Examing Issues Critical to a 1:1 Learning Environment: Student Outcomes


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Critical Issue Series Introduction
In the spring of 2008, the North Carolina State Board of Education awarded a contract to the Friday Institute for Educational Innovation to conduct a three-year evaluation of the NC 1:1 Learning Technology Initiative (NCLTI) pilot schools. The evaluation includes eight Early College high schools and ten traditional high schools, with a total across the 18 schools of approximately 9,500 students and 600 school staff. In these schools, every teacher and student received a laptop computer, and wireless Internet access was provided throughout the school. The overall goal of the initiative is to use the technology to improve teaching practices, increase student achievement, and better prepare students for work, citizenship, and life in the 21st century. The intent of the evaluation was to provide information about whether the initiative enhanced student learning, as well as to identify challenges to successful implementation of 1:1 programs, strategies for meeting those challenges, and services and supports needed to enable successful programs throughout the State.

This paper is one in a series of six papers that provide detailed explorations of several critical issues that emerged during the NCLTI evaluation. After a brief overview of the NCLTI initiative and its evaluation, this paper examines the role of instructional practices in successful implementation of a 1:1 program.

Review of 1:1 Literature
Schools across the United States have implemented 1:1 laptop initiatives with the aim of preparing future-ready students by developing skills needed for college and the workforce (Warschauer, 2006; Weston & Bain, 2010). Research defines 1:1 as an initiative that: a) provides every student and teacher with a personal digital wireless device with up-to-date software and access to the Internet at school (Penuel, 2006); and b) focuses on using those devices to meet specific teaching and learning goals (Muir, Manchester, & Moulton, 2005) such as increasing equity of access to technology, transforming quality of instruction, increasing student engagement, improving academic achievement and technology literacy, increasing economic competitiveness, and enhancing home-school connections.

While overall results are mixed, recent studies have shown that carefully implemented 1:1 laptop initiative programs can increase students’ general learning outcomes (Warschauer, 2006; Weston & Bain, 2010). While there is evidence that 1:1 programs do not increase test scores in all situations, especially in the case of paper-and-pencil tests (Warschauer, 2006; Weston & Bain, 2010), several studies have provided evidence that the use of laptops in the classroom can lead to increases in students’ math and writing skills (Bebell, 2005; Sclater et al., 2006; Warschauer, 2006) and overall achievement (Shapley, Sheehan, Maloney, & Carnikas-Walker, 2010; Suhr, Hernandez, Grimes, & Warshauer, 2010). Results of other programs have shown improvement in attendance (Lane, 2003) and engagement (Bebell & Kay, 2010; Great Maine Schools Project, 2004; Warschauer, 2006), and one study’s results indicated a decrease in disciplinary problems (Bebell, 2005).

Factors other than the distribution of laptops alone contribute to successful implementation. Teacher support for the initiative, effective instructional use of the technology, technical support, robust technical infrastructure, and quality of implementation are all influential in the success of a 1:1 laptop program (Weston & Bain, 2010). Schools must have not only the capability to use laptops for instruction effectively but also clear strategies and supports in place for ensuring effective student laptop use (Warschauer, 2006), including adequate hardware and software resources and strong leadership to guide the program (Kleiger Ben-Hur & Bar-Yossef, 2010; Maninger & Holden 2009; Silvernail & Lane, 2004). Teachers’ beliefs mediate the way they use technology in the classroom, and if teachers do not support the initiative they are less likely to integrate the laptops into their lesson plans (Antonietti & Giorgetti, 2006; Churchill, 2006; Ertmer, Addison, Lane, Ross & Woods, 2000; Penuel, 2006). Thus, in addition to school and district support, successful 1:1 initiatives require teachers to have access to professional development or tools that can aid them in integrating laptops into lesson plans (Kleiger Ben-Hur & Bar-Yossef, 2010; Penuel, 2006; Silvernail & Lane, 2004; Weston & Bain, 2010). Professional development
experiences can enhance teachers’ technology knowledge and skill level and therefore can improve the use of laptops in the classroom as well as teacher attitudes toward the technology (Kanaya, Light & Culp, 2005; King, 2002; Maninger & Holden, 2009; Swan & Dixon, 2006; Swan, Kratcoski, Mazzer & Schenker, 2005).

**Project Overview**

**Schools/Participants**
The 18 1:1 pilot high schools are located across North Carolina (*Figure 1*) in areas that reflect the state’s diverse geographic, economic, and cultural landscapes.

