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**Laptop Learning:**  
A comparison of teaching and learning in upper elementary classrooms equipped with shared carts of laptops and permanent 1:1 laptops

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Hello. I'm Damian Bebell. I'm an assistant research professor at Boston College's Lynch School of Education and a research associate at the Technology and Assessment Study Collaborative. Besides teaching courses in the Graduate school of Education, I participate in a variety of research projects that explore the effects of educational technology on teaching and learning in K12 settings. In the next few minutes, I'll share some fascinating findings from a recent study I conducted with my Boston College associates Mike Russell and Jennifer Higgins. It compared classrooms where every student had their own laptop computer to classrooms where students used shared carts of laptop computers.

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**What we already know...sort of**

- Increased engagement
- Decrease in discipline problems
- Increased use for writing, analysis and research
- Trend toward student-centered instruction
- Increased test scores
- Less TV, more time on homework

First, let's take a look at what we already know about what happens when students have one-to-one access to computers. I qualify this by saying we "sort of" know these things because the evidence is limited to anecdotal accounts, a few small scale descriptive studies, and a handful of program evaluations. As far as we are aware, no truly experimental studies of the effects of 1:1 computing exist. Nonetheless, initial evidence suggests some trends.

When the student-to-computer ratio is 1:1, students tend to be more engaged in their work. Discipline problems decrease. There is an increase in the use of computers for writing, analysis, and research. There is trend toward more student-centered instruction. Some evaluations have found limited

evidence of increased standardized test scores. And at least one research study found that students with one-to-one access at school went home to spend less time watching television and more time doing homework!

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**Research Question:**

What happens when students have full 1:1 access to laptops in classrooms?

Given these initial results, there has been a marked increase in 1:1 computing among educators and policy makers. So let's turn to the story of a 1:1 computing program where we designed and implemented a research plan to help the school and community answer the question "What happens when students have full, one-to-one access to laptop computers in the classroom?"

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**Background and Setting**



The South School is a public K-5 elementary school located in Andover, Massachusetts, a suburban community 20 miles North of Boston. During the 2000-01 school year, the district invested in a cart of 30 laptop computers which was shared among nine fourth and fifth grade classrooms. Towards the end of the school year, the principal experimented with scheduling the laptop cart so that teachers could use the technology exclusively for one week at a time, and then longer intervals. The principal noted that when teachers had more prolonged access to the technology, their

students' use of the laptops increased notably.

These observations planted the seed for a 1:1 laptop program where every student in a class could have full access to a personal laptop computer. Given a tight budget, the principal developed a voluntary parent purchase program. For those parents who could not afford a laptop, a fund was established which allowed any interested family to participate with a donated laptop computer. Not all parents opted to have their children participate. In 2002-2003, the second year of the program, the principal invited our research team to begin examining the effects of the program in an independent research study across the four 1:1 classrooms and remaining five classrooms that were still using a shared cart of laptop computers.

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Participants		
	4 <sup>th</sup> grade	5 <sup>th</sup> grade
1:1	2 classrooms	2 classrooms
Shared	2 classrooms	3 classrooms

This chart summarizes the classes involved. Nine fourth and fifth grade classrooms participated in the study. In four of the classrooms, students were given full access to laptop computers. In traditional research lingo, these classrooms represent our “experimental” or “treatment” group. We also carried out research in the remaining five classrooms where carts of laptops were shared. These “non-1:1” classrooms comprised our “comparison” or “un-treated” group. In total, 209 students participated.

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**1:1 classrooms**  
**The “treatment group”**

- Full student access to laptop computers in school and at home
- Plus
  - School Leadership
  - Curricular and Technical Support
  - Parental Involvement
  - Supportive School Community
  - Commitment to Research/Evaluation

Before continuing, it is important to note that the laptop program actually involved a lot more than just new laptops for students in the participating classes. Every classroom was equipped with wireless technology and a classroom printer. The school formed a network of participating parents, which offers technical support to students at home via phone, email, and home visits. Part of the laptop fund paid for a full time technology staff member in the school to provide support and assistance to all staff and students. The district and school were fortunate to already have a strong computer support system and offered professional development programs for all of the teachers, including biweekly technology reflections at faculty meetings. By design, the program had a tremendous amount of “buy-in” from parents and the school staff as well as very enthusiastic leadership. Previous and current literature underscore the importance of such components in any successful educational technology program.

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**The comparison classrooms**  
**were equipped with:**

- Access to a shared cart of laptops for one week out of every five weeks
- 3 desktop computers
- Classroom printer
- Professional development
- Technology support
- Leadership and community

Our comparison classrooms, the non-1:1 classes, had access to a cart of laptops one out of every five weeks. In addition, each classroom was equipped with printers and 3 stationary desktop computers. The teachers from the non-1:1 classrooms also participated in ed tech professional development and benefited from the schools support system and active leadership. In fact, when I have presented this study to general audiences, many school officials note that the

technology resources of the comparison classrooms themselves is actually pretty impressive and they're fortunate to have them.

