Examining Issues Critical to a 1:1 Learning Environment: Principal Leadership


Submitted to
Bill Harrison, Chairman
North Carolina State Board of Education

Angela Quick
North Carolina Department of Public Instruction

Submitted by:
Jenifer O. Corn, Ph.D.
The William and Ida Friday Institute for Educational Innovation
College of Education
NC State University

Contributors:
Ruchi K. Patel
Clara E. Hess
Daniel S. Stanhope
Jennifer Tingen
Rodolfo Argueta

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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 (NC1:1LTI) pilot schools. The evaluation includes eight Early College (EC) 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 the value of the initiative to enhance student learning, as well as to identify challenges to the successful implementation of 1:1 programs, strategies for meeting those challenges, and services and supports needed to enable successful programs throughout the State.

Review of 1:1 Literature

Recently, schools across the United States have implemented 1:1 laptop initiatives with the aim to develop future-ready students by aiding in the development of skills needed for college and the workforce, or 21st century skills (Warschauer, 2006; Weston & Bain, 2010). Research defines a 1:1 initiative as providing 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, a focus on using laptops for teaching and learning to meet certain goals (Muir, Manchester, & Moulton, 2005) such as increased equity of access to technology, transformed quality of instruction, increased student engagement, improved academic achievement and technology literacy, increased economic competitiveness, and enhanced home-school connection.

While overall results are mixed, recent studies have shown that 1:1 laptop initiative programs can increase students’ general learning outcomes (Warschauer, 2006; Weston & Bain, 2010). Several studies have provided evidence that the use of laptops in the classroom improve attendance (Lane, 2003; Mills, 2006) and engagement (Bebell & Kay, 2010; Great Maine Schools Project, 2004; Warschauer, 2006). Results of other programs have shown an increase 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). One study’s results indicated a decrease in disciplinary problems (Bebell, 2005). Still there is evidence that 1:1 programs do not increase all test scores, especially when tests are in paper and pencil form (Warschauer, 2006; Weston & Bain, 2010).

While some results of 1:1 laptop programs show improvement in student learning outcomes, factors other than the distribution of laptops contribute to successful implementation. Teacher support, instructional use, technology support, infrastructure and quality of implementation are influential in the success of a 1:1 laptop program (Weston & Bain, 2010). In 1:1 laptop programs, students are provided laptops for educational use; however, the schools must have the capabilities and strategies for the laptop use to be effective (Warschauer, 2006). This includes technology support, resources, and strong leadership guiding the programs (Kleiger Ben-Hur & Bar-Yossef, 2010; Maninger & Holden 2009; Silvernail & Lane, 2004). In addition to school and district support, teachers should support laptops learning in the classroom and have access to professional development or tools to aid them in integrating laptops into lesson plans (Kleiger Ben-Hur & Bar-Yossef, 2010; Penuel, 2006; Silvernail & Lane, 2004; Weston & Bain, 2010). 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). 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 situated in regions across North Carolina (see Figure 1), which has a richly diverse geographic and cultural landscape.

Figure 1. Map of 1:1 pilot high schools in NC.

The participating schools rolled out their 1:1 projects over time. Due to the staggered implementation model of the 1:1 initiative in NC, 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 EC high school (see Table 1).

1:1 Trad Cohort A
This cohort includes one large, long-established traditional high school in a rural eastern school district. This district has two other traditional high schools not participating in the 1:1 initiative. The school serves a diverse student population of 1300, as well as 86 teachers. This 1:1 Trad Cohort A 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 Cohort A
This cohort includes seven EC high schools participating in the study. Seven of the schools participating in the study are EC high schools in seven different school districts. These schools, located on the campuses of two-year community colleges, are intended to attract students from groups 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 HS and college courses requirements complete those college courses. 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 fall semester of the 2007-2008 school year and to students in the spring semester of the 2007-2008 school year.

1:1 Trad Cohort B
This 1:1 Cohort includes four traditional high schools across two districts participating in a district-wide implementation. All three traditional high schools 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 only high school 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 then distributed laptops to students in the fall semester of the 2008-2009 school year.

1:1 Trad Cohort C
The 1:1 Trad Cohort C includes five traditional high schools across two districts. All four traditional high schools 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. A rural district in the central part of the state provided laptops to all their teachers in September 2005. This district has three traditional high schools. One of their schools was selected to implement a 1:1 project where laptops were distributed to students in the fall semester of the 2009-2010 school year.