![Figure 1. Map of 1:1 pilot high schools in NC.](image)

The participating schools initiated their 1:1 projects over a series of years. Because of this staggered implementation model, the Friday Institute evaluation team grouped schools into cohorts depending upon when the laptops were distributed to the teachers and students and whether the school was a traditional or Early College (EC) high school (Table 1).

**Cohort A**

1:1 Traditional
This cohort includes one large, long-established traditional high school in a rural eastern school district. This district has two other traditional high schools that do not participate in the 1:1 initiative. The school’s 86 teachers serve a diverse population of 1,300 students. The school distributed laptops to teachers in the spring semester of the 2006-2007 school year and to students in the fall semester of the 2007-2008 school year.

1:1 EC
This cohort includes seven EC high schools located in seven different school districts. These schools, located on community college campuses, are designed to attract students from populations that are often underrepresented in college: racial minorities, students from low-income families, and those whose parents never attended college. Students in EC high schools graduate with both a high school diploma and two years of transferable college credit or an associate’s degree. In most cases, EC students stay in high school five years to complete their high school and college courses requirements. EC high schools are typically very small, with a maximum of 100 students per grade. The seven 1:1 EC Cohort A schools distributed laptops to teachers in the spring semester of the 2007-2008 school year and to students in the fall semester of the 2007-2008 school year.

**Cohort B**
1:1 Traditional
This 1:1 Cohort includes four traditional high schools located in two districts that are participating in a district-wide implementation of 1:1. Three of the schools, located in a rural district in the eastern part of the state, distributed laptops to teachers in the fall semester of the 2008-2009 school year and to students in the spring semester of the 2008-2009 school year. The fourth school, located in a school district in the central region of the state, distributed laptops to teachers in the spring semester of the 2007-2008 school year and to students in the fall semester of the 2008-2009 school year.

Cohort C
1:1 Traditional
Traditional Cohort C includes five high schools located in two districts. Four schools, located in a rural district in the western part of the state, distributed laptops to teachers during the spring semester of the 2008-2009 school year. Twelfth-grade students received their laptops in the fall semester of the following school year. The fifth school is in a rural district in the central part of the state that provided laptops to teachers district-wide in September 2005. The high school selected for laptop distribution to students is one of three high schools in the district. Distributed to students took place in the fall semester of the 2009-2010 school year.

1:1 EC
This cohort is made up of a new EC high school that distributed laptops to its teachers in September 2009 and to its incoming ninth grade students in November 2009.

Table 1. 1:1 School Cohorts

<table>
<thead>
<tr>
<th>Cohort</th>
<th>School</th>
<th># Students</th>
<th># Teachers</th>
<th>Laptops Distributed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Trad1</td>
<td>1,344</td>
<td>84</td>
<td>To teachers: March 2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>To students: September 2007</td>
</tr>
<tr>
<td></td>
<td>EC1</td>
<td>112</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EC2</td>
<td>132</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EC3</td>
<td>138</td>
<td>5</td>
<td>To teachers: November 2007</td>
</tr>
<tr>
<td></td>
<td>EC4</td>
<td>243</td>
<td>13</td>
<td>To students: March 2008</td>
</tr>
<tr>
<td></td>
<td>EC5</td>
<td>153</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EC6</td>
<td>193</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EC7</td>
<td>207</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Trad3</td>
<td>378</td>
<td>30</td>
<td>To teachers: September 2008</td>
</tr>
<tr>
<td></td>
<td>Trad4</td>
<td>975</td>
<td>59</td>
<td>To students: January 2009</td>
</tr>
<tr>
<td></td>
<td>Trad5</td>
<td>721</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trad6</td>
<td>1,611</td>
<td>83</td>
<td>To teachers: February 2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>To students: September 2008</td>
</tr>
<tr>
<td></td>
<td>Trad7</td>
<td>539</td>
<td>34</td>
<td>To teachers: April 2009</td>
</tr>
<tr>
<td></td>
<td>Trad8</td>
<td>728</td>
<td>48</td>
<td>To students: November 2009</td>
</tr>
<tr>
<td></td>
<td>Trad9</td>
<td>877</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trad10</td>
<td>636</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trad12</td>
<td>716</td>
<td>55</td>
<td>To teachers: September 2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>To students: September 2009</td>
</tr>
<tr>
<td></td>
<td>EC8</td>
<td>61</td>
<td>3</td>
<td>To teachers: September 2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>To students: November 2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9,764</td>
<td>595</td>
<td></td>
</tr>
</tbody>
</table>
Of the 1:1 teacher population \((n=595)\): 93% are fully licensed; 25% have advanced degrees, and 15% are National Board Certified; 18% have less than three years of experience, 26% have between four and ten years of experience, and 56% have more than ten years of experience. Of the 1:1 student population \((n=9764)\), 0.5% are American Indian, 1% are Asian, 9% are Hispanic, 30% are Black, and 60% are White.

