two at work, while the other group members offered verbal support or sat and observed the artists. They did not take turns, nor did they make small sketches to provide a sense of organization for the final drawing. As I went from group to group I heard little discussion about the book or the characters depicted in the drawings except when I asked, "Which character are you drawing?" As students answered this question I followed up and asked them to tell me about the character. As I became more familiar with the students I asked more questions. My questions were intended to be general inquiry based on the drawings. I was not checking for understanding, as such but it was clear that discussions about characters were not an explicit part of the instructor's plan. This period and others would be devoted to the completion of life-size drawings. At the close of the class session Karen mentioned that students would be expected to write about their science fair project, their experiment in their upcoming, free period.

C. Jen - Recording and Analyzing Data on Spreadsheets, Quick and Dirty

The mathematics teacher, Jen, had a specific, computer-based assignment that I observed. The assignment was to handle the data for the science fair project. Students were instructed to take their data recording sheets and transfer the data to an electronic spreadsheet. The science fair project was common to all students, and each teacher had a discipline-specific contribution to make. All students were required to perform an experiment, which entailed an application of the scientific method. Everything from identification of a research question to interpretation of quantitative data was to be included. For Jen the task was to provide instruction to each student in

data entry, data screening, data display and initial data interpretation using a spreadsheet program on the laptop computer.

As class began Jen found out that half of the students had forgotten their data disks. As the laptop computers were opened and booted up, Jen sorted the students into two large groups. On one side were students with their computers; for the other side she handed out a mathematics assignment. The assignment was to draw a shape using at least twenty triangles. She made no attempt to put students into pairs, or to have them work in cooperative groups. Once the laptop computers were opened she expected the students to work independently.

She spent the rest of the class period circulating around the classroom. While she appeared to walk around the room and check on everyone, she focused her time on students who requested her assistance. Working on a spreadsheet is a long procedure and there was a handout to guide students, a one-page list of procedures. The detailed instruction sheets, Making a Graph in Excel, were instrumental for independent work. Students were at various stages of data entry and data display. I stood by and observed a number of students working on the assignment, neither asked for assistance and neither was successful in completing the assignment in that time period. One student confused rows and columns for the data, and put all of the data for a variable in the same cell. He began to look at the other students for a hint. Everyone was busy, though, working on his or her own data. I suggested that he needed to separate the data from the data label, so he began the process of data entry again. Another student entered the data pointed to the graphing utility and produced a graph with a straight line. As soon as she saw the result she closed her laptop. She did not take the time to interpret her results. For her the assignment was complete, even though the graph was inaccurate. Finally, one student entered the data correctly and proceeded to the graphing utility. He was having trouble selecting the type of graph from all of the options in the computer program, pie chart, line graph, bar graph and so on. Which type of

graph would best represent his study? At that point in the lesson there was no specific guidance.

IV. Discussion of Findings

Overall, the qualitative portion of the study consisted of three site visits, in December, March, and a final interview in April. Based on these visits I observed the most impact in following areas:

- Clear, consistent expectations for student behavior were defined, associated with specific consequences relating to computer use. All teachers were very concerned about appropriate and safe use of the computers, and insisted on clear rules for behavior. For example, one teacher described the first two months of use as "computer boot camp." In order to minimize disruption during the transition from individual to whole group instruction, a command for shutting the laptop screen was defined. On the command, "close and focus" students were expected to close the screens and look at, if not pay attention to the instructor. General rules for behavior expectations were posted in every classroom. Punishment for infractions to the rules could include temporary loss of computer access. The overall classroom climate was orderly and positive, and the laptop computers were instrumental in setting this tone.
    - **Connections with classroom assessment:** Students seemed to be so interested in the laptop computers that, for the most part, behavior was very positive. However, to increase engagement and explore consequences and behavior students could be involved directly in developing behavior expectations.
- The teachers assigned two projects, the "Travel Project," and the other was a fairly typical "Science Experiment." Both of these assignments were common to all students in their 'house,' and supported by team planning and instruction, and designed to use the information search and retrieval capacity of the Internet. The timeline for completion was at least two to three weeks for each project.

- **Connections with classroom assessment**: Common assessments allow teachers to integrate curriculum and instruction. General expectations for the final product(s) in terms of criteria can be shared by teachers across classrooms; however there are specific achievement targets for each content area that must be defined clearly. For such lengthy projects there should be more intermediate checkpoints for students and teachers to share. For such lengthy projects students need feedback and formative assessment on process and procedure, as well as product.