1:1 EC Cohort C
This cohort is made up of a brand new EC high school who distributed laptops to their teachers in September 2009 and to their 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>1:1 Trad A</td>
<td>Trad HS1</td>
<td>1344</td>
<td>84</td>
<td>To teachers: March 2007 To students: September 2007</td>
</tr>
<tr>
<td>1:1 EC A</td>
<td>EC1</td>
<td>112</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>1:1 EC A</td>
<td>EC2</td>
<td>132</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>1:1 EC A</td>
<td>EC3</td>
<td>138</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1:1 EC A</td>
<td>EC4</td>
<td>243</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>1:1 EC A</td>
<td>EC5</td>
<td>153</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>1:1 EC A</td>
<td>EC6</td>
<td>193</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>1:1 EC A</td>
<td>EC7</td>
<td>207</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>1:1 Trad B</td>
<td>Trad HS3</td>
<td>378</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>1:1 Trad B</td>
<td>Trad HS4</td>
<td>975</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>1:1 Trad B</td>
<td>Trad HS5</td>
<td>721</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>1:1 Trad B</td>
<td>Trad HS6</td>
<td>1611</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>1:1 Trad C</td>
<td>Trad HS7</td>
<td>539</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>1:1 Trad C</td>
<td>Trad HS8</td>
<td>728</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>1:1 Trad C</td>
<td>Trad HS9</td>
<td>877</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>1:1 Trad C</td>
<td>Trad HS10</td>
<td>636</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>1:1 EC C</td>
<td>EC8</td>
<td>61</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>9764</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, 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), 5% are American Indian, 1% are Asian, 9% are Hispanic, 30% are Black, and 60% are White.
**Comparison Schools**

To enhance the scientific rigor of this evaluation, we 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 school for comparison with the 1:1 traditional high schools. The selection process produced a group of comparison schools that was as similar to the 1:1 schools as possible regarding variables such as teachers’ gender, race and ethnicity, and level of experience with instructional technology; and data about students’ scores on prior-year English I and Algebra I EOC Tests, and about students’ home Internet connectivity. In addition, data from the 2008 North Carolina Teacher Working Conditions Survey confirmed similarities among teachers’ perceptions at the 1:1 and comparison schools for items related to instructional technology and leadership. It is important to note that the NCDPI Annual Media and Technology Report (AMTR) data indicated that the comparison schools did have a significant amount of internet-connected computers available for instructional purposes, ranging from student-computer ratios of 1.31-5.65.

**Data Sources and Evaluation Questions**

The data summarized in this report were 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, TF, guidance counselor, etc.), classroom teachers, and students. Also at each point in the cycle, site visits were taken to each 1:1 school with classroom observations, interviews with school technology facilitators, and separate focus groups with school leadership, teachers, and students. For reference, data collection tools, including surveys and focus group protocols, are provided in evaluation report appendices available from http://www.fi.ncsu.edu/project/evaluation-of-nc-11-learning-initiative/publications. Archival data analyzed included attendance, discipline, dropout data, and achievement data for participating 1:1 and comparison schools.

Through classroom observations, focus groups, surveys, and analyses of existing data, we have examined the progress toward implementation of a 1:1 environment. Table 2 summarizes the alignment of the NCLTI project goals, evaluation questions, and data sources.

Table 2. Alignment of NC 1:1 LTI Project Goals, Evaluation Questions, and Data Sources.

<table>
<thead>
<tr>
<th>Project Goals</th>
<th>Evaluation Questions</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 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 students’ 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>2. 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>
<tr>
<td>3. 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>
<td>Classroom Observations 1:1 Online Survey Exemplary Lesson Plans Focus Groups</td>
</tr>
<tr>
<td>4. Improve student learning. (student-level)</td>
<td>How have students 21st century skills changed over time?</td>
<td>Classroom Observations 1:1 Online Survey Focus Groups</td>
</tr>
</tbody>
</table>
These evaluation efforts have enabled us to identify important critical issues for the 1:1 learning environment, including milestones, progress, major challenges, and recommendations. These critical issues focused on the following areas: leadership, instructional practice, student learning outcomes, infrastructure, special populations, and the quality of implementation. The following narrative focuses on the leadership critical issue.

**Review of Literature for 1:1 and Leadership**

There is much research available about successful leadership in schools (Davis, Darling-Hammond, LaPointe, & Meyerson, 2005; Marzano, Waters, & McNulty, 2005; Stein & Gewirtzman, 2003); however, there is significantly less literature regarding what makes an effective leader in a 1:1 school and the impact an effective leader can have on the 1:1 initiative. Research has primarily explored three areas: 1) developing taxonomies of leadership qualities, 2) evaluating and proposing professional development for leaders, and 3) enumerating lessons learned for leaders of technology initiatives.

The existing research has focused primarily on developing qualitative taxonomies of leadership effectiveness in technology-enhanced schools. For example, Anderson and Dexter (2000) constructed a six-part taxonomy of educational technology leadership decisions. The six functions include: strategic planning, goal setting, vision and vision sharing; budgeting and spending; organizational structure and processes; curriculum; program evaluation and impact assessment; and external relations and ethical issues. Similarly, Flanagan and Jacobsen (2003) developed a five-element model for technology leadership including: student engagement, shared vision, equity of access, professional development, and ubiquitous networks. A more recent taxonomy created by I-Hua, Chin, and Hsu (2008) specified five areas: vision, planning and management, staff development and training, technology and infrastructure, evaluation and research, and interpersonal and communication skills.

Our framework of leadership for technology innovation includes many of the constructs that previous models included as well as some these models omitted, like the importance of modeling technology use (Hall, 1999). To construct our framework we first looked to the literature and existing frameworks. We reviewed the Consortium for School Networking’s five technology leadership themes and action steps (CoSN, 2008) as well as the revised 2009 National Educational Technology Standards (NETS ● A) and Performance Indicators for Administrators presented by the International Society for Technology in Education (ISTE, 2009).