**Comparison Schools**

To enhance the rigor of this evaluation, the Friday Institute Evaluation Team analyzed comparative data for the EC 1:1 schools with matched comparison EC schools that were not implementing 1:1 environments. We also selected matched traditional high schools for comparison with the 1:1 traditional high schools. The selection process produced a group of comparison schools that were as similar to the 1:1 schools as possible based on variables such as: teachers’ gender, race and ethnicity, and level of experience with instructional technology; students’ scores on prior-year English I and Algebra I EOC Tests; and students’ access to Internet connectivity at home. In addition, data from the 2008 North Carolina Teacher Working Conditions Survey confirmed similarities among teachers’ perceptions of their working conditions across matched school pairs for items related to instructional technology and leadership. It is important to note that North Carolina Department of Public Instruction Annual Media and Technology Report (AMTR) data indicate that, even without 1:1 interventions, the comparison schools had a large number of Internet-connected computers available for instructional purposes, with student-to-computer ratios ranging from 1.31 to 5.65.

**Data Sources and Evaluation Questions**

The data summarized in this report were collected in recurring cycles from the 1:1 schools in April 2008, September 2008, April 2009, September 2009, and April 2010. At each point in the cycle, surveys were administered to three distinct groups: administrators (principal, assistant principal, technology facilitator, guidance counselor, etc.), classroom teachers, and students. Also, each cycle, site visits to every 1:1 school were made that included classroom observations, interviews with school technology facilitators, and separate focus groups with school leadership, teachers, and students.\(^1\) Archival data analyzed included attendance, discipline, dropout, and achievement data for participating 1:1 and comparison schools.

The evaluation team used the data above to address several evaluation questions that collectively assess school progress toward implementation of a functional 1:1 environment. Table 2 summarizes the alignment of the NCLTI project goals, evaluation questions, and data sources.

<table>
<thead>
<tr>
<th><strong>Project Goals</strong></th>
<th><strong>Evaluation Questions</strong></th>
<th><strong>Data Sources</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve school infrastructure and support systems to meet 21st century needs. (school level)</td>
<td>How have school infrastructures and support systems evolved to meet staff and student 21st century needs?</td>
<td>Policies/Procedures 1:1 Online Survey Focus Groups Site Visit Checklist Laptop Repair Checklist 1:1 PD Inventory/Quality</td>
</tr>
<tr>
<td>Improve staff attitudes and skills related to technology. (teacher level)</td>
<td>How have staff attitudes and skills changed over time?</td>
<td>Classroom Observations 1:1 Online Survey Focus Groups</td>
</tr>
</tbody>
</table>

\(^1\) Data collection tools, including surveys and focus group protocols, are provided in evaluation report appendices available at http://www.fi.ncsu.edu/project/evaluation-of-nc-11-learning-initiative/publications.
### Project Goals

<table>
<thead>
<tr>
<th>Evaluation Questions</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhance instructional practices by facilitating teachers’ ability to infuse instructional technology into routine classroom pedagogy. (classroom level)</td>
<td>How have teachers’ instructional practices changed over time?</td>
</tr>
<tr>
<td>Improve student learning. (student level)</td>
<td>How have students’ 21st century skills changed over time?</td>
</tr>
<tr>
<td></td>
<td>How have student learning and achievement in core academic subjects changed over time?</td>
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<td></td>
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</tbody>
</table>

These evaluation efforts have enabled the identification of several important critical issues areas for successful implementation of 1:1 learning environments: leadership, instructional practice, student learning outcomes, infrastructure, special populations, and quality of implementation. The remainder of this paper discusses in detail the student outcomes in successful 1:1 schools.

