
THE IMPACT OF PORTABLE TECHNOLOGIES ON TEACHING AND LEARNING: YEAR ONE REPORT

Prepared For:
Athens Academy

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THE IMPACT OF PORTABLE TECHNOLOGIES ON TEACHING AND LEARNING: YEAR ONE REPORT

INTRODUCTION

In the summer of 1999, faculty in the Department of Instructional Technology at The University of Georgia were contracted by technology leaders at Athens Academy to conduct a long-term evaluation of the use of portable technologies in their school. This document describes the results from year one of the evaluation project.

The document begins with background information on the *Media Across the Curriculum Project* (MACP), focusing primarily on the final phase of MACP, *The 21st Century Classroom Initiative*, that began in June 1999. Next, we present a description of evaluation activities this year (participants, data collection and analysis efforts). This is followed by a presentation of results from the data collection, and a review of findings to date. Finally, we summarize key points from the year one evaluation and make recommendations for year two.

BACKGROUND

Administrators and teachers at Athens Academy, an independent co-ed day school located in northeast Georgia, began an intensive long-term initiative to integrate media into the lives of their students in 1990. Known as the Media Across the Curriculum Project (MACP), this project, supported by the Bertelsmann Foundation, has received international acclaim for its achievements. This innovative project has recently moved into its final phase. This phase, which is scheduled to last from June 1999 until June 2003, focuses on the integration of portable technologies (e.g., NEC's Compact Edition (CE) hand-held computers and PC laptops) into the teaching and learning environment at Athens Academy.

In preparing for the portable computing technologies initiative at Athens Academy, Keith and Smith (1997) prepared an initial review of the use of laptop programs in other schools, nationally and internationally. According to this report, laptops are selected for use in the schools for two reasons: to act as a catalyst for changes in the curriculum, and to integrate technology into an existing curriculum. Athens

Academy already has a strong curriculum that includes many technology and media components, but the need for continual improvement is acknowledged by the entire Academy community. As a result, this institution is well positioned for bringing portable technologies into its teaching and learning environment.

A primary focus of the MACP is the infusion of technology across the curriculum. The vision established in the rationale for laptop technologies focuses on creating "...a 'toolset' that could be effectively used in almost every curriculum area" and could be used anywhere, anytime to facilitate writing, communication, and resource use (Keith & Smith, 1997). By providing each teacher and student with portable technology that can assist them in their day-to-day tasks and communication, it is believed that the learning anywhere, anytime goal will soon be a reality.

This belief in anywhere, anytime learning is a goal shared by others, and in fact, the Academy is not the first independent school to decide to integrate laptops into their curriculum. Rockman (1998) reported on a laptop program pioneered by Microsoft and Toshiba American Information Systems to integrate portable technologies into the classrooms in 29 schools throughout the United States. According to Rockman, "the pilot program was designed to demonstrate that providing every student within a classroom with access to "real world" business tools would produce substantial educational benefits by supporting learning anytime and anywhere" (p. 3). Rockman's evaluation provides evidence of significant learning effects as well as student and teacher accomplishments in skill development, applications of technology for schoolwork, and improved critical thinking. These and other laptop initiatives are predicated on the belief that computing is becoming an essential tool for thinking, problem-solving, and learning in the 21st Century. But belief is not sufficient, and vigorous evaluation is required. Continuing this line of inquiry is important if we are to uncover best practices for creating ubiquitous computing environments. The *21st Century Classroom Initiative* is the perfect environment for doing so.

YEAR ONE PROGRAM ACTIVITIES

The first year of the *21st Century Classroom Initiative* was one filled with activities that can largely be characterized as preparing the ground work for year two when students at Athens Academy will begin to receive their laptops. For example, the summer and fall of 1999 found project personnel working on establishing relationships with partners (e.g., Bertlesmann & Microsoft), creating an infrastructure for student and teacher training, and establishing a plan for longitudinal evaluation. After receiving their own laptops in January, 7th and 8th grade teachers were encouraged to participate in staff development activities. Rather than subject the teachers to long technology training workshops, the Athens Academy technology leaders introduced a more flexible approach. Known as *20-Minute Modules*, this approach works to overcome some of the traditional shortcomings of staff development while meeting the needs of teachers interested in discovering best practices for using the laptops to "...directly impact their teaching and their student's learning" (Keith, 2000). The *20-Minute Modules* are readily available, and prepare teachers and administrators to participate in a wired learning environment.

During the spring of 2000, the *20-Minute Modules* were offered at a variety of times throughout the day (before school, during lunch and planning periods, after school). The *20-Minute Modules* address five main areas in staff development: (1) Fundamentals for Instructional Technology, (2) Technologies for Communication, (3) Applications, (4) Accessing and Using Information, and (5) Integrating Technology into Teaching and Learning. Examples of specific modules include networking sessions (e.g., Login/logout network procedures, Windows) and modules targeting educational use in the classroom (e.g., Evaluating Web sites, Copyright and citing sources, Microsoft Office applications) [see the schedule on the Web site (<http://www.athensacademy.org>) for the most up-to-date information]. The 7th and 8th grade teachers met with the Instructional Technology Coordinator twice a week as a grade level team for training. This training resulted in more contact time with the laptop teachers than the *20-Minute Modules* and was targeted at their grade level needs and prerequisite skills.

While teachers worked on becoming more comfortable with the tools, students were exposed to the technology in the classroom. Teachers utilized their laptops on a daily basis, both on campus and at home, beginning the modeling of portable technology use in a classroom setting. During end-of-the-year interviews, teachers indicated they used their laptops to keep connected with team members, find information on the Web, and to continue doing work at home after school. The teachers indicated it enabled them to help their students as they were working on assignments in class (e.g., web access to find immediate answers to student questions) and taking notes while the students are talking so as not to interrupt.

YEAR ONE EVALUATION ACTIVITIES

The evaluation of the laptop initiative is longitudinal, with a duration of four years (1999-2003). During the fall of 1999, we finalized the evaluation proposal for the project and made decisions regarding major activities to be utilized during the four year period. In the spring of 2000, we focused our efforts on four main activities:

- (1) preparing a white paper on the use of laptops in learning environments (see <http://lpsl.coe.uga.edu/Projects/Aalaptop/Papers/>),
- (2) introducing the evaluation project to the teachers involved in the first phase of the project (7th and 8th grade teachers),
- (3) establishing a project Web site (see <http://lpsl.coe.uga.edu/Projects/Aalaptop/>), and
- (4) the first round of gathering data with project participants.

Data was gathered from the 7th and 8th grade teachers participating in the project (n=8). We also collected data from the 7th grade students (n=67), the first group of students who will receive the laptops in the fall of 2000. Our major evaluation questions were:

1. What is the impact on teaching and learning?
2. What is the impact on writing?
3. What is the impact on community and communication?
4. What is the impact on resource use?

