7-1-2005

Does Maine's Middle School Laptop Program Improve Learning?

David L. Silvernail PhD
University of Southern Maine, Center for Education Policy, Applied Research and Evaluation

Does Maine's Middle School Laptop Program Improve Learning?

A Review of Evidence to Date

Occasional Brief

Dr. David L. Silvernail
Director
University of Southern Maine
Center for Education Policy, Applied Research, & Evaluation

July 2005

Occasional Brief

Does Maine's Middle School Laptop Program Improve Learning?

David L. Silvernail **University of Southern Maine**

"**Laptop Students Still Test The Same."** This headline from an August 2004 Portland Press Herald newspaper article caused a great deal of angst on the part of proponents of Maine's innovative middle school laptop program, while it fueled the fires for the critics of the program. The newspaper article states in part:

> "The first children to use laptops in the class show no improvement in statewide MEA tests after two years…The eighth grade scores for reading, writing, math, and science in the Maine Education Assessments were essentially unchanged in the past school year compared with the previous two years." (Bell, August 10, 2004, Al).

It is true that overall performance on the 8th grade Maine Education Assessments (MEAs) has not changed appreciably in the last three years. And at first blush this may be somewhat disconcerting, particularly in light of the fact that other laptop programs appear to have had positive impacts on student achievement. For example, several studies report improved writing scores. Rockman et al. (2000) found that students who used laptops outperformed students who did not use them, in four specific areas of writing, Jeroski (2003) reported that giving students laptops increased the percentage of students who met performance standards by 22% over the course of one year, and Lowther (2003) found significant improvements in writing and problem-solving performance for students given 24 hour access to laptops. Mann et al (1999) reported higher performance on a state examination for students with laptops, and in one South Carolina middle school, students with laptops sustained their achievement gains over their middle school years, in contrast to students who did not have laptops (Stevenson, 1998).

So there is a growing body of research showing the academic benefits of laptops. But even given this evidence from other states, Maine's MEA performance still is not surprising for several reasons.

Given the manner in which the laptop program was implemented, changes in test scores on any statewide standardized tests should not be expected. Essentially, implementation of the program was left in the hands of each school district. The State did not dictate when and how the program was to be implemented in the 240+ Maine middle schools, nor did the State say how the laptops were to be used inside these schools. As a result, some schools began implementing the program right away, some several months later. Some used the laptops in just selected classes and in a limited number of disciplines, others in all classes. Some schools gave teachers considerable help and support in learning to use the laptops, while others did not. And some schools let the students take the laptop home, others did not. Consequently, the variations were so great it is unrealistic to expect clear, consistent changes on any standardized test. Even within specific schools and classrooms, wide variations in the way the laptop program was implemented would, in all likelihood, have differing effects on any achievement test scores. To determine if, and to what extent, standardized achievement test scores would improve, one needs a much more controlled implementation strategy.

Second, even if the implementation strategy had been more uniform, Maine's assessment program is not designed to measure growth from year to year for a particular group of students. The MEAs merely provide a snapshot of the performance of a single 8th grade group at a particular point in time. It is a one-time assessment given to all 8th graders every year, and different groups of 8th graders each year. In other words, different groups of 8th graders are tested each year, not the same groups from year to year. Thus, the 8th grade MEAs cannot be used to assess the growth in learning in a specific group of 7th and 8th graders over the course of two years.

Third, and possibly most importantly, the present MEA is not designed to measure the type of learning one might expect as a result of the introduction of an ubiquitous 1-to-1 laptop program. The goal of the Maine Learning Technology Initiative, the initiative that has spearheaded Maine's laptop

program, was to prepare Maine's students for the 21st Century. In the words of the original task force:

> *We live in a world that is increasingly complex and where change is increasingly rampant. Driving much of this complexity and change are new concepts and a new economy based on powerful, ubiquitous computer technology linked to the internet.*
>
> *Our schools are challenged to prepare young people to navigate and prosper in this world, with technology as an ally rather than an obstacle. The challenge is familiar, but the imperative is new: we must prepare young people to thrive in a world that doesn't exist yet, to grapple with problems and construct new knowledge which is barely visible to us today. It is no longer adequate to prepare some of our young people to high levels of learning and technological literacy; we must prepare all for the demands of a world in which workers and citizens will be required to use and create knowledge, and embrace technology as a powerful tool to do so.*
>
> *If technology is a challenge for our educational system, it is also part of the solution. To move all students to high levels of learning and technological literacy, all students will need access to technology when and where it can be most effectively incorporated into learning.* (Task Force on Maine's Learning Technology Endowment, 2001, p.i.).