### Review of Literature for 1:1 and Student Outcomes

In general, results from studies of 1:1 initiatives among K-12 students point to positive impacts for various student outcomes (Penuel, 2006). Some studies have indicated positive relationships between laptop use and student achievement (Rockman, 2003; Harris & Smith, 2004; Apple Computer, 2005; Shin, Norris, & Soloway, 2007; Silvernail & Gritter, 2007). Others have noted that participation in a 1:1 initiative has had a positive impact on engagement (Lane, 2003; Silvernail & Lane, 2004), interest in school (Lowther, Strahl, Zoblotsky, & Huang, 2007; Silvernail & Harris, 2003; Cavanaugh, Dawson, White, Valdes, Ritzaupt, & Payne, 2007; Mitchell Institute, 2004), and motivation (Mitchell Institute, 2004; Lowther et al., 2007; Silvernail & Lane, 2004; Shin et al., 2007).

### Data Analysis

Survey data from the first and last years of data collection were analyzed using the z-test for two proportions. This test is useful for determining whether there are significant differences between two proportions. Focus group data was audio-taped, transcribed, and finally imported into Atlas.ti software. Transcripts from focus groups with students, teachers, and school leaders were open-coded first, followed by extraction of themes and pertinent quotes.

### Results

**Engagement and Motivation**

Student engagement and motivation was measured via survey items, focus group questions, and classroom observations. Responses to survey questions related to engagement and motivation varied across cohorts. Close to half of students among the Cohort A traditional high school reported agreement that they are more involved and more interested in school when using laptops, and the proportion increased over time (see Figure 2). When asked in focus groups, some students said the laptops were a distraction and were used more for surfing the Internet, while other students commented that they enjoyed the laptops a lot and think that the laptops help students learn better because it gives them “other ways of learning.”
As shown in Figure 3, the majority of traditional Cohort A teachers agreed that students were more actively involved and engaged when using laptops at both time points. While teachers’ perceptions remained relatively stable over time, a slightly greater percentage of administrators agreed that use of laptops positively affect student involvement and engagement in 2010 as compared to 2008. Teachers and administrators were also asked about motivation and engagement in focus groups. While some teachers and administrators said some students were distracted by the technology, most students were more engaged. One teacher said “I’m not going to say they’re jumping out of their skins they’re so excited, but you can tell, they’re looking forward to doing something different.”
The majority of cohort A EC students reported agreement with survey items measuring motivation and engagement, and a significantly greater proportion of students expressed agreement with these items in 2010 as compared to 2008 (see Figure 4). When asked in focus groups, students responded that they were more engaged in school. One student said "my interest in school is higher now because [of] having the laptops".

Note. * Indicates significant difference

**Figure 3.** Percent of 1:1 traditional Cohort A spring 2008 administrators (n = 10) and teachers (n = 57) and 1:1 traditional Cohort A spring 2010 administrators (n = 9) and teachers (n = 75) indicating agreement with various statements related to engagement and motivation.

**Figure 4.** Percent of 1:1 Cohort A spring 2008 (n = 771) and 1:1 Cohort A spring 2010 (n = 722) ECHS students indicating agreement with various statements related to technology attitudes and beliefs.
Figure 5 shows survey responses for 1:1 EC Cohort A administrators and teachers over time. As the Figure shows, 100% of administrators surveyed in spring 2010 agreed that use of laptops positively impacts student involvement, up from about 85% in spring 2008. More than half of the administrators agreed that laptop use was related to student engagement across both time points. Slight decreases were found in the percentage of teachers endorsing these statements over time, but a large majority did indicate agreement that use of laptops in school had a positive impact on student involvement and engagement at both time points. Teachers also agreed that their students are more engaged with the laptops. A teacher was quoted saying, “I think it’s kept some more interested that would have become bored.”

![Chart showing survey responses for 1:1 EC Cohort A administrators and teachers over time]

Figure 5. Percent of 1:1 EC Cohort A spring 2008 administrators (n = 21) and teachers (n = 56) and 1:1 traditional Cohort A spring 2010 administrators (n = 16) and teachers (n = 53) indicating agreement with various statements related to engagement and motivation.

Just over half of the traditional Cohort B students indicated agreement that use of laptops was related to increased involvement and interest in school (see Figure 6). Although the change was not significant, there was a slight increase noted in the percent of students endorsing these survey items when comparing 2009 to 2010. As seen with Cohort A students, Cohort B students agreed in focus groups that they are more interested in school: “I think I’d be lying if I said I wanted to come to school a whole lot more, but I do think that school is less like a downer when you go.”
As shown in Figure 7, over 90% of administrators in Cohort B felt that laptop use was related to increased student involvement and engagement in spring 2010, up from just under 90% in spring 2009. At both measurement points, more than half of the teachers agreed that use of a laptop affected student involvement and engagement, but there was a slight decrease in the proportion indicating agreement in spring 2010 as compared to spring 2009.
Similarly to Cohort B, slightly more than half of the students in Cohort C endorsed statements related to motivation and engagement (see Figure 8). Although not significant, a greater proportion of students expressed agreement that laptops helped them be more involved and interested in school in 2010 compared to 2009. While the laptops are still relatively new in the Cohort C schools, teachers are noticing an increase in engagement and interest in school work: “It makes them more curious… you put them in a direction and you say, ‘You need to go to this site, you need to find this,’ and then they find something, and they’re like, ‘woah,’ and they’re more fired up, they’re more enthusiastic, you know, they want to find out more.”