Several instruments were used to gather data to address the various evaluation questions. These included questionnaires with the teachers and students, and group interviews with the teachers.

YEAR ONE PARTICIPANTS

Teachers

The cohort of participating teachers (n=8), four 7th grade and four 8th grade teachers, completed the questionnaire (see Appendix A for a copy of the instrument). The teachers' main subjects come under the fields of science as well as the humanities and languages, with the following subjects being represented: mathematics (2), science (2), geography (1), history (1), and English (2). These teachers were selected for inclusion in the first year of the project for a variety of reasons: (1) past experiences/projects in the MACP; (2) manageability and funds, (3) the subject areas they represent encompass a variety of types of disciplines, some requiring a high degree of procedural knowledge and others needing a strong command of problem-solving skills; (4) the subject areas are represented across grade levels at the Academy, (3) the subject areas represent the "core" foundation of knowledge development at the Academy, and (6) the "lessons learned" in the middle school integration should be easily ported to the high school.

These eight teachers all teach about the same number of students each week (n=67), and deal with the same average size of classes (n=17). Teaching experience varies greatly in the sample: with a minimum of one and a maximum of 29 years of prior experience. The average teaching experience gained by the end of 1999 amounts to 11 years.

Learners

The learner sample consists of 63 students who answered the questionnaire on May 30, 2000 (total student population for this cohort, n=67). They were all in 7th grade at this time.

The laptop program is being initiated with this group of students for several reasons. As stated in the Middle School profile, "The Academy believes the middle school student is ready to be challenged, so broader and more rigorous aspects of learning are presented.... Emphasis is placed upon individual responsibility, traditional values, independent thinking, and creativity. Laying foundations laced with challenges is the principle goal of the Academy's Middle School." Given the emphasis on challenge and independent learning, the middle school is an ideal setting to begin ubiquitous computing efforts.

The sample includes 54 percent female and 46 percent male students (that is 34 female and 29 male students). The students' age ranges between 12 and 14, with an average age of 13 years. The distribution is as follows: 16 students are 12, 45 are 13, and two are 14 years old. Out of the 63 students in the sample, 87 percent are Caucasian, and 13 percent Asian-American (that is 55 White and 8 Asian-American students). This closely aligns with the overall demographic profile of the school, where 15 percent of the population are minorities.

DATA COLLECTION AND ANALYSIS

Data Collection

The laptops were delivered to the initial participating teachers in the spring semester of 2000. We collected our first data for the evaluation project just prior to the delivery of the laptops to the teachers, and ended our data collection at the end of the school year in May 2000. As described more fully in the project evaluation plan, our evaluative efforts are focused on four key goals:

- enhancing the teaching and learning environment at Athens Academy,
- enhancing the writing process,
- enhancing communications throughout the Athens Academy community, and
- enhancing the utilization of on-line resources.

Specific questions and data collection methods are displayed in Table 1 below. Instruments used during the first year are displayed in the Appendices (A: teacher questionnaire, B: interview protocol, C: student survey).

Table 1: Data collection methodologies by instrument

Questions	Methods	questionnaire	survey	interview
Impact on teaching & learning?		✓	✓	✓
Impact on writing process?				✓
Impact on community & communication?			✓	✓
Impact on resource usage?		✓	✓	

Data Analysis

Several methods of analysis were used to inform the interpretation of the data. Responses to the teacher surveys and student questionnaires were imported into SPSS so that descriptive statistics could be generated. Factor analysis was also used to help inform the results. Tapes from the interviews were analyzed and themes were identified through inductive analysis and coding. Reflective notes were recorded by each member of the evaluation team who participated in the focus group meetings with the teachers. The reflective notes were used to substantiate the themes identified from the analysis of the focus group tapes. The results of the analysis from the initial data collection are discussed in the next section of this report.

FINDINGS TO DATE

The Findings to Date section of the report is organized around several major themes. These have been divided into two main sections: themes related to teachers and themes related to learners.

Teachers

- Views on teaching and learning
- Attitudes towards using computers for teaching
- The teaching and learning environment

Learners

- Computer use and expertise
- Attitudes towards school and using computers for learning
- The learning environment

Each theme is reported in a separate section that includes the following information:

- A quotation from the literature relevant to the theme
- An Introduction to the theme and its key points
- Data revealed by the evaluation to date (e.g., quotes from focus groups, percentages from surveys)
- The evaluators' Interpretation of the data, and
- A recommendation captured in Next Steps.

The teacher models complex teaching and learning in a relationship with students which becomes similar to an apprenticeship.

— Robert Chambers,
Headmaster,
Athens Academy

TEACHERS: VIEWS ON TEACHING AND LEARNING

Introduction

This theme incorporates many areas associated with teaching and learning: how teachers structure their courses, teacher satisfaction with student performance, views of teacher and student roles in the process, and perceptions of their satisfaction with the teaching process.

Data

All teachers state that they enjoy teaching (88% *strongly agree*) and that they welcome innovations (75% *strongly agree*). A high percentage also claimed to organize their courses to accomplish outcomes (50% *agree*), as well as to suit their instruction to the students' needs (63% *agree*).

The two items that asked for the teachers' preferences concerning giving students choice in what they do, and directing most student work, respectively, produced many neutral reactions (63% / 88% *neutral*). A majority of the teachers *agree* with the statement that they were pleased with the standard of work accomplished by their students (67%), but this item, too, also caused a significant portion of *neutral* reactions (37%). On average, the teachers *agree* that they encourage students to help each other with schoolwork, that they prefer students to take responsibility for their own learning, and that students seem to enjoy learning.

Data related to general views on teaching and learning are summarized in Table 1. The numbers indicate the average response by the teachers on each item based on a 5-point scale.

Table 1. Teacher views on teaching and learning

Teacher Views on Teaching & Learning	
Mean Score	
Strongly Agree (1) Agree (2) Neutral (3) Disagree (4) Strongly Disagree (5)	
1. I enjoy teaching.	1.1
2. I generally welcome innovations.	1.3
3. I organize my course primarily to accomplish the outcomes.	2.3
4. I organize my course primarily to suit my students' needs.	2.3
5. I prefer to give students choice in what they do.	2.5
6. I prefer directing most student work.	2.9
7. I am pleased with the standard of work produced by my students	2.4
8. I encourage students to help each other with school work.	1.9
9. I prefer students to take responsibility for their own learning.	1.5
10. Most of my students seem to enjoy learning.	2.4

In terms of specific roles, The most typical role of the teachers in the sample seems to be that of a lecturer (average time that role is taken on is 50%), but variance is high. Some teachers reported that lecturer was a bigger role for them while others reported that lecturer was not as big of a role (standard deviation: 25%). This data is summarized in Figure 1.