- As the first attempt at a laptop computer project "The Travel Project" built on a model of integrated learning, a strategy that incorporates collaborative work on the part of teachers. Together they produced an assessment guide, "USA - Canada Coast to Coast Travel Project Worksheet" (See Appendix B). The score sheet is packed with information: 1) a general description of a 4-point rubric, 2) grade point conversions for the 4-point rubric, and 3) the eight criteria of the task. While the teachers may have discussed the project with each other, and agreed on all of these key points, students did not seem to benefit from team planning as much.
  - **Connections with classroom assessment:** As a first-time project there was no history of instruction or of student work. By the teachers own admission the Travel Project was too open-ended. Students may have needed more procedural direction, because so many learners got sidetracked in the journey. While the teachers made up the project checklist and undoubtedly communicated the quality criteria, the checklist needed to be revised and expanded; I was lost trying to match the criteria with the general rubric. Furthermore, the rubric used phrases like "care and effort" as an outcome, with little definition of what was meant or any attempt to define this outcome at the four performance levels. To engage students and clear up questions and misconceptions students could have worked together to brainstorm and define criteria for the final

product. These comments raise the question of whether the teachers themselves had a clear understanding of the achievement target. Clear enough, that is, to get from their own thinking to communications to all students. For such an extensive project, and one that is new, involvement of students allows teachers to hear discussions and questions about content and process. By combining small group and large group discussions, the teacher can listen and gain crucial understanding of how students intend to approach such a task, and an understanding of the students' knowledge and skills necessary to complete the task successfully.

- The Science Experiment was the standard science project, define a problem, corresponding research questions and hypotheses, set up the experiment, collect, analyze and present data, and interpret the data. A Science Fair Project Booklet of 26 pages in length was produced and handed out to students.
    - **Connections with classroom assessment:** By comparison with the Travel Project, the team of Karen, Jen, and Jake made a tremendous improvement in the Science Fair project. The project was familiar to the teachers and the booklet contained materials that were developed over years of trial and error. The materials were organized with page numbers, but the table of contents was still unfinished. For avid science students there was an abundance of ideas and suggestions for organizing and completing the project. However, the booklet needed to be edited thoroughly, as there were numerous errors with sentence structures and grammar, for starters. The booklet seemed to have sections that were duplicated; the scientific method and the section entitled "The Invention Connections" were so similar that it was difficult to distinguish them. I suspect students would need time to differentiate a science experiment from an invention.
- Instructional use of laptop computers for the production of visual/graphic images. The science teacher was constantly using the "draw and paint"

programs in the computers to teach concepts. For example, to teach the layers of the earth types of rocks he had students reproduce a side-view picture of the earth's layers. A more complicated example was to draw and label a volcano to explain metamorphic rocks. The mathematics teacher has students graphing data from a science project, one of the few instances for computer use in mathematics.

- **Connections with classroom assessment:** Students may need more practice with feedback to draw and design more complex visuals. Examples of containing computer-generated drawings could be produced by students. Visuals accompanied by notes would help to explain design steps. Students could participate in the development of criteria to assess the drawings.

- Use of the computer to store quizzes and tests. The science teacher was trying to resolve questions in his teaching about learning and assessment. He tested the use of visual/graphic images with multiple choice quizzes.
  - **Connections with classroom assessment:** With little professional development and no graduate education in testing and assessment there was no understanding of quality on the tests that were designed. There was no evidence of a table of specifications or other planning tools. While content was relevant the items written for test construction were of medium to low quality. The science teacher was a big user of tests, and laptop computers were a part of his plans to change classroom assessment. It is an opportunity to reach these teachers while they are at the early stage of implementing laptop computers in their classrooms.
- Use of computers for data entry, data display, and graphing. The lesson in graphing was part of the Science Fair Project, so it had additional relevance and consequences for students. All students who had their data with them were involved in the task, but students were at widely differing stages of completion and understanding. Apparently the instructional goal was to produce a graph according to the procedures. While the students had a

specific procedure to follow there were questions and choices about the finished product. In addition, half of the students were working on a mathematics task that had nothing to do with the Science Fair Project.

- **Connections with classroom assessment:** The instructor needed to clarify the achievement target, and needed to address her instruction and feedback to all of the students. If students had been grouped in pairs, all of them could have looked at a laptop computer. She had numerous possibilities, practice constructing graphs on a sample set of experimental data. Students could have been shown how to produce 2-3 different types of graphs, and then asked for their feedback about how the graphing format helped or hindered data interpretation. Students, especially those who struggled with the procedure needed more models and more practice prior to working on their data. Jen chose to look at individual student work, but did not address the class as a whole about any common problems. A possible strategy for such general feedback would be to look at the work of 4-5 students of varying achievement levels to get an idea of the things they were doing right, wrong, and questions they had. Based on these observations she could make general comments and work through the practice data set as an example. The instruction would be helpful for all students, even if they did not have their own data set.