**Figure 8.** Percent of 1:1 Cohort C fall 2009 (n = 450) and 1:1 Cohort C spring 2010 (n = 466) traditional high school students indicating agreement with various statements related to motivation and engagement.

**Technology Attitudes and Beliefs**
To examine whether students’ perceptions related to technology attitudes and beliefs have changed over time, survey results from the first and last years of data collection were compared for each cohort. In general, a larger percentage of traditional Cohort A students endorsed positive statements related to technology attitudes and beliefs when comparing responses from spring 2008 to spring 2010 (see Figure 9).
As shown in Figure 10, a significantly greater proportion of EC high school students indicated agreement with ten out of eleven positive statements related to technology attitudes and beliefs in 2010 when compared to 2008. In focus groups, students said they did work “a lot quicker and more efficiently;” that the laptops give the students “more opportunities to do stuff;” and that when “[teachers] can incorporate technology, it makes it more interesting for us and keeps us involved with the class.”
As shown in Figure 11, among 1:1 Cohort B traditional high school students, a significantly larger percentage of students felt that laptop use related to increased interaction with teachers, increased understanding of school work, and improved work quality; would allow them to get a good job; and increased their enjoyment of school when comparing 2010 responses 2009 responses. Fewer students in spring 2010 agreed that use of a laptop helps them be better organized and increases the likelihood of revising their work when compared to spring 2009, but the percentage endorsing these survey items remained well over 50%. In focus groups, students said they are able to grasp different information better, the laptops make it “easier to keep up with stuff”, and that it has “helped out with a lot of classes.” Teachers also noted that the laptops have helped keep their students more organized and more efficient in class.

While not significant, increases were noted in the proportion of traditional Cohort C students endorsing positive statements related to their technology attitudes and beliefs for all but one item (see Figure 12). Notably, more than half of all students expressed agreement that having a laptop helped them be better organized, increased their involvement in school, increased the likelihood of revising work, allowed them to work more efficiently, increased the amount of work completed, increased their interest in school, improved the quality of their work, would enable them to get a good job in the future, and increased their enjoyment of school.
Among 1:1 Cohort A traditional high school students, increases in the percentage of students indicating agreement that the use of a laptop at school is helping them learn 21st century skills were noted for all skills except Life and Career Skills (see Figure 13). Four of the increases from fall 2008 to spring 2010 reached significance.

**21st Century Skills**

Among 1:1 Cohort A traditional high school students, increases in the percentage of students indicating agreement that the use of a laptop at school is helping them learn 21st century skills were noted for all skills except Life and Career Skills (see Figure 13). Four of the increases from fall 2008 to spring 2010 reached significance.

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*Note.* * Indicates significant difference

**Figure 12.** Percent of 1:1 Cohort C fall 2009 ($n = 450$) and 1:1 Cohort C spring 2010 ($n = 466$) traditional high school students indicating agreement with various statements related to technology attitudes and beliefs.

**Figure 13.** Percent of 1:1 Cohort A fall 2008 ($n = 831$) and 1:1 Cohort A spring 2010 ($n = 464$) traditional high school students indicating agreement that use of a laptop at school is helping them learn 21st century skills.
The majority of Cohort A ECHS students expressed agreement that using a laptop at school is helping them learn 21st century skills in both fall 2008 and spring 2010 (see Figure 14). Decreases, however, were noted for four of the items including Life and Career Skills, Learning and Innovation Skills, Technology Literacy, and Civic Literacy.

Note. * Indicates significant difference

Figure 14. Percent of 1:1 Cohort A fall 2008 (n = 868) and 1:1 Cohort A spring 2010 (n = 690) EC high school students indicating agreement that use of a laptop at school is helping them learn 21st century skills.