Percentage of Time in Each Role Teacher Rated

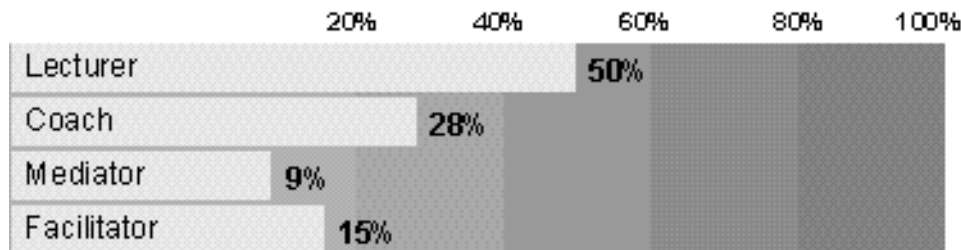


Figure 1. Time teachers spend in various roles

Interpretation

Trying to paint a picture from a limited data set can be challenging. However, based on the data gathered, there are some trends which can be explored. Overall, the 7th and 8th grade teachers enjoy teaching. They also welcome innovation in the classroom. These two factors will be very important to the success of the laptop initiative.

Another item of interest to the laptop initiative is the teachers' orientation to outcomes and students. These are both closely aligned in the survey results. This could indicate that while the teachers are very focused on meeting outcomes, they are

also equally interested in their students' needs, and how well the outcomes are accomplished on an individual basis.

The teachers perceived that their role in the classroom is also of special import to the laptop initiative. Many teachers stated that a primary role for them was that of lecturer. This directed approach is not supported in other responses in the survey, including the teachers' role in directing students (88% *neutral*), providing students with choice (65% *neutral*), and 100% of the teachers said that students should be taking on more responsibility for their own learning (50% *strongly agree*, 50% *agree*).

Next Steps

There would appear to be some conflict in terms of what teachers would like to see happen with students in the classroom (i.e., taking on more responsibility) and their role in the classroom (i.e., that of lecturer and directing student learning). Research indicates that in order for students to take on responsibility for learning, they need to be given ownership over their learning. While the role of lecturer may not mitigate this move, other roles (e.g., coach, mentor) will help promote and strengthen it. Providing teachers with incentives for adopting new roles, as well as providing guidance in making the transitions, will be important for the successful change. The integration of ubiquitous computing is predicted to shift classrooms from teacher-centered to student-centered. If this happens, future teacher surveys should indicate that the participating teachers perceive their roles as shifting.

We envision technology as a teacher's liberator to help reestablish the role and value of the individual classroom teacher. To do so, two things must happen. First the perspective of the classroom must change to become learner centered. Second, students and teachers must enter into a collaboration or partnership with technology in order to create a "community" that nurtures, encourages, and supports the learning process.

— Hooper & Rieber, 1995

TEACHERS: ATTITUDES TOWARDS USING COMPUTERS FOR TEACHING

Introduction

This theme captures information concerning teachers' attitudes toward computers in general as well as specific information on the laptop program.

Data

All of the teachers indicated that they are enthusiastic about the laptop program (88% *strongly agree*) and expect that their teaching will benefit from laptop use (50% *strongly agree*). The teachers' enthusiasm for the project was also evident in the end of the year interviews. The teachers commented on the excitement of the program, and the high level of support they were receiving. Overall, they are generally confident regarding their computer use (13% *strongly agree*, 50% *agree*), however several indicated a *neutral* stance on this item (25%).

In terms of the need to learn new skills, 63% of the teachers indicate that they *agree* they will need new skills. Several suggestions were offered during the teacher interviews. One teacher suggested that the technology training should not counter other types of professional development, such as learning other strategies of teaching. Another teacher mentioned a need for personalize training to match her/his curriculum. Yet another teacher stated they needed training on technology integration.

A majority also indicated that computer use will essentially change their teaching (50% *agree*), although 13% *disagreed* with this item. The teachers' views of the role of the technology (e.g., productivity tools vs. ideas tools) could have an influence on their perception of how computers will change their teaching. For example, if the teachers view the computer as a productivity tool, it is likely to have no or little impact on their teaching. Table 2 provides an overview of the data.

Table 2. Views on computer use for teaching

Views on Computer Use for Teaching	
Mean Score	
Strongly Agree (1) Agree (2) Neutral (3) Disagree (4) Strongly Disagree (5)	
1. I feel enthusiastic about the laptop program.	1.1
2. I expect my teaching to benefit from laptop use.	1.5
3. I feel confident about my ability with computers.	2.4
4. I need to learn many new skills before I can use computers for teaching.	2.4
5. Computer use will essentially change my teaching.	2.6

Changes in the teaching and learning environment were also mentioned in the interviews. Several teachers stated that the classroom would change as a result of the technology, and in ways that were perceived as positive. For example, when the teachers were asked about the benefits of the students having laptops, the teachers responded that they thought it would make the students more sophisticated, would enable saving paper, that school would be more relevant for the students and that the students would have greater ownership over their work.

The teachers also described several challenges associated with the technology. Many teachers mentioned a concern with students wasting time (e.g. playing games) or being distracted. Teachers also mentioned that finding ways to manage the students with the laptops would also be a challenge.

Interpretation

Clearly, the sample of teachers holds positive attitudes towards the laptop initiative and holds mildly positive to neutral attitudes towards their own ability with computers. *Neutral* (38%) responses to the 5th item (computer use might change my teaching) could mean that some of the teachers have not yet developed any clear opinions or expectations in this area.

Next Steps

Overall, teachers are expressing very positive views on the use of computers for teaching. This will be a great benefit for the laptop initiative. In order to maintain this positive attitude, it will be important to provide a lot of support and guidance to the teachers as they move further toward the seamless integration of the technology into their classrooms.

A sample of the kinds of support and guidance that might be provided includes:

- Time for finding resources and/or individual consulting.
- Job aids providing general information on the use of laptops in the classroom and/or specifically targeted for activities in the classroom (e.g., Top 10 list of ways to use the laptop in your classroom).
- Workshops on topics related to the use of technology in the classroom (e.g., How to enhance collaboration with technology or Gender differences in technology use).

Students will continue taking ownership of their learning and adapt the use of the technology for their personal needs and learning styles. Students who learn best working with others in projects and problem solving will have more opportunities to apply their strengths, while students who learn best individually will be free to do so. Classroom dialogue will be enriched and enhanced and students will be able to communicate easily with one another and their teachers outside the classroom or the period assigned. Experience and research with schools using laptops have shown this extended dialogue to be a major educational advantage of personal laptop use.

— Athens Academy
Web page

TEACHERS: THE TEACHING AND LEARNING ENVIRONMENT

Introduction

This theme captures teachers' attitudes towards the teaching process and how they create their learning environment. This includes teaching methods, activities, and how computers are used in the classroom.