- Use of computers for Internet searching and information retrieval for projects and reports. In 2 out of 3 classes computers were used regularly to search for information. From my observations the English teacher, Karen, consistently used the Internet for instructional support however she assumed that students knew how to use the web correctly and effectively.
  - **Connections with classroom assessment:** The instructional resources on the World Wide Web are vast, which appeals to some students who have mastered ways to organize and structure information, and an overwhelming challenge to other students who struggle to put two thoughts together. The directions and procedures

for the use of web resources must be adapted and accessible to all learners. It seemed like there were opportunities for the teacher to have examples ready and to incorporate systematic observations with a review and discussion of these examples. This is an example of how assessment connects with instruction. That is teachers must examine and re-examine the clarity of goals and expectations for all learners. On the one hand, the Road Trip Project was very open ended, with little or no organized information. There were web-based resources, so-called web quests that organize information in advance. Use of the laptop computers as tools for information gathering is embedded in complex, lengthy projects. Teachers must consider the importance of structure on learning, and must work to clarify the achievement skills of information gathering, management, and interpretation.

V. Discussion: Combining Observations and Interviews with Survey Results

The statewide survey was conducted as a collaboration of the University of Maine at Orono and the University of Southern Maine. The response rates to surveys were as follows: 46% of students (8,007 out 17,223), and 33% of teachers (731 out of 2, 231). The central questions for the survey were:

1. How are the laptops being used?
2. What is the impact of using the laptops?
3. Are there obstacles to full implementation of the Maine Laptop Initiative?

For this study questions 1 and 2 are most relevant. The focus of the study is to observe teachers as they adapt to a change in the learning environment of the classroom.

According to survey results, only 28% of the teachers rated themselves as advanced or expert users of the computers. A consistent finding in the surveys and the observations was that classroom assessment was one of the areas least affected by the use of laptop computers. Based on the teachers' survey the most frequent use of laptop computers was for teachers to

communicate by email with other teachers with approximately 55% communicating with colleagues by email at least a few times a week. By contrast only 21% of teacher respondents indicated that they used laptop computers to assess student work a few times a week. What did teachers perceive as the effects of laptop computers on instructional areas? The areas affected positively were "creating assignments" (79%) and "planning for instruction" (74%). Also, 66% reported a positive impact on "presenting lessons," 65% of the teachers reported positive effects on creating integrated lessons, and 60% indicated a positive impact on teacher-teacher collaboration. The two instructional areas listed as least affected were "providing feedback to students" and "assessing students." In each case only 41% of the teachers surveyed reported a positive impact on "providing feedback to students" and "assessing students." In addition only 48% of the teachers surveyed reported positive effects on classroom management.

VI. Conclusion

The laptop program was a pilot program in several schools but it has amounted to innovation by immersion for teachers and students. Rarely have students been so directly involved in instructional change; they are at the keyboards in an instant. Everything about the change is mobile and adaptable. While immersion is a powerful environment for change, teachers were unfamiliar with the computing environment created by the wireless, laptop computers. In essence, classroom teachers were told that computers were theirs for the using. Little, if any, prescription was advanced in order to use the computers.

It's difficult to dismiss the teachers' claims about the inherent power of laptops to be useful, flexible resources for a "just in time" classroom environment – ready to find, organize, create, manipulate, store and retrieve information. Every time I visited their classrooms, these three teachers were mediating their instruction with these gadgets in different ways. The active presence of computers in various modes of use provided a multi-layered set of

instructional strategies, requiring thoughtful instructional design from planning and expectations to testing and assessment. From what I saw there is little doubt that teachers and students have been energized by the use of laptop computers. Computers are powerful gateways to open-ended learning, but teachers themselves wonder, has the level of achievement been changed? My concerns remain with the classroom assessment environment, the quality of feedback to students, the design and use of testing and assessment, and the effective communication of testing results to support learning. Based on information gathered so far, one of the biggest challenges for teachers is to present clear, feasible achievement targets to the students. Teachers' capacity to articulate clear, appropriate achievement targets, in the form of tests, quizzes, homework assignments and projects, is a concern for all classrooms that pre-dates the use of laptop computers.

Without careful instructional planning the presence of laptop computers did not account for improvements in one of the most basic instructional questions, how clearly do students understand the achievement targets? The projects which incorporate the open-ended nature of the internet did little to improve the clarity and coherence of learning targets. In fact, it appeared that web-based learning contained numerous sources of confusion in expectations of the curriculum, the match of methods to the achievement target, and the sources of error and mis-measurement in rubric and in the test questions.

Key questions about other aspects of classroom assessment remain. Do teachers have clear instructional goals? Have the computers contributed to improvement in the use of assessment information? From my perspective, the effectiveness of the laptop computer initiative still rests on the shoulders of the teachers who must understand the role of instructional media design and its connections with clear, coherent classroom assessment.

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