Among Cohort B traditional high school students, increases were noted over time for each 21st century skill except for the item pertaining to Life and Career Skills (see Figure 15). The majority of these increases reached statistical significance.
A greater percentage of 1:1 Cohort C traditional students indicated agreement that use of a laptop at school is helping them learn 21st century skills in spring 2010 than in fall 2009 (see Figure 16). The majority of these increases reached statistical significance.

Note. * Indicates significant difference

Figure 15. Percent of 1:1 Cohort B spring 2009 (n = 2619) and spring 2010 (n = 1549) traditional high school students indicating agreement that use of a laptop at school is helping them learn 21st century skills.

Figure 16. Percent of 1:1 Cohort C fall 2009 (n = 422) and spring 2010 (n = 448) traditional high school students indicating agreement that use of a laptop at school is helping them learn 21st century skills.
Technology Skills
As shown in Figure 17, a greater percentage of 1:1 traditional Cohort A students indicated that they could independently create multimedia presentations, create graphs/charts, create a spreadsheet, and create a database in spring 2010 when compared to spring 2008. Notably, well over half of all Cohort A traditional students surveyed indicated that they could independently do or teach others each technology skill except “create a web page.”

Note. * Indicates significant difference

Figure 17. Percent of 1:1 Cohort A spring 2008 (n = 521) and spring 2010 (n = 466) traditional high school students indicating that they can independently perform various technology skills.

When comparing survey results from spring 2010 to those gathered in spring 2008, a significantly larger proportion of Cohort A ECHS students reported being able to independently complete all technology-related tasks (see Figure 18).
Among traditional Cohort B students, a larger percentage indicated that they could independently engage in all but one of the targeted technology skills when comparing spring 2010 to spring 2009 (see Figure 19).

Note. * Indicates significant difference

Figure 18. Percent of 1:1 Cohort A spring 2008 ($n=752$) and spring 2010 ($n=694$) ECHS students indicating that they can independently perform various technology skills.

Figure 19. Percent of 1:1 Cohort B spring 2009 ($n=2,637$) and spring 2010 ($n=1,576$) traditional high school students indicating that they can independently perform various technology skills.
While not significant, a larger proportion of Cohort C students indicated that they could independently format text documents, create multimedia presentations, import/edit digital images, import/edit video, create a web page, and write a computer program in spring 2010 as compared to fall 2009 (see Figure 20). Fewer students felt that they could independently create graphs/charts, create a spreadsheet, and create a database in spring 2010 compared to fall 2009.

**Figure 20.** Percent of 1:1 Cohort C fall 2009 \((n = 428)\) and spring 2010 \((n = 451)\) traditional high school students indicating that they can independently perform various technology skills.

**Web 2.0 Skills**

When comparing 2008 to 2010, a larger percentage of traditional Cohort A students indicated that they could independently engage in all four Web 2.0 skills (see Figure 21).

**Figure 21.** Percent of 1:1 Cohort A spring 2008 \((n = 521)\) and spring 2010 \((n = 466)\) traditional high school students indicating that they can independently perform various Web 2.0 skills.
Among EC high school students (see Figure 22), significantly more students endorsed being able to independently engage in all four Web 2.0 skills when comparing spring 2010 to spring 2008.

![Chart: Percent of 1:1 Cohort A spring 08 (n=752) and spring 2010 (n=694) ECHS students indicating that they can independently perform various Web 2.0 skills.](image1)

Figure 22. Percent of 1:1 Cohort A spring 08 (n = 752) and spring 2010 (n = 694) ECHS students indicating that they can independently perform various Web 2.0 skills.

Significantly more 1:1 traditional Cohort B students indicated that they could independently engage in all four Web 2.0 skills in 2010 compared to 2009 (see Figure 23).

![Chart: Percent of 1:1 Cohort B spring 2009 (n=2,637) and spring 2010 (n=1,576) traditional high school students indicating that they can independently perform various Web 2.0 skills.](image2)

Figure 23. Percent of 1:1 Cohort B spring 2009 (n = 2,637) and spring 2010 (n = 1,576) traditional high school students indicating that they can independently perform various Web 2.0 skills.

While not significant, a greater percentage of Cohort C students indicated that they could independently engage in all four Web 2.0 skills in 2010 compared to 2009 (see Figure 24).
Achievement
In NC, EOC tests are used to provide an estimate of a student’s knowledge of content-specific concepts aligned to the NC Standard Course of Study. The multiple-choice EOC tests are reported as scale scores, which are standardized across all tests and range between 120-180 (North Carolina Department of Public Instruction, 2005). School-level performance is also reported as the percent of students who are considered proficient for each EOC test.