Data

Whole class instruction is the method used most in the learning environment (63% *often*) with teachers leading the discussion in class (63% *often*) or leading demonstrations (63% *often*). Teacher prepared activities are used more often than student prepared activities. Group work and group projects are used less often.

Data are summarized in Table 3.

Table 3. Views on the teaching and learning environment

Views on Teaching & Learning Environment Average Frequency Ratings of Different Learning Activities	
Never (1) Rarely (2) Sometimes (3) Often (4) Almost Always (5)	
1. Whole class instruction.	3.9
2. Textbook work.	2.9
3. Teacher prepared activity.	3.75
4. Student prepared activity.	2.6
5. Group work.	3.25
6. Group projects.	2.6
7. Individual projects.	3.3
8. Teacher led class discussions.	3.5
9. Teacher demonstrations.	3.6

Interpretation

Teacher prepared activities are more frequently used than student prepared activities or textbook work, and individual projects are more frequent than group work or group projects. This implies that teacher-led activities are generally more common and when student prepared activities occur, they are usually accompanied and organized by teacher instructions.

Next Steps

To realize the full benefits of technology integration, a variety of teaching methods and learning techniques will need to be implemented. While teacher demonstrations and whole-class instruction are certainly effective in traditional classrooms, other models of teaching and learning have proven effective in technology-enhanced learning environments. Providing support to teachers as they learn these new methods and techniques will greatly assist with their implementation and adoption (see sample of ideas for support on page 14).

Access to laptop computers anytime of day, wherever it is needed, will allow our students to accomplish many of their current school tasks more effectively and efficiently. A rich supply of information will be available to them whenever they need it, creating a robust learning environment and leading to new ways of thinking. Time previously spent getting information can now be used for the much more important business of investigating, analyzing and assessing the information. Knowledge can be combined and recombined, giving rise to new opportunities for understanding.

— Athens Academy
Web page

TEACHERS: USE OF COMPUTERS IN THE CLASSROOM

Introduction

This theme captures teachers' current practices with computers in the classroom. It also includes information on the types of software that are currently used in the classroom.

Data

Several questions were asked in regard to teachers' uses of computers in the classroom. The vast majority reported using a computer in the classroom (88%). When computers are used, they are used most *often* for individual work (50%) and *rarely* used for group projects (50%). Computers are most often used for individual projects (50%) and rarely used for in-class demonstrations. Sixty-three percent reported not using them this way. Data are summarized in Tables 4, 5 and 6.

Table 4. How students and teachers are using computers in the classroom

How Students and Teachers are Using Computers in the Classroom	
Mean Score	
Strongly Agree (1) Agree (2) Neutral (3) Disagree (4) Strongly Disagree (5)	
1. I use the computer for demonstration to the class.	1.6
2. Students use the computer individually.	3.4
3. Students use the computer in groups.	2.3
4. Students choose when they want to use a computer.	2.5
5. Students work on individual projects.	3.1
6. The class has access to a printer.	4

Table 5. Classroom applications of computers

Classroom Applications of Computers	
Mean Score	
Never (1) Once or Twice a Year (2) Monthly (3) Weekly (4) Daily (5)	
1. Computers in general.	3.2
2. Word processing.	3.0
3. Spreadsheets.	1.25
4. Databases.	1.2
5. Graphics.	1.75
6. Presentation software.	1.25
7. Desktop publishing.	1
8. Internet.	1.75
9. Web searches.	2.5
10. Hyper/multimedia.	1
11. Simulations/microworlds.	1.2
12. Drill & practice tutorials.	1
13. Integrated learning software.	1
14. Other	0

Table 6. How computers are used in the classroom

Ways Computers Can Be Used	YES %	NO %
To store and organize information.	75	25
To collect data and perform measurements.	25	75
To manipulate/analyze/interpret data.	50	50
To communicate information as the result of investigations.	87	13
To use e-mail.	50	50
To access and use the WWW.	87	13
To gather information from a variety of sources.	75	25
To communicate with others outside of the school.	25	75
To create visual displays of data (graphs, charts, maps etc.)	50	50
To plan, draft, proofread, revise, and publish written text.	75	25
To create original graphics or visuals of non-data products (diagrams, pictures, figures etc.)	25	75
To create visual presentations.	50	50
To perform calculations.	0	100
To create models or simulations.	13	87
To support individualized learning.	25	75
For remediation for basic skills.	0	100
To compensate for a disability or limitation.	0	100

During the interviews, teachers mentioned specific programs that they would want to integrate into their classrooms. These included: Discourse, Geometer's Sketchpad, and the Microsoft® Office Suite.

Interpretation

Computers seem to be mainly used to gather, organize and communicate information, (including the use of the World Wide Web) and for text processing purposes.

Computers are used in the classroom less than once a week, and corresponding to this, none of the applications listed is used on a weekly basis.

Word processing is the most frequently used application, followed by Web searching and – less frequently - other Internet applications such as e-mail. Graphical applications are on average used “once or twice a year”; and all other software tools are not currently applied.

Next Steps

Although students are currently using computers in a variety of ways, to realize the full benefit of the technology, teachers and students need to be introduced to alternative models of integrating technology into the curriculum (e.g., WebQuests).

LEARNERS: COMPUTER USE AND EXPERTISE

Children understand computers because they can control them. They love them because they can set their own windows of interest.

— Negroponte, 1996

Introduction

This theme relates to where learners are using computers, the activities in which they are engaged with computers, and their perceptions of their own expertise with using computers.

Data

Computer Use at Home. All students report that their family has a computer at home, and on average they report to be using it almost daily. The average time that the family has had a computer at home is five years, but variance is high, and the values range between 1 year and 10 years with a computer at home.

Computer Use at School. All students report that they have access to a computer at school. Individual access and access to a computer as a whole class seem to be more common than using it in a small group setting or in pairs, although still 54 / 47 percent state that computers are also used in the latter settings (compared to 89 / 89 percent individual and whole-class use). The mean value of the grade since when these students reported using computers at school is third grade (variance is 3.0).

Concerning the frequency of use, the students state that computers are used at school about weekly during a school year. On average they report that they can “sometimes” choose whether they want to use a computer for an assignment.

Internet applications are the most frequently used programs, followed by games, doing schoolwork, and word-processing. These applications are on average used on a weekly or even daily basis. Working with graphics, using spreadsheets, presentation or multimedia software is considerably less frequent, with the average of all answers ranging between “once or twice a year” and “monthly”. Finally, the majority of all students hardly ever use database applications or engage in computer programming. It should be noted that average values are reported; this does not exclude that some individuals behave differently.

Some students reported that they also applied software other than the applications listed above. Most often, the “other programs” included software used for downloading and listening to music (e.g. Napster). Some students named certain games (e.g. Cybercity), and one student listed ‘scanning’. See Table 7 for a summary.