Once we examined the existing literature we supplemented it with qualitative data collected regarding leadership at schools with technology innovations. This leadership framework has been tested over the past year, and results support seven factors (Hess et al., 2010) associated with the following areas: Advocacy, Evaluation, Communication, Infrastructure, Professional development, Shared decision making, and Vision. The results of this critical issues paper will first address the descriptive statistics associated with the leadership framework we developed, as well as additional behavioral descriptions of principals.

**Research Question 1:** Within the 1:1 schools, to what extent are principals’ behaviors consistent with effective leadership?

Related to describing principal behaviors, we are interested in learning if any school characteristics were associated with the behaviors.
Research Question 2: Are there certain situational characteristics which can predict principal leadership?

While predictors of leadership are important, stakeholders and decision-makers often want to know why leadership is important at all. Leadership has long been associated with the attitudinal, behavioral, and cognitive outcomes of followers (Bandura, 1986; Bass, 1985; Herscovitch & Meyer, 2002; Piderit, 2000). In turn, followers’ attitudinal, behavioral, and cognitive reactions to a systematic change have a great effect on the successful implementation of an initiative (Ajzen, 1991; Ajzen & Fishbein, 1980; Bandura, 1986; Lazarus, 1991; Vroom, 1964). Therefore, teachers’ perceptions of their principal’s leadership behaviors may be vital to the success of the 1:1 initiative in a school. Anderson and Dexter (2000) constructed a six-function taxonomy of educational technology leadership and developed eight indicators to summarize technology leadership. After looking at three categories of outcomes (net use, technology integration, and student tool use), they found a positive relationship between technology leadership and each of the three categories of technology outcomes.

Student outcomes are a critical aspect of any education initiative; however, there is a paucity of research on the relationship between leadership in 1:1 learning environments and student outcomes. As such, the current paper will begin to address this relationship.

Research Question 3: What are the teacher-level and student-level outcomes associated with effective principal leadership?

To ensure that a 1:1 initiative remains successful, principals must take certain measures to ensure that the initiative is not just a passing fad.

Research Question 4: What do principals have to do for successful sustainability of a 1:1 initiative?

And lastly, principals at the 1:1 schools encountered surprises related to the 1:1 initiatives, as could be expected with any new program. These principals were asked to share things they’d wished they’d known before implementing a 1:1 initiative, as well as things they could have done differently, to benefit schools and principals who plan on implementing a 1:1 learning environment in the future.

Research Question 5: What are some of the lessons learned related to principal leadership?

Data Sources and Analysis

Participants
The participants in the entire study are described in a previous section; however, this critical issues paper did not include participants from all schools. Specifically, only one school from Cohort C was included. All schools in the western NC district were excluded because the traditional high schools only distributed laptops to 12th graders, and the EC high school only distributed laptops to 9th graders. Although the EC high school only had 9th grade during the 2009-2010 school year, there was not sufficient data from this school for meaningful interpretation. The results of this particular district will be detailed in a separate critical issues paper.

Descriptions of Principal Behavior
Principals were asked to evaluate themselves based on the framework Hess et al. (2010) established. Teachers were also asked to evaluate their principal on the same dimensions. The seven dimensions on which principals were evaluated are: Advocacy, Evaluation, Communication, Infrastructure, Professional development, Shared decision making, and Vision. See Appendix A for the list of items in each dimension. Respondents were asked to rate their level of agreement with each item on a 5-point Likert-type response scale, where 1 = strongly disagree, and 5 = strongly agree.
When a single principal score was used, this score was determined as the mean of all the dimension scores for each rater. In addition to quantifying principal behavior, focus group and interview data were also content analyzed to describe the principal’s role in a 1:1 learning environment. When a single principal score was used as a school-level variable, as in the multi-level modeling analyses, the final principal score was determined as the mean of all teachers’ ratings within a particular school.

**Situational Characteristics**

*Length of implementation.* As seen in Table 1 above, schools that were part of the 1:1 initiative received laptops at various times over the past three years. Therefore, length of 1:1 implementation will be operationalized as the number of months students had laptops in May 2010, by which all survey responses were collected.

*School type.* The two school types were either traditional high schools or EC high schools.

**Teacher-level Outcomes**

*Teacher attitudinal outcomes.* Teachers’ attitudes toward the 1:1 initiative (see Appendix B) were assessed with an 18-item measure with a 5-point Likert-type response scale ranging from 1 = strongly disagree to 5 = strongly agree. The items on the measure tapped into two distinct attitudinal dimensions that were theoretically predetermined and corroborated by factor analytic support. Nine of the 18 items tapped into teachers’ attitudes toward teaching and laptops, and the other nine items tapped into the teachers’ attitudes toward learning and laptops.

*Teacher behavior outcomes.* Teachers’ technology use represented teachers’ behavioral responses to the 1:1 initiative (see Appendix C). This 16-item self-report frequency measure consisted of a 5-point Likert-type response scale ranging from 1 = never to 5 = daily, with the other response options indicating frequencies in between. The items on this instrument tapped into two distinct dimensions that were theoretically predetermined and corroborated by factor analytic support. Seven of the 16 items tapped into teachers’ reported technology use for planning, while the remaining nine items measured teachers’ reported technology use for instruction.