Thus, a major goal of Maine's laptop program has been to help students acquire 21st Century skills using technology. However, the current MEA is designed to assess, at best, gateway skills and basic knowledge; skills and knowledge which may be necessary, but not sufficient for the demands of the 21st century. Furthermore, the MEAs are designed to determine if students have acquired knowledge, rather than created new knowledge; a skill which is becoming increasingly important as we move into the new century.

Consider these science examples. Below is an item that, according to the MEA test developers, is designed to assess students' ability to **communicate effectively in the application of science and technology:**

Boiling Points of Carbon Compounds

Name	Number of Carbon Atoms	Boiling Point
Ethane	2	-88°C
Butane	4	0°C
Hexane	6	69°C
Octane	8	126°C
Decane	10	174°C

2. Which of the following is the best estimate of the boiling point of heptane, a compound that contains seven carbon atoms?

   A. -40°C C. 95°C

   B. 35°C D. 150°C

How does this compare to 21st Century communication skills? The Partnership for 21st Century Skills, a partnership of educators, businesses and community leaders, and parents, describes a 21st Century skill of **communicating science information** as follows:

- Use appropriate tools to analyze and synthesize information (e.g., diagrams, flow charts, frequency tables, bar graphs, line graphs, and stem-and-leaf plots) to draw conclusions and implications based on investigations of an issue or question.

  For example, compile qualitative and quantitative data gathered through an investigation of past and current earthquake epicenters and regions of volcanic activity in order to identify needs and problems arising from events relating to the earth's crust.

Consider another MEA science item, one designed according to the test developers to have students **apply inquiry and problem-solving approaches in science and technology:**

Minerals With A Metallic Luster

Mineral	Color	Streak	Hardness	Specific Gravity
graphite (C)	steel gray	black	1	2
galena (PbS)	silver gray	gray	2.5	7.5
chalcopyrite ($CuFeS_2$)	golden yellow	greenish black	4	4.3
pyrite (FeS_2)	brass yellow	greenish black	6	5
hematite (Fe_2O_3)	steel gray	reddish brown	6	5.2
magnetite (Fe_3O_4)	black	black	6	5.2

3. Which characteristic would be most useful in distinguishing a sample of hematite from the other minerals listed in the table?

A. color
B. streak
C. hardness
D. specific gravity

And here is a 21st Century **problem solving skill:**

- Collect real-time observations and data synthesizing and building upon existing information (e.g., online databases, NOAA, EPA, USGS) to solve problems.

  For example, collect data and search print and electronic resources to gather and record past data on the change in the turbidity of a river after a rainfall and its effect on the plants and animals living in this habitat.

It is clear from these examples that what is being asked of students on the MEA, and the 21st Century skills we are now asking students to demonstrate in classrooms all across the state, are very different. The MEA simply does not measure the kinds of knowledge and skills we should expect Maine's middle school students to acquire and create through the use of laptops. (The one exception may be in the area of writing, which is discussed in more detail later). The MEA items only require students to recall information, and to select from a list of multiple choice answers. Twenty-first Century skills, on-the-other-hand, require students to locate information, sort it, analyze it, formulate and test solutions, and communicate it effectively to others. As Rockman (2003) says, "Computers don't provide content, they offer the tools to access, manipulate, and organize content." So it is not surprising that the introduction of the laptops in Maine's middle schools has not translated directly into higher scores on the statewide MEA achievement tests.