Table 7. Frequency of use of various computer applications

Frequency of Use of Various Computer Applications	
Mean Score	
Never (1) Once or Twice a Year (2) Monthly (3) Weekly (4) Daily (5)	
1. Games.	4.1
2. Do schoolwork.	3.8
3. Word processing.	3.7
4. Spreadsheets.	2.1
5. Presentations.	2.1
6. Programming.	1.3
7. Databases.	1.3
8. Multimedia.	1.8
9. Internet.	4.7
10. WWW Searches.	4.2
11. Email.	4.5
12. Tutorials.	2
13. Graphics.	2.7

Expertise with Computer Applications. The students rated their own ability with computer applications on a five-point scale: 'I always need help' (1), 'I sometimes need help' (2), 'I rarely need help' (3), 'I never need help' (4), 'I can help other people. I am an expert' (5). Table 8 shows the average ratings for eleven applications.

Table 8. Expertise with computer applications

Expertise with Computer Applications	
Mean Score	
I Always Need Help (1) I Sometimes Need Help (2) I Rarely Need Help (3) I Never Need Help (4) I Can Help Others. I Am An Expert (5)	
1. Games.	3.9
2. Word processing.	3.8
3. Spreadsheets.	2.9
4. Presentations.	2.9
5. Programming.	1.9
6. Databases.	2.2
7. Multimedia.	2.6
8. Internet.	4.4
9. Email.	4.5
10. Tutorials.	3.3
11. Graphics.	3.3

Of course, the students' evaluations of their own abilities are subjective and should be complemented with objective measures of ability, at some point. The students made use of all the categories of the scale, and the measures can be considered a valid estimation of the students' confidence about their skills with various computer programs.

Interpretation

Computer Use at Home or School. Using the average of the ratings of all the applications, a summative score of 'computer use' was calculated. Testing for gender effects, no difference between male and female student in terms of overall frequency of computer use resulted ($p = .708$; One-Way-ANOVA).

Factor analyzing the items of the 'computer use scale', resulted in a four-factor solution (see Table 9 below). It seems that the applications - the way they are used by the students - can be grouped together in four categories that could be interpreted as follows. Using a computer for playing games constitutes one factor (factor 4 below), doing schoolwork with computers is another, which is associated with 'word-processing' and 'tutorials' (factor 3 below). Internet applications represent the third group (factor 2), and the remaining applications could be grouped together as "other applications that are not associated with schoolwork, the Internet, or gaming".

Table 9. Categories of computer use

	<i>Factors</i>			
	1	2	3	4
Games	--	--	--	.865
Do schoolwork	--	--	.834	--
Word-processing	--	--	.771	--
Calculations with spreadsheets	.661	--	--	--
Create presentations	.784	--	--	--
Programming	.752	--	--	--
Databases	.555	--	--	--
Multimedia	.762	--	--	--
Internet use	--	.850	--	--
Search information on the WWW	--	.654	--	--
e-mail communication	--	.837	--	--
Tutorials/drill and practice	--	--	.426	--
Graphics and pictures	.640	--	--	--

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization. a Rotation converged in 7 iterations.

Testing for gender effects, again, a significant difference concerning the factor scores only resulted for the 'games-factor'. Male and female students do not seem to differ in the applications they use, except for playing games, which is significantly more frequently done by boys ($p = .025$; One-Way ANOVA). This finding is in keeping with other studies examining gender differences in software use among students.

Expertise and Computer Use. The average ratings of the frequency of use of specific applications are significantly correlated with the ratings of expertise with the same application, except for 'word-processing' (.139), 'spreadsheet calculations' (.176), and presentation software (.094). The remaining correlations between use and

expertise are of medium height and significant ('games': .647**, 'multimedia': .480**, 'programming': .459**, 'databases': .451**, 'graphics': .434**, 'Internet use': .386**, 'tutorials': .308*, 'e-mail': .290*; Sig. two-tailed).

As with 'frequency of computer use', a summative score was calculated for 'computer expertise', creating a new variable containing the average of all ratings for each subject. Again, a test for gender effects was run - with a significant result in favor of the boys. Boys do not report a higher 'frequency of computer use', but male students rate their overall computer expertise slightly higher than the girls do ($p = .030$; One-Way ANOVA).

Next Steps

Given the higher rating of perceived overall computer expertise by the boys, it will be interesting to study the effect of laptops on gender differences in ratings of expertise. We predict that these reported differences may decrease with greater access to computers among both girls and boys.

In a study of eighth graders in 161 schools, Lounsbury and Clark, “found that all too many students were little more than ‘sponges’ – soaking up lessons with little opportunity to discuss or analyze them. Most eighth graders spent their day as passive learners – listening to teachers, copying from chalkboards, reading assignments, filling in worksheets, and taking tests. Such an arrangement – the authoritarian teacher and passive student – may or may not have worked in the past, but it is certainly not working now

— Fiske, 1991, p. 63

LEARNERS: ATTITUDES TOWARDS SCHOOL AND USING COMPUTERS FOR LEARNING

Introduction

This theme examines four aspects of attitudes toward computers and school: (1) attitudes toward school and schoolwork in general, (2) attitudes toward using computers for schoolwork and learning, (3) interest in computers and perceived relevance of computer ability, (4) and the confidence a student holds about his or her own computer skills.

Data

The questionnaire included a 17-item attitude scale. Table 10 shows the average rating of each item on the scale.

Table 10. Attitudes towards computer use

Average Ratings of Attitude Items Concerning Schoolwork & the Laptop Initiative	
Strongly Agree (5) Agree (4) Neutral (3) Disagree (2) Strongly Disagree (1)	
1. Computers make schoolwork easier to do.	4.0
2. I prefer to use computers to do schoolwork instead of using pencil and paper.	3.7
3. Using computers for schoolwork can also have disadvantages.	2.5
4. Most days, I look forward to attending school.	2.1
5. Computers make schoolwork more fun/interesting.	3.7
6. Computers help me improve the quality of my schoolwork.	3.7
7. Computers help me understand my classes better.	3.0
8. I look forward to the laptop use in my classes.	4.4
9. I need to learn many new skills to use computers for my schoolwork.	3.2
10. I generally enjoy schoolwork.	2.1
11. Compared to other students, I really enjoy being in class.	2.2
12. Many of my classmates know more about computers than I do.	3.0
13. I want to learn more about computers.	3.8
14. I currently try to learn more about computers.	3.6
15. I would be equally prepared to enter college without the laptop program.	3.1
16. Having a computer in class is an advantage when it comes to learning.	3.9
17. I think my ability with computers will affect the grades I get.	3.4

Interpretation

Factor analyzing the items replicated the expected four categories, but the factor solution calls for further differentiation within the attitude scale: two additional factors – that is a six-factor solution – resulted. They may be interpreted as follows: (1) attitudes toward school and schoolwork in general, (2) attitudes toward using computers for schoolwork and learning, (3) interest in computers and readiness to learn about them, (4) confidence of own computer skills, (5) perceived relevance of the laptop program, (6) and relevance of computer skills for grades. Table 11 shows the six factors, the items they represent, and an interpretation of the factors:

Table 11. Factors related to attitudes toward school and computers

Factor	Items (items with higher factor loadings are listed first)	Interpretation / factor name
1	<ol style="list-style-type: none"> 1. Compared to other students, I really enjoy being in classes. 2. I generally enjoy schoolwork. 3. Most days, I look forward to attending school. 	a) Attitudes toward school and schoolwork in general
2	<ol style="list-style-type: none"> 1. Computers help me understand my classes better. 2. Computers help me to improve the quality of my schoolwork. 3. I prefer to use computers to do school-work instead of using pencil and paper. 4. Computers make schoolwork easier to do. 	b) Attitudes toward using computers for schoolwork and learning
3	<ol style="list-style-type: none"> 5. Computers make schoolwork more fun / interesting. 	
4	<ol style="list-style-type: none"> 1. I want to learn more about computers. 2. I currently try to learn more about computers. 3. I look forward to the beginning of the laptop use in classes. 4. Having a personal computer in class is a serious advantage concerning learning outcomes. 	c) Readiness to learn about computers / interest in computers
5	<ol style="list-style-type: none"> 1. I need to learn many new skills to use computers for my schoolwork. 2. Many of my classmates know more about computers than I do. (This item correlates equally with factor 4 and factor 2.) 	d) Evaluation of / confidence about own computer skills
6	<ol style="list-style-type: none"> 1. I would be equally prepared to enter a college without the laptop program at my school. 2. Using computers for schoolwork can also have disadvantages. 	e) Perceived relevance of laptop initiative
	<ol style="list-style-type: none"> 1. I think that my ability with computers will affect the grades I get. 	f) Relevance for grades

Table 12 shows the average ratings of agreement and disagreement on the six attitude dimensions mentioned above. The score represents the mean value of the items that have been grouped together by factor-analysis.

Table 12. Attitudes toward school and computer use

Attitudes Toward School & Computer Use	
Mean Score	
Strongly Agree (5) Agree (4) Neutral (3) Disagree (2) Strongly Disagree (1)	
1. School & schoolwork in general.	4.1
2. Using computers for schoolwork and learning.	3.6
3. Readiness to learn/interest in computers.	4.0
4. Confidence in ability with computers.	3.4
5. Relevance of laptop initiative.	2.8
6. Relevance for grades.	3.4

On average, the students' attitudes toward school and schoolwork are positive. But the students seem to hold generally positive expectations for using computers for schoolwork and learning, and also seem to be motivated to increase their knowledge and skills with computers.

Right now, they appear to be only mildly optimistic about their own ability with computers, though, which might reflect both high variance in responses and the fact that they have difficulty clearly evaluating their own skills.

Concerning ratings of the relevance of the laptop program for future education and school grades, the students do on average seem to feel rather undecided about their evaluations. Again, variance in the ratings is high.

Testing for gender effects concerning the factor scores showed that the boys hold less positive attitudes toward school and schoolwork than the girls ($p = .001$).

Comparing students who are among the 50% of the sample who score lowest on 'frequency of computer use' to those who score above the 50th percentile, showed that students higher on 'frequency of use' have significantly more positive attitudes towards computer use for schoolwork, that is they score differently on factor two on the attitudes scale ($p = .033$). No differences exist among these groups concerning the other attitude scales, however (One-Way ANOVA). Using the same approach, effects of 'computer expertise' on attitudes measures were tested, showing no significant differences.

Next Steps

Since the students have a somewhat positive attitude toward schoolwork and a general positive attitude toward computer use, teachers have the opportunity to take advantage of this attitude and potentially use the laptops to help students develop a more positive outlook on the formal teaching and learning process.

...many researchers have begun to focus on the potential of technology to support certain fundamental changes in the pedagogic models underlying our traditional approach to the educational enterprise. Within this "constructivist" paradigm:

- *Greater attention is given to the acquisition of higher-order thinking and problem-solving skills, with less emphasis on the assimilation of a large body of isolated facts.*
- *Basic skills are learned not in isolation, but in the course of undertaking (often on a collaborative basis) higher-level "real-world" tasks whose execution requires the integration of a number of such skills.*
- *Information resources are made available to be accessed by the student at that point in time when they actually become useful in executing the particular task at hand.*
- *Fewer topics may be covered than is the case within the typical traditional curriculum, but these topics are often explored in greater depth.*
- *The student assumes a central role as the active architect of his or her own knowledge and skills, rather than passively absorbing information proffered by the teacher.*

—President's Committee of Advisors on Science and Technology, 1997

LEARNERS: THE LEARNING ENVIRONMENT

Introduction

This theme examines student perceptions of various activities during a school day as well as preferred teaching and learning methods.

Data

Table 13 summarizes the frequency of different learning activities.

Table 13. Frequency of different learning activities

Average Ratings of Different Learning Activities	
Never (1) Rarely (2) Sometimes (3) Often (4) Almost Always (5)	
1. Teacher instruction/demonstrations.	4.2
2. Students work from textbooks.	4.2
3. Teacher prepared activities.	3.9
4. Group work.	2.9
5. Individual projects.	3.7
6. Group projects.	2.5
7. Class discussion.	4
8. Media use (videos, tapes)	2.9
9. Student presentations of individual or group projects.	2.9
10. Go beyond classroom information at home.	1.9

Among the activities listed above the students named the two they think they learn the most from, as well as the two they enjoy the most. Figures 2 and 3 show accumulated scores of “choice 1” and “choice 2” for both questions (“choice 1” was weighted with the factor two, and the average value of “choice 1” and “choice 2” was calculated).

Activities Students Think They Learn from the Most Mean percent of Students (n=60)