*Teacher cognitive outcomes.* Teachers’ cognitive reactions were represented by technology-specific self-efficacy (see Appendix D), which was assessed with a 15-item measure. This instrument consisted of a 4-point summated rating scale ranging from 1 = “I have never done this” to 4 = “I can show someone how to do this,” with the other response options indicating levels of comfort that fall somewhere in between. The items on the measure tapped into two distinct dimensions that were theoretically predetermined and corroborated by factor analytic support. Six of the 15 items tapped into teachers’ confidence in their basic technology skills, and the other nine items tapped into the teachers’ confidence with more advanced, Web 2.0 technology skills.

**Student-level Outcomes**

In North Carolina, End Of Course (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). The EOC scores used for this study are from the fall 2009 scores from the following courses: Algebra I, Algebra II, Biology, Civics/Economics, English I, Geometry, and US History. Because the scores are standardized, they can be aggregated to determine a student’s mean EOC score in fall 2009. Both mean EOC scores and subject-specific EOC scores will be used.
Sustainability Issues
Issues regarding sustainability of the 1:1 initiative were gathered from teacher, TF, and principal responses in interviews and focus groups. 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.

Lessons Learned
Principals were asked in their interviews what they would have done differently to lead a 1:1 initiative. Teachers were also asked if their principals could have done anything else differently for greater success of their 1:1 initiative. Additionally, principals were asked for advice they would offer other school districts considering a 1:1 initiative in terms of leadership. 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/Findings

Research Question 1: Within the 1:1 schools, to what extent are principals’ behaviors consistent with effective leadership?
To answer this question, we provide descriptive statistics associated with the leadership framework we developed, as well as additional behavioral descriptions of principals.

Principal evaluation. Means were calculated for each of the seven dimensions associated with effective leadership. Figures 2-5 show the mean levels of agreement for each respondent group, separated by cohort and school type (EC vs. traditional). Agreement levels refer to the extent to which principals are observed performing various behaviors related to the seven dimensions.

Figure 2. Mean principal evaluation scores among 1:1 Cohort A ECHS faculty in spring 2010.
**Figure 3.** Mean principal evaluation scores among 1:1 Cohort A traditional high school faculty in spring 2010.

**Figure 4.** Mean principal evaluation scores among 1:1 Cohort B traditional high school faculty in spring 2010.
Apparent in the figures above, the different rater groups tended to evaluate the principal similarly, with the exception of Cohort B schools. The group of Cohort A EC high schools appear to have the highest ratings of effective principal behavior on all dimensions, while the Cohort C high school appears to have the lowest ratings. An interesting observation is that the Cohort B traditional high schools’ principals rated themselves visibly higher than the other groups. As a whole, the means of all school groups are higher than 3, indicating that principals are participating in effective leadership behavior to some extent. Analysis of significant differences is inappropriate here due to low sample sizes.

**Principal role.** The role of the principal has changed since schools started implementing the 1:1 initiative. Participation in the 1:1 initiative increased principals’ 21st century skills and willingness to learn new skills as one principal describes: “I’ve also become the student, because the kids help me learn how to do different things with technology.” Some principals indicated that part of their role is guarding instructional time from all of the professional development activities. One principal felt that he became part of “a genuine professional learning community with blogs…, and communicating to those kids at all times of night and day, and holding them accountable.”

There is also a shift in principals’ involvement in instruction: “I want to be in schools and changing instruction now, instead of some of those other roles that I had envisioned for my future.” Principals in all cohorts dealt with different discipline issues such as downloading inappropriate content, finding missing laptops, and cheating/plagiarism. One student, for example, discovered the password for the monitoring software and caused trouble throughout the school.

**Principal as visionary.** Supporting the leadership framework developed by Hess et al. (2010), principals continued to emphasize the role of a principal as a visionary for new school-wide initiatives, such as a 1:1 project. One principal said:

> Like self-directed learning, to integrate that with what they already do and know…, the principal is the leader and the visionary, but it just forces me to be more knowledgeable about one-to-one laptops.

Another principal recommended:
We have got to… help our teachers feel comfortable with knowing that…your kids are probably going to know more about this than what you know, in some aspects, and you’re going to have to be okay with using their knowledge to help you with some of this.

**Support for professional development.** Support for professional development was emphasized by both teachers and principals in all cohorts. Both groups recommended that professional development should be up-front, ongoing, content-specific, and differentiated for different skill levels. Several teachers would have preferred to have their laptops before students. One teacher said:

Give the teachers…an opportunity to work with laptops first, that need help, to be able to work and…at least be knowledgeable of the programs that the laptops have, and the capabilities of these laptops.

Another teacher expressed a similar idea: “Do a little preliminary training with students and faculty, just to prepare the students.” Most principals and teachers also found ongoing professional development beneficial:

Give the teachers enough staff development so that they can use it…in the classrooms without being intimidated by it, as we know that a lot of teachers are trained without computers, laptops, as they come out of college… If you’re going into a program, if you know that you’re going to do it next year, have enough staff development that teachers will feel comfortable using it.