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<b>Data Sources</b>
<ul style="list-style-type: none"><li>• Classroom Observations</li><li>• Teacher Interviews</li><li>• Student Surveys</li><li>• Student Drawings – “Draw a picture of yourself writing at school.”</li></ul>

In our study, four types of data were collected. Between March and April of 2003, fifty-six classroom observations were conducted. Every ten minutes, observers used a checklist to record students' engagement level, the number of students working with technology, the number of students working independently, in pairs, in small groups, or in large groups, and the role of the teacher. In addition, observers recorded narrative accounts of the activities occurring throughout the one hour observation period, with a specific emphasis on teacher-student interactions, student-student interactions, uses of technology, and student engagement. At the end of each observation, a detailed summary of the observation was produced.

In addition to the classroom observations, teachers were interviewed using a protocol that focused on several issues related to the use of technology in his or her classroom. All two hundred and nine students completed a survey that focused on students' specific uses of technology in school and at

home, their teacher's use of technology in the classroom, as well as demographic information. Finally, to provide further insight into students' writing processes, students responded to the following drawing prompt: "Think about the work you do in your classroom. In the space below, draw a picture of yourself writing in school."

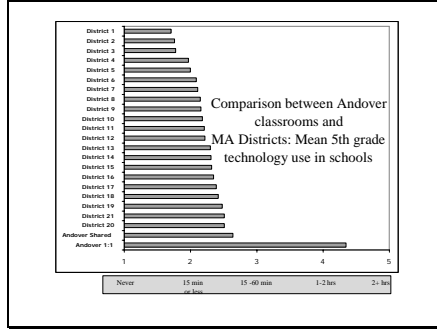
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**What did we learn from exploring ?**

- Technology Used More Frequently in 1:1 settings
- Higher motivation and engagement in 1:1 settings
- Computers became students' primary writing tool in 1:1 settings
- Differences in classroom structure
- Differences in home computer use for 1:1 students

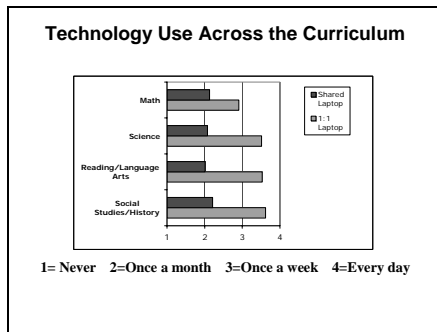
Across the different data sources, five major findings emerged. First of all, the increase in access to technology led to increases in technology use. Second, there was evidence suggesting that 1:1 computing helped improve student motivation and engagement. Third, we saw that computers became students primary writing tool in the 1:1 classrooms, whereas paper and pencil remained the primary writing tool in the shared laptop settings. Fourth, we found differences in the ways class was structured in the 1:1 settings. Lastly, students participating in the 1:1 setting in school were more likely that their non-1:1 peers to use their home computers for scholastic and academic pursuits.

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The classroom observations, teacher interviews, and student surveys all indicated that technology use by students and their teachers was significantly higher in the 1:1 classrooms as compared to the shared classrooms. Although such an increase was not unexpected, the sheer magnitude was dramatic. In earlier research, we surveyed thousands of students’ technology use in fifth grade classrooms in 20 Massachusetts districts. We used the student survey data to rank those 20 districts on the basis of general technology use. This chart shows how our 1:1 classrooms and our non-1:1 classrooms compared with the district rankings in the earlier study. Although many of the surveyed districts were nearby and had similar demographic characteristics, the shared laptop students were nonetheless using technology slightly more regularly than their neighbors. But look at the 1:1 classrooms! We see just how profound and dramatic the increase in student technology use really is.

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In this figure we see that students in the 1:1 classrooms reported significantly higher levels of technology use across all studied subject areas. For example, students in the shared laptop classrooms reported using computer during science about “once a month” compared to somewhere between “once a week” and “every day” for the 1:1 students – a difference that represents between 4 and 12 times more frequent use.

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**Motivation and Engagement**

Content Analysis Results of the Classroom Observations

	Shared	1:1
Engagement	4.92	6.06
Disengagement	5.23	4.78

Student engagement is often defined by the degree to which students are on-task or by “students’ willingness to participate in routine school activities.” We found evidence of higher levels of student engagement in the 1:1 classrooms. The chart on this slide reports findings from the content analysis of our observation notes. References to student engagement were greater in number in the 1:1 classrooms. Similarly, references to disengaged behavior were lower in number than in the shared laptop classes. These differences are relatively small but are consistent with our other data. These findings are mirrored in the teacher survey data.