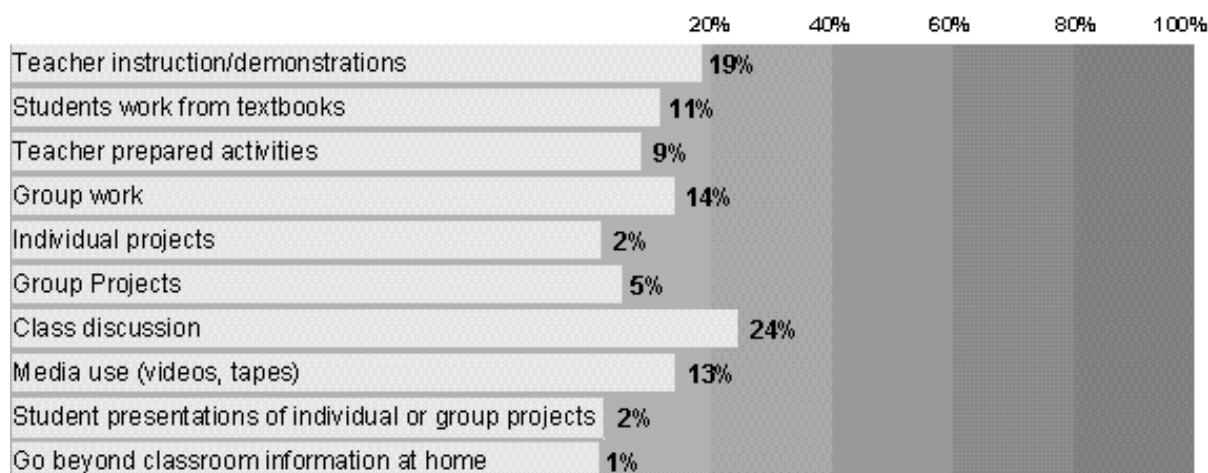
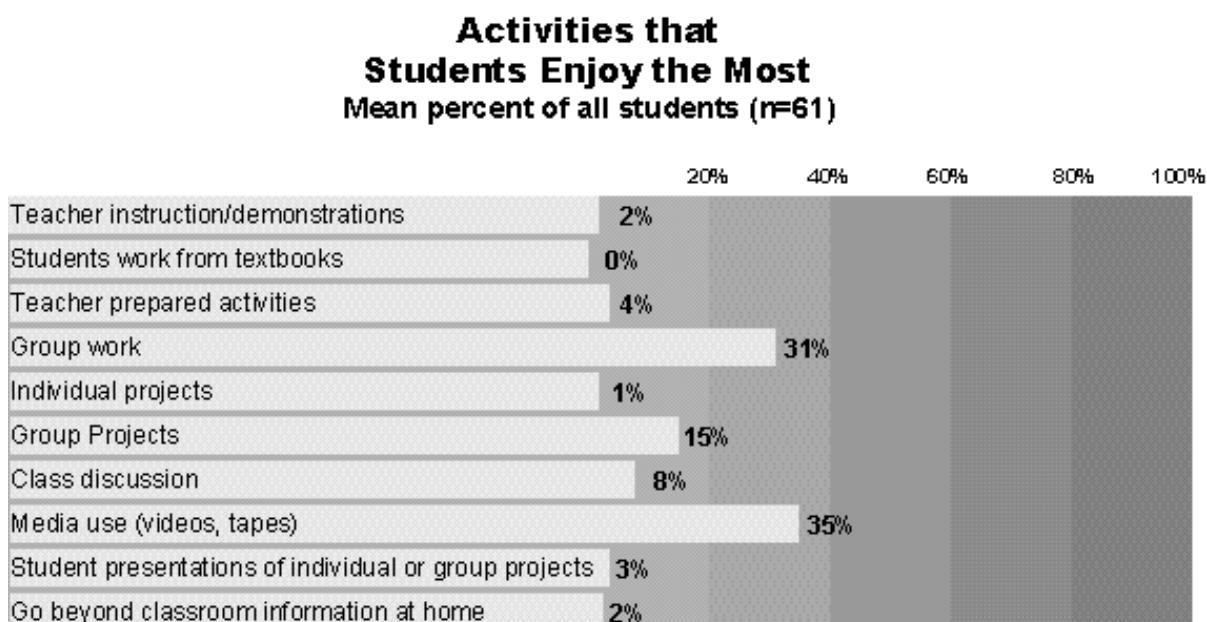
**Figure 2. Activities which students think they learn the most from**

Figure 3. Activities which students say they enjoy the most



Interpretation

Overwhelmingly, students reported learning most from teacher demonstration and class discussion. Group projects also rated high. On the low end, students reported learning least from individual projects and student presentations.

What they reported learning the most from did not align with the activities they reported enjoying most. In terms of enjoyment, students rated group work and mediated instruction the highest. On the low end were learning from textbooks, individual projects, and teacher demonstration.

Next Steps

Given the students' positive attitude toward teacher-directed instruction, they may find moving to a more student-centered approach challenging. Careful implementation will be critical in making this transition. The students' interest in mediated instruction (non-human) is of particular interest and may prove to be the factor that makes the transition into a technology-integrated learning environment easier.

CONCLUSIONS & NEXT STEPS

CONCLUSIONS

While the initial data provides a snapshot of the current environment, we were able to glean a few overall insights based on evaluation activities to date.

One overall insight is that teachers want students to take responsibility for their own learning. However, many activities are primarily teacher-driven and lecture-based. This conflicts with a move toward self-regulation, independence, and full use of the technology. This issue will need to be addressed.

Another insight relates to the students. According to the survey, students feel they learn most from teacher demonstrations/instruction and class discussion. Yet again, this clashes with a movement toward being an independent, self-regulated learner. Interestingly, students stated they enjoy the use of the media most in the classroom. So while the students may seek external guidance from the teacher, the use of media may provide a good strategy for moving toward a culture of independence and self-regulation.

Yet another insight relates to how teachers and students view the learning environment. Currently, the learning environments described by the teachers and students are very similar. While it may clash with overall goals of the MACP (self-regulation, independence, etc.), at least both parties are starting from a common ground. This will enable change to occur in a much more democratic and evolutionary fashion.

A final insight relates to the teachers' and students' attitudes toward the laptop initiative. Overall, both teachers and students are very positive and enthusiastic. This will also assist in making the project successful.

At this point, we do not have enough data to provide answers to the overall project questions. However, we can provide a few speculative insights for each question:

1. What is the impact on teaching and learning? Uncertain, but given the discrepancies described above, this area may need considerable time and attention
2. What is the impact on writing? Potential is high.
3. What is the impact on community and communication? Potential is high.
4. What is the impact on resource use? Potential is high.

Next Steps

The second year of the study will begin in August 2000, and once again the year will be filled with many activities. The timeline for Year Two is displayed in Appendix D.

We will continue to work closely with the Athens Academy laptop participants both in terms of gathering data, and in working to make the initiative run smoothly toward success.

Some specific indicators for Next Steps may be guided by teacher suggestions during the interviews. Teachers mentioned the following in terms of types of training and support they felt they would need in order to be successful with the laptop:

- Personalized to the curriculum
- A part of what is taught and not take over
- Both technical and integration training
- Training/support just-in-time
- Problem/need/situation-based, not an information dump (just-in-case)
- Hand-outs/how to's to help trigger after workshops
- Software evaluations—teachers don't have the time

Several teachers mentioned that professional development would need to change as a result of the laptops being integrated into the classroom. One teacher mentioned that the training should go beyond the technology to other issues related to teaching and learning with technology. One example might be the integration issue. Another example is time management. Several of the teachers mentioned that they were worried about time on a number of fronts... time to help the students with the technology, time to grade all the work, time to sit and chat with students/parents. Each of these could become a 20-Minute Module and help in extending the teachers knowledge base.