Another principal said, “Make sure that we re-tool our teachers, because there’s always the latest, greatest thing that comes out.” One principal advocating content-specific professional development stated:

And with staff development, prior to giving students the computer, I think staff development should be…content-specific, because it’s real easy for us to go sit in there and say, “Alright, this is how you do this, you do this and you do that.” As a math teacher, when I walk out, I want to have something that I can use from day one.

As for differentiated professional development, one principal said, “They have training at a variety of levels—not everyone needs the same thing. I think it’s important to have lead instructors involved, whether it be the ITF or lead teacher on campus.”

**Shared decision making.** As additional support for our leadership framework, a couple of teachers recommended involving all faculty members to make certain decisions. One teacher suggested that leaders “get input from the staff in terms of technology development—what does the staff need—rather than a requirement of every single staff member has to do this and this.” Another teacher seemed to express some resentment for not having been asked for input:

Many of the programs, they were given to us, they went out and purchased them. “Oh, you can do this and you can do this and you can do this,” but we were never given the opportunity to work with them hands-on ourselves before incorporating them to our students.

**Research Question 2: Are there certain situational characteristics which can predict principal leadership?**

Two school-level variables were used to predict principals’ overall leadership scores. The two variables were school-type (EC or traditional) and length of 1:1 implementation in that teacher’s school. A linear regression using only teacher data \( (N = 330) \) indicated that the two variables together predict 9% of variance in principals’ overall leadership scores. While both variables explained significant variance, length of implementation was a stronger predictor. The interpretation of these results is that teachers in schools that have had the 1:1 initiative longer tend to rate their principals higher for participating in effective leadership behaviors. Results also indicate that teachers in EC high schools rate their principals higher than teachers in traditional high schools.
The overall leadership score was also broken down into each dimension, and linear regressions were employed to determine the effect of school-type and length of implementation on each of the seven dimensions. Together, the two variables predicted between 5% and 13% of variance in each of the dimension scores. Length of implementation was a significant predictor for each of the dimensions, but school-type was only a significant predictor for the dimensions regarding Advocacy, Infrastructure, Professional Development, Shared Decision Making, and Vision. In fact, school-type was actually a stronger indicator than length of implementation for the Advocacy dimension. Results suggest that teachers in schools that have had the 1:1 program longer tend to rate their principals higher on all dimensions of leadership, and that teachers in EC high schools rate their principals higher on the five dimensions listed above.

**Research Question 3:** What are the teacher-level and student-level outcomes associated with effective principal leadership?

*Teacher attitudinal outcomes.* Stepwise multiple linear regressions were employed to assess the effect of leadership on teacher attitudes. See Figure 6 for mean levels of agreement towards various statements measuring teacher attitudes toward laptops and teaching and laptops and learning. Length of implementation and school type were entered in the first step, and the two variables accounted for 6% of the variance in teacher attitudes toward teaching ($N = 327$). However, only school type made a significant contribution as a predictor in this model. Teachers’ ratings of their principal on each of the seven dimensions in the leadership framework were entered in the second step. The seven dimensions explained an additional 31% of the variance in teacher attitudes toward teaching. Specifically, the dimensions which contributed significantly were Advocacy and Vision. School type remained a significant contributor.

![Figure 6. Mean agreement levels with various statements regarding teacher attitudes toward laptops and teaching, and laptops and learning.](image)

When teacher attitudes toward learning was used as the outcome variable, length of implementation and school type explained 4% of the variance in the outcome ($N = 327$). Again, only school type made a significant contribution. The addition of teacher ratings of their principal on the seven leadership dimensions explained an additional 24% of variance in teacher attitudes toward learning. The dimensions which provided significant contributions were Shared Decision Making and Vision. School type remained a significant contributor.

The implications of these results are that teachers in ECHS had significantly more positive attitudes toward both teaching and learning with laptops. Additionally, teachers who gave higher ratings to their principal on the Advocacy and Vision dimensions had significantly more positive attitudes toward teaching and laptops. Teachers who gave higher ratings to their principal on Shared Decision Making and Vision had significantly more positive attitudes toward learning and laptops.
Teacher behavior outcomes. Stepwise multiple linear regressions were employed to assess the effect of leadership on teacher behavior outcomes. See Figure 7 for mean levels of teachers’ frequency of laptop use for planning and instruction. Length of implementation and school type were entered in the first step, and the two variables accounted for only 1% of the variance in teachers’ self-report technology use for planning ($N = 326$). Neither school type nor length of implementation made a significant contribution. Teachers’ ratings of their principal on each of the seven dimensions in the leadership framework were entered in the second step. The seven dimensions explained an additional 5% of the variance in teacher attitudes toward teaching. Advocacy was the only significant predictor of teachers’ technology use for planning.

When teachers’ technology use for instruction was used as the outcome variable, length of implementation and school type explained 2% of the variance in the outcome ($N = 326$). Only school type made a significant contribution. The addition of teacher ratings of their principal on the seven leadership dimensions explained an additional 5% of variance in teachers’ technology use for instruction. None of the leadership dimensions made significant contributions; however, school type remained a significant contributor.