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**In one teacher’s words...**

*“Few kids are absent, there is higher motivation to learn, find out, and that students are more persistent learners because they see results quickly.”*

*“...leveled the playing field” for special education students.*

Teacher interview data also showed higher student engagement. Here is an example of the type of responses we received when we asked teachers about student engagement in general. It’s also worth noting that 1:1 teachers reported higher levels of engagement among special education students as compared to their non-1:1 peers. In fact, one of the 1:1 teachers told us that the laptops had “leveled the playing field” between special education students and non-special education students.

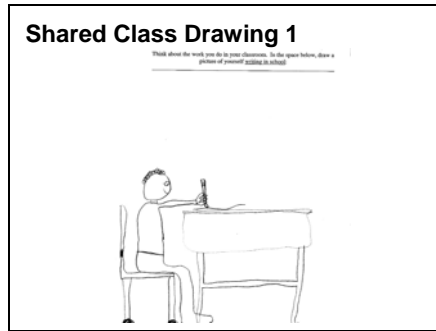
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Classroom Observations	Shared	1:1
Composing text on laptop	.08	3.39
Composing text on paper	.44	.58

The classroom observations, student drawings, and teacher interviews all provide evidence that students in the 1:1 classrooms viewed laptop computers as their primary writing tool. In addition, we found evidence that the amount of time students spent writing was greater in the 1:1 classrooms. For example, students in the 1:1 classrooms were observed composing text on laptop computers more frequently than the students in the shared classrooms. Specifically, the 1:1 classroom observations had an average of 3.39 instances per observation where the observer recorded at least one student composing text on a laptop compared to an average of 0.08 for the shared laptop classrooms. Interestingly, students in the 1:1 classrooms were also observed composing text on paper slightly more often than those students in the shared classrooms. Students in the 1:1 classes were nearly six times more likely to be observed composing text on a laptop than with paper and pencil. Conversely, students in the shared laptop classrooms were eight times more likely to be observed composing text using paper and pencil rather than using laptop.

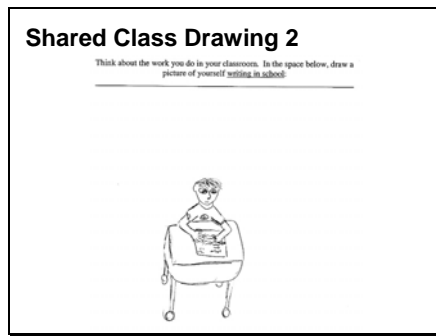


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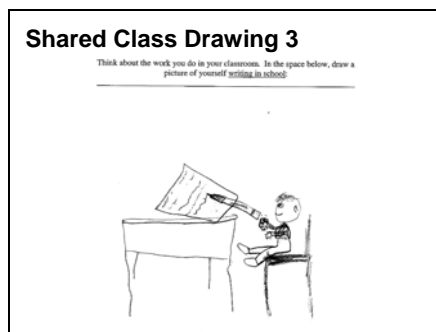
The students drawings themselves graphically illustrate these findings. Here is a sample of drawings from students in the shared laptop classrooms. Note the prevalence of paper and pencil as students' primary writing tool.

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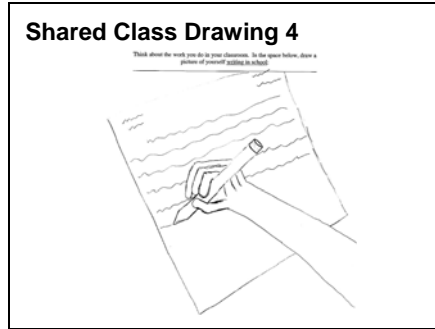
Even with shared access to laptops, students in the shared laptop environments depicted themselves using paper and pencil when asked to draw themselves writing in school, such as this 4th grade boy.

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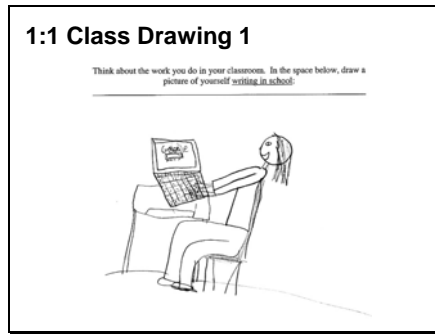
Here is another drawing from a student in a shared laptop classroom.

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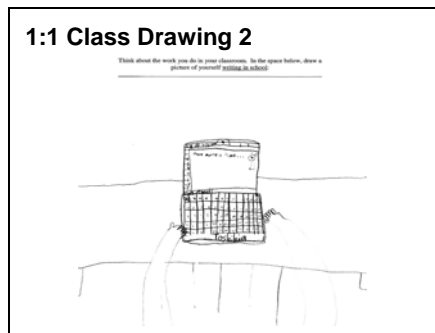
Here is an interesting first-person perspective of writing in school from a shared-laptop student.