Our current data set includes scores for students enrolled in 1:1 and comparison schools from the 2008, 2009, and 2010 school years in the following subjects: Algebra I, Algebra II, Biology, Civics/Economics, English I, and US History. The following analyses are based upon scores from each of the subject areas.

The major research question is: How has the implementation of a 1:1 initiative influenced student achievement? In order to answer this question, we conducted different types of analyses of the EOC data for participating and comparison schools in order to determine the following:
1. Has the percentage of students considered proficient for each of the EOC tests changed for the 1:1 and comparison schools?
2. Are there variables associated with the 1:1 initiative which are related to differences in individual EOC scale scores for spring 2010?
1. Are there differences in the percentages of students at each achievement level for the 1:1 and comparison schools?

**Cohort A**

(Average student access to laptops in school at time of spring 2010 EOC exams: 26 months)

Figure 25 shows the average percent of students who were considered proficient in Cohort A schools across the six EOC exams mentioned above. While 1:1 and non-1:1 EC high schools show similar patterns of proficiency, there is a marked difference between the two traditional high schools—it appears that the 1:1 traditional high school had a lot more students passing the EOC exams in the 2009-2010 school year than in the previous two years. However, this data cannot be used to conclude that the 1:1 initiative is the only cause for this rise.

![Figure 25. Percent of students proficient from 1:1 and non-1:1 Cohort A high schools.](image)

**Cohort B**

(Average student access to laptops in school at time of spring 2010 EOC exams: 16 months)

As shown in Figure 26, 1:1 and non-1:1 traditional high schools from Cohort B exhibited similar patterns of performance. Schools with and without the 1:1 laptop initiative showed improvement in the percent of students passing EOCs. If only the 2009-2010 scores were examined, it would seem that the non-1:1 high school was performing better than the 1:1 high school; while this is true, examining EOC scores over three school years suggests that the non-1:1 high schools seem to systematically perform better than the 1:1 high schools—both before and after implementation of laptops in the 1:1 schools.
Figure 26. Percent of students proficient from 1:1 and non-1:1 Cohort B high schools.

**Cohort C**  
(Average student access to laptops in school at time of spring 2010 EOC exams: 6 months)

Figure 27 indicates that 1:1 and their comparison schools are showing similar rates of improvement in the number of students considered proficient based on EOC tests. It should be noted that the line representing “1:1 Trad HS (12th grade)” is for the four high schools in a county where the 1:1 initiative was only implemented for 12th graders. This particular county had many 12th graders who did not participate in the initiative, and many of the EOC courses had a mix of students from all grades, rendering incorporation of laptops into the curriculum difficult for teachers. Additionally, the percent of students proficient in the EOC subject tests is based on data from all grades—not just 12th graders; thus, interpretation of results for this district are limited, and will be further discussed in a separate document.

Figure 27. Percent of students proficient from 1:1 and non-1:1 Cohort C high schools.
2. Are there variables associated with the 1:1 initiative which are related to differences in individual EOC scale scores for spring 2010?

Statistical analyses were conducted on students’ 2010 EOC scores for Algebra 1, Algebra 2, Biology, English 1, Civics, and US History to determine the effects of 1:1 implementation between 1:1 schools and comparison schools. Results indicated that 1:1 implementation had no significant (α = .05) effect on a student’s EOC score for any of the subject areas, while controlling for the following variables:

1. School level: EC high school versus traditional high school, ABC distinction, percent of minority students, percent of students receiving free or reduced lunch, and urbanicity of school district (based on district size and distance from large city)
2. Student level: previous achievement in math and/or reading, minority status, economic disadvantage status, disability status, limited English proficiency status, grade enrollment, and sex

Results of multi-leveling modeling analyses indicated that the best predictor for any of the EOC scale scores was previous achievement as determined by 8th grade EOG scores. Specifically, previous math achievement predicted scores for Algebra 1 and Algebra 2 EOC tests; previous reading achievement predicted scores for English 1, Civics, and US History EOC tests; and, previous math and reading achievement predicted Biology EOC scores. (Note that reading achievement was not tested as a predictor of Algebra 1 or Algebra 2 scores, and math achievement was not tested as a predictor of English 1, Civics, or US History scores.)