![Figure 7. Mean levels of teachers’ self-reported use of laptops for planning and instruction.](image)

These results suggest that the leadership dimensions we measured did not have much of an effect on teacher use of technology for planning or instruction, other than the minimal contribution of Advocacy.

While the survey results show minimal support for the effect of leadership on teachers’ technology use, focus group data did garner some support. One principal, for example, made use of technology a part of teacher reviews. At another high school a TF mentioned, “Technology is a goal in the teacher’s growth plan. [The principal] expects teachers to use the technology and the students to use it properly.” Even principals who were not tech-savvy themselves have been encouraging daily use of technology from teachers. However, as one principal noted, frequency of technology use does not equal quality of technology integration:

…you don’t have to use technology just for technology’s sake; we want to see the laptops in use, but it’s not as if I come in and students are actually writing an essay by hand there’s going to be trouble.

Teacher cognitive outcomes. Stepwise multiple linear regressions were employed to assess the effect of leadership on teachers’ self-reported technology skills. See Figure 8 for teachers’ self-assessed basic and advanced technology skills. Length of implementation and school type were entered in the first step, and the two variables accounted for only 1% of the variance in teachers basic technology skills ($N = 323$). Neither school type nor length of implementation made a significant contribution to explained variance. Teachers’ ratings of their principal on each of the seven dimensions in the leadership framework were
entered in the second step. The seven dimensions explained hardly an additional 1% of the variance in teacher basic technology skills. No predictors made significant contributions.

When teachers’ self-reported advanced technology skills was used as the outcome variable, length of implementation and school type explained 2% of the variance in the outcome ($N = 324$). Only months of implementation made a significant contribution. The addition of teacher ratings of their principal on the seven leadership dimensions explained an additional 3% of variance in teachers’ advanced technology skills. None of the leadership dimensions made significant contributions; however, both months of implementation and school type became significant contributors. It should be noted that the Professional Development dimension of principal leadership would have been a significant predictor at $\alpha = .10$ level.

Figure 8. Mean levels of teachers’ self-assessed technology skills.

These results suggest that the leadership dimensions we measured did not have a significant effect on teachers’ self-reported assessments of basic or advanced technology skills. However, with a less stringent $\alpha$ level, principals’ support for professional development did seem to have an effect on teachers’ self-reported advanced technology skills.

Student achievement outcomes. Results of multi-level modeling analyses showed that there were no significant effects on a student’s mean fall 2009 EOC score based on teachers’ ratings of principal leadership; when controlling for the following variables:

- School level: ECHS versus traditional high school, school’s ABC distinction status, percent of minority students in the school, percent of students with economic disadvantage in the school, length of 1:1 implementation, and quality of 1:1 implementation
- Student level: minority status, economic disadvantage status, disability status, grade enrollment, and gender

Consistent with the average EOC score as the student outcome, principal leadership scores did not influence fall 2009 EOC scores split by subject area. Sixteen schools were included in these analyses, and the total number of students was 3,185.

There could be several explanations for why leadership did not seem to affect EOC scores directly. One reason is that the relationship between the two variables could be indirect, mediated by various teacher outcomes. Another reason is that students who take EOC exams in the fall semester are not representative of the general student population, and therefore principal leadership does not influence the students in the same way as it could other students. Student achievement is a limited perspective on student outcomes associated with 1:1 programs; however, the structure of our data limits exploring the relationship between leadership and other student outcomes, such as student engagement, 21st century skills, etc.

Research Question 4: What do principals have to do for successful sustainability of a 1:1 initiative?

Leaders were considering various options for sustaining the laptop project. One traditional school system is discussing rollout for “one grade level at a time, our seniors, as they graduate, we can retire that group of laptops, and hopefully stand up a new set of laptops with the incoming freshmen.” There is also talk of
a lease-to-own system. One system will move to Dell laptops once the initiative ends. Another district will be making all middle and high schools 1:1 using Macbooks, which were less expensive than Lenovos. One principal almost lost his TF, and had that happened, “it would have been very detrimental to the program…we would have probably just had to pack the laptops up in the cart and …let them use them in class.” In order to maintain technology staff, one school opted to make the TF half-time rather than full-time.

Research Question 5: What are some of the lessons learned related to principal leadership?
The major theme of lessons learned was for principals to start planning various strategies and communicating buy-in as soon as possible. When teachers were asked if there was anything that their principal could have done differently, teachers recommended that principals have a policy guide in place instead of “building an airplane while we’re flying in it.” Principals would also benefit from a training of some sort at the beginning of the initiative so they may become more tech-savvy alongside the staff. While using new available technology is an understood goal of 1:1 initiatives, one principal clarified that the higher level goal is to teach students to use technology as a tool, not just to teach students technology:

… I think that we would have spent way more time on the front end on how do you plan using technology, and what types of projects are appropriate, and what types of skills do our kids need to be able to do that, as opposed to how do you use iMovie and how do you use GarageBand.