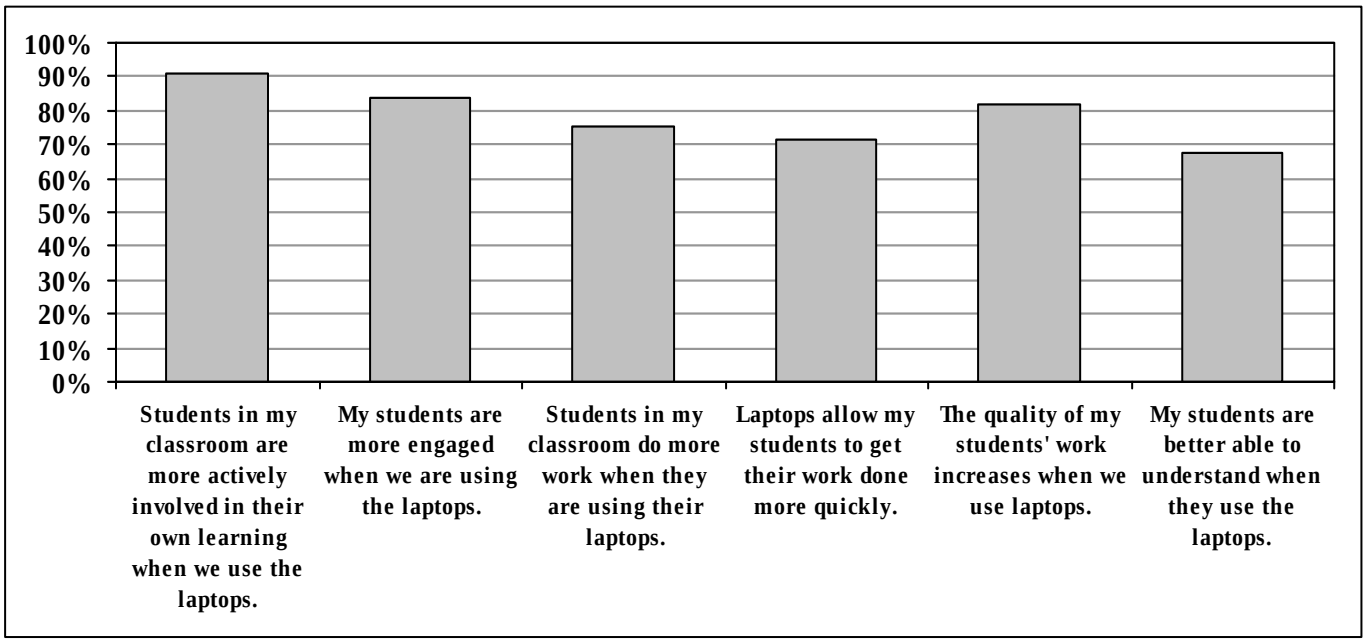
Is there evidence that learning has changed and improved as a result of the laptops performance in Maine? Unfortunately, to date we do not have exhaustive evidence of how, and how much, the introduction of laptops has changed learning. But we do have what British physicist Eddington (1929) called "pointer readings" – evidence that begins to answer questions and points toward particular conclusions. In this case, we have evidence of pointer readings of several different types, that when taken together may point toward a particular conclusion.

First, there is evidence that teachers all across the state are developing lessons and curriculum-embedded assessments designed to help their students acquire 21st Century skills like those describe above. For example, here are some sample tasks teachers are assigning their students:

1. To learn about the biological cell students used a website to compare a cell's organelles and functions to those of a city. Then students designed and made physical modules of human organizations to compare to a cell.
2. To learn about calculating volume and density of irregularly shaped objects, students collected experimental data, graphed it using their laptops, created formulas for doing the calculations, and modeled and tested the formulas on new sets of objects.
3. To examine discrete mathematics concepts, students measured their height, arm span and foot size, used their laptops to collect class data, calculated averages, developed predictions, and then tested their predictions with a second data collection cycle some months later.
4. To understand personal and social responses to natural disasters, such as the tsunami, students searched online databases, sorted and synthesized this information in their Social Studies classes, used websites to examine the physics of the tsunami in their Science classes, and developed skills of oral and written slideshow presentations in their Language Arts classes.