When focusing only on the 1:1 schools, results of multi-level modeling analyses showed that there were no significant effects on students spring 2010 EOC scores based on the length of 1:1 implementation, the quality of 1:1 implementation, or the teachers’ ratings of principal leadership when controlling for the following variables:

1. School level: EC high school versus traditional high school, ABC distinction, percent of minority students, percent of students receiving free or reduced lunch, and urbanicity of school district (based on district size and distance from large city)
2. Student level: previous achievement in math and/or reading, minority status, economic disadvantage status, disability status, limited English proficiency status, grade enrollment, and sex

Results of these analyses were consistent with previous analyses—the best predictors of EOC scores were previous achievement scores. For both sets of analyses, results also provided limited support for well-documented achievement differences related to disability and ABC distinction status. However, the predictive ability of ABC distinction may be somewhat redundant, as ABC distinctions are determined by schools’ overall EOC performance.

In summary, with regard to EOC Proficiency Levels, both 1:1 and non-1:1 schools have shown improvement in the percent of students passing EOC tests. While one high school in Cohort A appears to have dramatic improvement, the cause of the improvement cannot be attributed solely to the 1:1 initiative based on the data available. With regard to EOC Scale Scores, when analyzing 1:1 versus comparison schools, 1:1 implementation had no significant effect on a student’s mean EOC score. When focusing only on 1:1 schools, analyses of EOC scale scores suggested that there were no significant effects based on length of 1:1 implementation, quality of 1:1 implementation, or principal leadership.

Discussion

In general, students, teachers, and administrators agreed that laptops have a positive impact on student engagement and motivation. Among students, the percentage agreeing with statements related to engagement and motivation increased over time. While survey responses from administrators and teachers varied more over time, the majority expressed agreement that use of laptops in school helps students be more actively involved and increases their engagement.
Students generally endorsed positive statements related to technology attitudes and beliefs, and the percentage of students expressing agreement increased over time for many survey items. Across all cohorts, more than half of the students surveyed agreed that use of laptops helped them be better organized; made them more likely to revise their work and work more efficiently; and would enable them to get a good job in the future.

The most recent survey administration in spring 2010 revealed that the majority of students indicated that use of laptops was having a positive impact on a number of key 21st century skills including learning and innovation skills, technology literacy, information literacy, civic literacy, understanding of the global world, and group collaboration. In addition, a larger proportion of students agreed or strongly agreed with these statements when asked at time two as compared to time one, suggesting that students’ perceptions about the impact of laptop use on the development of 21st century skills improved over time.

Survey responses indicated that across all cohorts of students, the majority indicated they could independently engage in a variety of technological skills including formatting a text document, creating a multimedia presentation, creating graphs/charts, creating spreadsheets, creating databases, and importing/editing digital images and video. Furthermore, survey results indicate that students are becoming more skilled in these areas over time. Less than half of all students surveyed indicated that they could independently create a web page or write a computer program. More than half of all students surveyed indicated that they could independently create a blog. While fewer than half said they could independently subscribe to a podcast, create a podcast, and contribute to a Wikispace, the proportion of those students indicating independent ability to engage in these Web 2.0 skills increased over time, supporting the notion that use of laptops in school are helping students develop key Web 2.0 skills.

According to the NCDPI (2005) EOCs are an estimate of a student’s knowledge of content-specific concepts aligned to the NC Standard Course of Study. These standardized tests measure content knowledge—not student learning skills. In this study, more than half of all 1:1 students surveyed agreed or strongly agreed that use of laptops at their school helps them develop key 21st century learning skills. It is our recommendation that high quality, valid assessments of these 21st century learning skills (e.g. leadership, ethics, personal productivity, self-direction, social responsibility, adaptability and flexibility, initiative and self-direction, creativity and problem-solving, cross-cultural skills, communication, information literacy, and collaboration) would be a more accurate measure of the merit and success of 1:1 learning environments.

In addition, the requirements to prepare students for EOC exams may be limiting how teachers use the laptops. The evaluation team recently finished the spring 2010 site visits to all 18 of the 1:1 schools. An alarming finding emerged from the teacher focus groups: educators who teach EOC courses indicated they feel very constrained in how they use the laptops in their classrooms. They stated that their first priority is getting through the course content, not finding new and creative ways to integrate the laptops into their curriculum. Teachers with non-EOC courses agreed with their colleagues by saying they had more freedom to explore how the laptops could be used in new ways since they do not need to focus on preparing students for high-stakes tests.

Over time, we have seen positive results in the 1:1 schools in relation to student achievement and learning outcomes. We have also seen students’ technology skills improve and engagement and motivation have increased. Self reporting of technology attitudes and beliefs also became more positive as the students became more familiar with the laptops and the new digital tools.
References


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