Most teachers report that they would not change anything about what their principal did, but rather decisions “made by people other than administration or teachers. I think [principals] had a little input, but ultimately the decision was made at central office of how [technology] would be used.”

For other school districts considering a 1:1 initiative, several principals emphasized the importance of cultivating buy-in from stakeholders. One principal said, “I would say make sure that you have buy-in from the staff, students, and the parents. That whole community buy-in that will make the difference in how [laptops are] used in the classroom.” Another principal suggested that the principal has “to be energetic in your efforts to get people onboard.” Several principals and teachers suggested that schools develop an acceptable use policy (AUP) as soon as they can: “Have rules and regulations in place and ready to give to parents immediately of expectations, guidelines, um, what students can and can’t do with them, and… a system of consequences, if they misuse them.”

Discussion
On average, principals in 1:1 schools from all cohorts are participating in effective leader behavior based on teacher, administrator, and principal evaluations of leadership. This is especially true for the Communication and Professional Development dimensions across all cohorts. The two dimensions which seemed to have lower ratings were Advocacy and Evaluation, even among schools which have had laptops the longest, suggesting that professional development sessions for principals could focus on these two areas a little more heavily, or that 1:1 school communities could implement a way for principals to be held accountable for behaviors consistent with these two dimensions. Results of qualitative data gleaned continue to emphasize necessary attributes of principals—as visionaries, as providers of support for professional development, and as advocates of shared decision making.

Even though all principals on average appeared to have positive ratings of leadership, teachers in schools that have been implementing the 1:1 program longer gave higher ratings to their principal on all dimensions of leadership. One explanation could be that principals with more experience in 1:1 environments are participating more heavily in effective leader behaviors because they have had time to learn and implement these behaviors. Principals of EC high schools also received higher ratings on five out of the seven leadership dimensions. One explanation of this result could be in the structure and purpose of EC high schools. EC high schools are smaller, and students go through an application and selection process to attend these schools—implying a choice to attend. The small size could provide teachers with greater opportunity to observe their principal’s behaviors. The size and student choice to
attend the school also contribute to fewer discipline and other problems—leaving principals more time and energy to devote to successfully implementing a 1:1 initiative.

Of all the outcomes addressed in this paper, the principal’s leader behaviors have the greatest effect on teachers’ attitudes towards teaching and laptops. Principal behaviors associated with advocacy and vision contributed the most to this relationship, suggesting that principals who are vocal advocates of the 1:1 initiative, and those who can clearly articulate a vision can dramatically improve teachers’ attitudes towards teaching with laptops. Teachers’ attitudes towards learning and laptops were also significantly influenced by principal leadership. Specifically, in addition to principal vision, teachers who thought their principals were including them in the decision making process regarding the initiative had more positive attitudes toward laptops and learning.

Teachers’ use of technology and comfort with technology skills were not as influenced by their principals’ leadership. One explanation could be that the relationship between leadership and these outcomes is not a direct relationship. There may be various factors mediating the relationship, including teacher attitudes. Another issue is the operationalization of the outcome measures: using self-report assessments of technology use and skill level has limitations. Additionally, we are more interested in the quality of technology use rather than the frequency of technology use. Similarly, we are more interested in how well teachers apply their technology skills to instruction, rather than just how good their skills are. We also found no support for the effect of leadership on student outcomes. Again, this relationship may be indirect, and the EOC exam’s measure of content knowledge is not the only student outcome in which we are interested. Principal leadership may have more substantial effects on other student outcomes such as student engagement, 21st century skills, and workforce readiness.

An important aspect of a principal’s role, other than successful implementation of the 1:1 initiative, is to secure resources and have strategies in place for the sustainability of the initiative. The different schools involved in our study have methods planned, but strategies include recycling graduating seniors’ laptops to incoming freshmen and switching to cheaper laptops. When funding has been an issue, reducing the TF position from full-time to part-time was another option. This suggests that principals are willing to make sacrifices in order to maintain the success of the 1:1 initiative.

Because teachers and school leaders recognize the positive effects of the 1:1 initiative, they have offered advice to principals who may be implementing a similar initiative in their schools. The broadest piece of advice is that principals need to start planning and garnering support for the program as early as possible. Principals should have a plan in place for all the different elements that contribute to successful implementation, such as laptop rollout, professional development scheduling for teachers, AUP development, parent information session planning, etc. As apparent from survey data and teacher and principal input from focus groups and interviews, effective leadership practices of principals of schools with 1:1 initiatives are critical to ensure success.
References


I-Hua, C., Chin, J., & Hsu, C. (2008). Teachers' perceptions of the dimensions and implementation of


Appendix A

1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, 5 = strongly agree

Please indicate your level of agreement with the following statements. (NOTE: If you are the principal, please respond to the statements as you would evaluate yourself.)

Regarding the 1:1 laptop Initiative, my principal...

Advocacy
- Secures funding for the 1:1 Initiative.
- Takes steps to ensure the sustainability of the 1:1 Initiative.
- Advocates for policies that support our 1:1 Initiative at the district level.
- Leverages strategic partnerships to support the 1:1 Initiative.