Second, we have evidence from teachers' assessments of the impacts of the laptops on their students and their learning. As part of the first year evaluation of Maine's middle school laptop program, teachers were asked about the impact of the laptops on their student's learning. These teacher assessments may be seen in Table 1. As indicated by this evidence, teachers believe that the laptops have improved the quality of learning, and improved students understanding of what they are learning (Silvernail and Lane 2004).

Table 1
Teacher Assessments



And this evidence should not be taken lightly. Research has shown that teachers' judgments are very accurate measures of actual student achievement (Coladarci and Hodge, 1988; Chakuluk and Kenny, 1993; and Fuller, 2000). As Guskey (1996) asserts:

> "*Because teachers know their students, understand various dimensions of students' work, and have clear notions of the progress made, their subjective perceptions may yield very accurate descriptions of what students have learned.*"

Third, we have some evidence from parents, another group of individuals adept at assessing changes in children's learning. For example, a survey of middle school parents in one Maine school district yielded some very interesting results (Palfrey, 2004). As shown in Table 2 on the next page, over 80% of the parents that responded to the survey indicated that the laptops have positively impacted their child's learning, and almost 60% indicated laptops have improved their child's organizational skills, skills specifically desired by colleges and employers alike.

Table 2
Middle School Parent Assessments

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Too Early To Tell
1. Laptops have positively impacted how my son or daughter learns at school.	NG	3.2%	10.2%	29.3%	51.5%	5.7%
2. My son or daughter is more organized as a result of using a laptop.	1.2%	10.1%	22.6%	29.6%	28.9%	7.5%

As one parent put it:

> "*My son was in the first 7th grade class to have laptops. The first year, his grades improved dramatically and continued to do so every year since. I attribute this mostly to the ability to access information more easily whether it be on the internet or in his files. Organization has definitely improved and interest in school projects heightened due to having access to a variety of resources.*"

Another source of evidence is a preliminary analysis of differences in performance of students completing the writing section of the MEA, some using paper and pencil and some using their laptops. As noted earlier, the one area where the introduction of laptops may be discernable in MEA results is in the area of writing. In this case, the MEA does measure directly a skill area which is not only important today, but also one that will continue to be important in the 21st Century – that is, the skill of communicating ideas effectively in written form.

In 2004, approximately 10% of the 8th graders completed the writing section of the MEA online using laptops, while the remaining 90% completed the writing section the traditional way – using paper and pencil. Table 3, on the next page, reports the results from an analysis of these writing scores by the Maine Department of Education (MDOE, 2004]. The analysis revealed that the students who completed the assessment online scored on average 3 points higher than those who wrote their responses on paper, a difference greater than the standard error of measurement and approximately equal to ⅓ of a standard deviation better than the paper and pencil scores. And the difference was even greater for higher performing students. Obviously this is not definitive evidence, and it is unclear whether the results were because laptops had significantly improved students

Table 3
Comparison of Online and Paper MEA Writing Sample

Statistics	Writing	
	Online	Paper
Average	539.6	536.6
SD	9.9	9.2
n	1,816	14,870

written communication skills or whether the sudden shift back to providing a writing sample using paper and pencil had hindered the performance of some students. But the evidence does provide one more pointer reading indicating laptops have positively affected students' academic performance in some way.

Another source of evidence is that collected by individual teachers with their students. One example comes from a middle school mathematics teacher. Table 4 reports this teacher's analysis of student performance in his Basic Algebra classes before and after the introduction of laptops (Toy, 2004). As the

Table 4
Student Performance Before and After Introduction of Laptops

2001-02 Year Before Laptops	Quizzes (No changes made)	2002-03 1st Year of Laptops	Increase in Class Average
74	Decimal/Fractions	91	17
71	Mixed Numbers	84	13
79	Decimals	89	10
87	Statistics	96	9
85	Fractions	94	9
88	Patterns	96	8
81	Systems of Equations	89	8
82	Negatives	88	6
85	Percents	90	5
86	Linear Equations	91	5
94	Coordinates	98	4
82	Geometry	85	3

data shows, performance improved anywhere from 3% to 17%, with an average improvement of slightly more than 8%. This is only one example but it demonstrates that improvements in achievement may be seen if changes are

assessed at the individual school or class level using consistent, uniform curriculum-embedded assessments.