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APPENDIX A INITIAL TEACHER QUESTIONNAIRE

Initial Teacher Technology Survey

Name _____ (used by researcher only)

Main Subject Taught _____

Current Grade Level Being Taught _____

As of the end of the last school year (1998-99), how many years had you been teaching? _____

How many different students do you teach each week? _____

What is your average class size? _____

Your Views on Teaching and Learning

Please select the best response to the following:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I enjoy teaching.					
I generally welcome innovations.					
I organize my courses primarily to accomplish the outcomes.					
I organize my courses primarily to suit my students' needs.					
I prefer to give students choice in what they do.					
I prefer directing most student work.					
I am pleased with the standard of work produced by my students.					
I encourage students to help each other with schoolwork.					
I prefer students to take responsibility for their own learning.					
Most of my students seem to enjoy learning.					

In an average week, you may take on a variety of roles. What percentage of the time do you think you act in each of the following roles:

Lecturer (primary deliverer of content): _____%

Coach (mentors and/or direct): _____%

Mediator (assist with negotiations): _____%

Facilitator (provide guidance): _____%

Total: 100% (should add up to 100%)

Your Views on Computer Use for Teaching

Please select the best response to the following:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I feel enthusiastic about the laptop program.					
I expect my teaching to benefit from laptop use.					
I feel confident about my ability with computers.					
I need to learn many new skills before I can use computers for teaching.					
Computer use will essentially change my teaching.					

What kinds of technology-related professional development activities did you attend in the past year? What applications/techniques did you learn?

What kinds of technology-related professional development activities would you still like to have? Are there specific technologies and/or techniques that you would like to learn?

Your Teaching and Learning Environment

Please select the best response to the following:

	Always	Often	Some- times	Rarely	Never
I instruct the whole class.					
Students work from a textbook.					
Students work on activities I have prepared.					
Students work on activities they have defined.					
Students work in groups.					
Students work on group projects.					
Students work on individual projects.					
I lead the whole class in an investigation/discussion.					
I demonstrate to the whole class.					

Are you currently using a computer in your classes?

NO YES

If YES, approximately how many days per week? _____

If your answered NO to the last question, then FINISH HERE (with many thanks for your time!); otherwise, please continue with the survey...

Please select the best response to the following:

	Always	Often	Some- times	Rarely	Never
I use the computer for demonstration to the class.					
Students use the computer individually.					
Students use the computer in groups.					
Students choose when they want to use a computer.					
Students work on individual projects.					
The class has access to a printer.					
I feel good about my level of computer literacy.					

How do students use computers in your classes (check all that apply):

To organize and store information |

To collect data and perform measurements	
To manipulate/analyze/interpret data	
To communicate information as the result of investigations	
To use e-mail	
To access and use the World Wide Web	
To gather information from a variety of sources	
To communicate with others outside of the school	
To create visual displays of data/information (graphs, charts, maps, etc.)	
To plan, draft, proofread, revise, and publish written text	
To create original graphics or visuals of non-data products (diagrams, picture, figures, etc.)	
To create visual presentations	
To perform calculations	
To create models or simulations	
To support individualized learning	
For remediation for basic skills	
To compensate for a disability or limitation	
Other (please specify)	

Approximately how often do you use each of these applications with your students (check one):

Application	Daily	Weekly	Monthly	Once or twice a year	Never	NA (Not available)
Computers in general						
Word processing						
Spreadsheets						
Databases						
Graphical applications						
Presentation software						
Desktop publishing						
Internet (e-mail, listservs)						
Web search engines						
Hyper/Multimedia						
Simulations/Micro-worlds						
Drill & Practice/Tutorials						
Integrated Learning Systems						
Other (please specify)						

Thanks for your time! We appreciate your participation!

APPENDIX B INTERVIEW PROTOCOL

Initial Teacher Interviews

1. Using the Technology

- You and your colleagues have had your laptops for about three and a half months. How have you used them during this time?
- There's a TV commercial running for IBM laptops now that shows a woman opening her new laptop up with the same glee that she might have opened a toy at Christmas when she was a child. What kind of reactions have you had to your laptop?
- What have been the reactions of your colleagues who have laptops?
- What have been the reactions of your colleagues who don't have laptops?

- Where are you using your laptop the most, in your classroom, at home, or elsewhere?
- What kind of pressures do you feel to use the laptop more, if any?
- What is the source of any pressure you feel to use the laptop more?

- What prevents you from using computers more, if anything?
- What kinds of hardware problems have you experienced, if any?
- What kinds of software problems have you experienced, if any?

- Has having the laptop for the last two months been a timesaver or a time drain?
- If a time saver, how has the laptop saved time for you?
- If a time drain, what have been the demands on your time as a result of having the laptop?

- How do you expect the demands on your time to change when the students receive their laptops next year?
- What types of training and support do you feel you need in order to be successful with the laptop?
- What kinds of technical training and support do you need?
- What kinds of curriculum integration training and support do you need?
- Have you attended any of the before-school training sessions offered here at the Academy?
- If yes, which ones have you found most helpful?
- What other kinds of training and support do you need?
- What other resources (such as the training sessions, tutorials, friends, help pages, and so forth) have you used to help you with the laptop other than that provided here at Athens Academy?
- How does your current level of computer use and technology literacy compare with most teachers here at Athens Academy?
- How would you compare your current level of computer use and technology literacy with teachers in the public schools near here?

- **Expectations**

- What are your personal goals for integrating the laptops into your classroom?
- Please give me a concrete example of a practical goal you hope to accomplish with the laptops in your classroom?
- Please give me an example of something that you think you might do with the laptops that would be unexpected or different from your normal instructional methods?
- How will you know if you're successful in achieving the goals you just described?
- Describe how you foresee your classroom changing once the students have their laptops?
- What will be some of the benefits of students having laptops?
- What will be some of the disadvantages of students having laptops?
- What types of software applications do you envision integrating into your teaching once the students have their laptops?
- What are some of the challenges you'll face in using those software applications?
- How will the software be bought? Installed? Maintained?
- How will students learn to use these applications?
- What do you think the students are expecting from having their laptops?
- What do think their parents are expecting?

- **Reservations**

- What reservations do you have about this whole laptop initiative?
- Where does this initiative fit with other new things you might be doing next year?
- How does this laptop initiative fit with any other professional development activities you are undertaking?

- What are your concerns about integrating the laptops into your curriculum?

- What are your concerns about students bringing laptops into your classroom?

- Which students are likely to benefit from this laptop initiative?
- What kinds of students will benefit the most?
- What kinds of students will benefit the least?

- What is the most positive thing about the laptop initiative?
- What is the most negative thing about it?

3.6 What else do you want to tell me about the hopes or concerns about the laptop initiative here at Athens Academy?