Evaluation
- Uses clearly defined criteria for assessing 1:1 laptop integration.
- Uses multiple sources of data for evaluating the impact of technology on student outcomes.

Communication
- Communicates how teacher performance will be assessed.
- Promotes the legal and ethical use of information and technology (e.g., respect for copyright, intellectual property).
- Effectively communicates via technology.

Infrastructure
- Designs policies for the appropriate use of technology.
- Makes sure teachers have access to technology tools that facilitate their work (e.g., smartboards, classroom management software).
- Ensures technical support is available.
- Ensures an appropriate infrastructure is maintained (e.g. wireless connection, IT support, server space, extra laptops, power strips) in the school.

Professional development
- Makes sure that opportunities for professional development are available.
- Supports professional development by providing resources such as substitutes, release time, etc.
- Understands the professional development needs of teachers.
- Participates in administrative professional development.
- Encourages teachers to incorporate innovative technology into their instructional strategies.
- Understands that incorporating technology into the curriculum may take more time for some people.
- Evaluates the effectiveness of professional development.

Shared decision making
- Makes me feel comfortable in expressing my concerns or opinions about the laptop initiative.
- Includes teachers in decisions about school policies on student use of technology.
- Includes teachers in decisions about measuring student and teacher success in technology integration.
- Trusts teachers to make sound decisions about technology integration in instruction.
- Requests feedback from teachers about the 1:1 Initiative.
• Provides time for us to solve problems as a team.

Vision
• Sets ambitious, yet realistic goals for integrating technology (i.e., not too high, and not too low).
• Believes in the laptop initiative.
• Has articulated a vision for the school’s laptop initiative.
• Has established clear objectives and goals for our school to meet on the 1:1 initiative.
• Communicates how the laptop initiative supports the larger strategic plan for the school.
Appendix B

1 = strongly disagree, 2 = disagree, 3 = neither disagree nor agree, 4 = agree, 5 = strongly agree

Attitudes Toward Teaching

- My teaching benefits from laptop use.
- I am better able to individualize my curriculum to fit student needs as a result of having the laptops.
- Having a laptop has helped me to access more up-to-date information for my students.
- I am better able to access diverse teaching materials and resources for my students when using the laptop.
- Having laptops in the classroom has increased my expectations for students’ work.
- I am able to cover more material in class when we use the laptops.
- Use of the laptops helps me to create instructional materials which better meet the NC Standard Course of Study.
- Having a laptop has reduced the amount of paper-based supplies that I need in my classroom (e.g., newspapers, textbooks).
- I am able to explore topics in greater depth with my students when we use the laptops.

Attitudes Toward Learning

- My students are better able to meet learning objectives when using the laptops.
- Students in my classroom are more actively involved in their own learning when we use the laptops.
- Use of the laptops facilitates more open communication between my students and I.
- Students in my classroom are more productive when they are using their laptops.
- Laptops allow my students to get their work done more efficiently.
- The quality of my students’ work increases when we use the laptops.
- My students are better able to understand content when they use the laptops.
- My students are more organized when they use their laptops.
- My students are more engaged when we are using the laptops.
Appendix C

1 = never, 2 = once per semester, 3 = monthly, 4 = weekly, 5 = daily

During this school year, on average, how often have you used your laptop provided through the 1-1 project to do the following for planning:

Technology Use for Planning

- Develop instructional materials (e.g., handouts, tests)
- Develop homework assignments.
- Assess and grade student work.
- Manage student information.
- Communicate with parents and students; use E-mail and/or other forms of electronic communication to facilitate communication with parents and guardians.
- Collect formative assessment data for your instructional planning.
- Refer to the ISTE National Educational Technology Standards for Students when planning lessons that integrate software and web-based resources.

During this school year, on average, how often have you used your laptop provided through the 1-1 project to do the following for instruction:

Technology Use for Instruction

- Present curriculum content.
- Administer online quizzes or tests.
- Provide directions for an activity (e.g., lab procedures).
- Utilize online textbook resources.
- Utilize out-of-classroom labs/fieldwork with technology (e.g., scientific probes, GIS).
- Engage students in virtual field trips (e.g., museums).
- Invite online guest speaker (e.g., video conference).
- Utilize media for presentation purposes (e.g., video, film strip).
- Create and maintain website(s) and/or blogs for instructional purposes.
Appendix D

1 = I have never done this, 2 = I can do this with some help, 3 = I can do this on my own, 4 = I can show someone how to do this

Please indicate your comfort level with the following skills using your laptop provided through the 1-1 project:

Comfort with Basic Skills
- Format a text document (e.g., set tabs/margins, insert page breaks/tables).
- Create a multimedia presentation (e.g., PowerPoint).
- Create graphs and charts.
- Create and update a spreadsheet (e.g., Excel).
- Create and update a database (e.g., Access)
- Import and edit still digital images.

Comfort with Advanced (Web 2.0) Skills
- Import and edit digital video.
- Import and edit audio (e.g., voice, music).
- Create and update a blog.
- Subscribe to and download a podcast and/or RSS feed.
- Create and post a podcast.
- Contribute to a collaborative Wiki.
- Create and update a Web page.
- Write a computer program.
- Participate in professional online networking.