Finally, Maine very soon will have another "pointer reading" on the impact of the laptop program on student learning. Maine was awarded one of only ten federally funded competitive grants designed to examine the impact of technology on classrooms and learning. This three-year grant is providing Maine an opportunity to examine up-close, and in a very systematic and structured way, the impact of laptops on middle school students' mathematics learning. Although it is too early to have conclusive results (i.e., at the midpoint of the three year study), early reports from teachers are very positive. Teachers report that with the use of the laptops and online resources in their classrooms students are learning facts, rule making, and concepts quicker, developing deeper understandings of abstract mathematics processes, and learning how to apply mathematics in solving real-world problems. And in Spring 2005 Maine will have completed the first phase of the study and will have test results for over 4500 middle school students, evidence collected from a rigorously designed experimental study of Maine's laptop program.

In summary, then, it appears that Maine's introduction of its ubiquitous 1-to-1 laptop program has been beneficial to learning, if one looks in the right places. There is growing positive evidence from teachers, parents, classroom assignments and tests, and even in one case, on a standardized test, all pointing toward a similar conclusion. Students are learning more, better, and quicker with the laptops. The collection of additional evidence needs to continue in order to determine how widespread the impacts are for learning, and to determine the accumulative effects of this new level of learning on high school student performances. But these "pointer readings" are very promising, and bode well for the future achievement of Maine's middle school students.

References

Bell, T. (August 10, 2004). "Laptop students still test the same." Portland, Maine: Blethen Maine Newspapers, Inc. Al.

Chekaluk, E. and Kenny, D.T. (1993). Early reading performance: A comparison of teacher-based and test-based assessments. Journal of Learning Disabilities, 26, 4, 227-236.

Coladarci, T., and Hoge, R.D. (1989). Teacher-based judgments of academic achievement: A review of literature. Review of Educational Research, 59, 3, 297-313.

Department of Education, Task Force on the Maine Learning Technology Endowment, Augusta, Maine (2001). *Teaching and Learning for Tomorrow: A Learning Technology Plan for Maine's Future*.

Eddington, A.S. (1929). The Nature of the Physical World. London: Cambridge University Press.

Fuller, M. (2000). Teacher Judgment as Formative Assessment of Student Performance on Ohio's Fourth and Sixth Grade Proficiency Tests. Paper presented at the Annual Meeting of the American Educational Research Association.

Guskey, T.R. (1996). Reporting on student learning: lessons from the past, prescriptions for the future. Chapter 3 of the 1996 ASCD Yearbook, Retrieved from the World Wide Web: http://www.ascd.org/reading room/books/guskey96book.html#chapter3

Jeroski, S. (2003). Wireless Writing Project Research Report: Phase II. Vancouver, B.C.: School District 60, Peace River North.

Lowther, D.L., Ross, S.M., & Morrison, G.M. (2003). "The Influences on Teaching Strategies and Student Achievement of Using Laptops in the Classroom." Educational Technology Research and Development, 51, 3, 23-44.

Maine Department of Education (July 2004). Preliminary Analysis of the Comparability of Paper and Online Administration of the MEA Writing Assessment. Augusta, Maine. (Unpublished report).

Mann, et al. (1999). West Virginia Story: Achievement Scores from a State Wide Comprehensive Instructional Technology Program. West Virginia.

Palfrey, S. (December 2004) Summary of laptop use surveys. Falmouth, Maine: Falmouth Public School System.

Partnership for 21st Century Skills, Washington, D.C.: (2004). *The Road to 21st Century Learning.*

Rockman Et Al (2000). A more Complex Picture: Laptops Use and Impact in the Context of Changing Home and School Access. San Francisco, CA: Rockman Et Al.

Rockman, S. (2003). Learning from laptops. Threshold Fall (2003) 25.

Silvernail, D.L., and Lane, D.M. (2004). The impact of Maine's one-to-one laptop program on middle school teachers and students: Phase one summary evidence. Gorham, Maine: Maine Education Policy Research Institute, University of Southern Maine Office.

Stevenson, K.R. (1998). Education Report – Year 2: Schoolbook Laptop Project. Beaufort, S.C.: Beaufort County School District.