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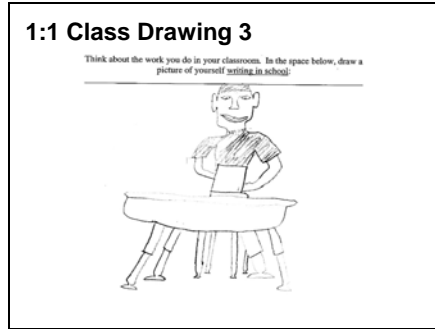
Now contrast those drawings with these from the one-to-one classrooms. Here you can see a student beginning the writing process by searching the Internet using “Google” from her desk.

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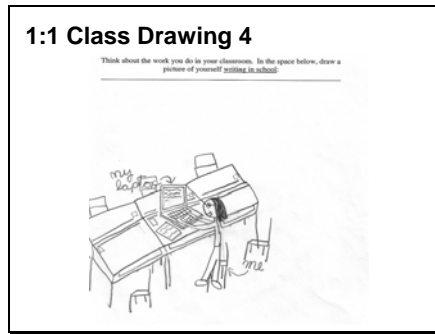
Here’s another student drawing from a 1:1 laptop classroom. If you look closely you can see the brand of laptop—Toshiba—and that this student is beginning a story using Microsoft Word; see the little dog helper?

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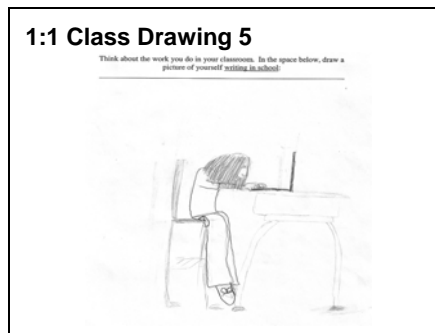
In this student drawing from a 1:1 laptop classroom you can see a boy depicted at his desk with his laptop.

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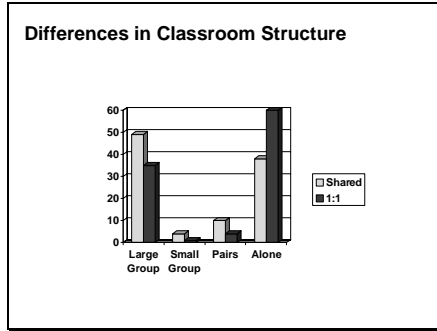
This student drawing from a 1:1 laptop classroom shows desks pushed together and the student working alone on her laptop.

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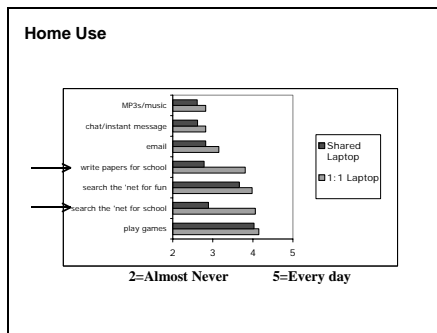
One last student drawing from a 1:1 laptop classroom. Hmm, perhaps not the best posture, but she's engaged!

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Our data also provide evidence that student-teacher interactions, student-student interactions, as well as the way in which classroom activities were structured differed between the shared and 1:1 classrooms. As an example, this figure shows that students in the 1:1 classrooms were observed working alone more often than in large groups, small groups, or in pairs. Conversely, students in the shared laptop classrooms were observed more often working as a large group rather than alone, or in small groups or pairs. The figure also shows a significant difference between the percentage of students that were observed working alone in the 1:1 classrooms as compared to the shared laptop classrooms. These findings suggest that learning activities were most often structured in an individual format in the 1:1 classrooms but in a large group format in the shared laptop classrooms.

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When surveyed, students in the 1:1 classrooms reported using their home computers slightly more frequently for personal activities, such as music, email, chat, or games, and *significantly* more frequently for school work as compared to students in the shared classrooms, despite nearly universal access to technology in the homes of both groups of students.

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**In closing...**

<http://www.intasc.org>

The study summarized here was supported in part under the Field Initiated Study Grant Program, PR/Award Number R305T010065, as administered by the Office of Educational Research and Improvement, U.S. Department of Education. The finding and opinions expressed in this report do not reflect the positions or policies of the Office of Educational Research and Improvement, or the U.S. Department of Education

I hope you have found this summary of our 1:1 laptop research to be informative. At the Technology and Assessment Study Collaborative website, you may download the full report. You'll also find links there to information on our previous and current projects investigating other aspects of the integration of technology in education.