Leveraging Laptops: Effective Models for Enhancing Student Achievement

Seminole Research Report

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Principal Investigator
Cathy Cavanaugh, Ph.D.
Associate Professor
College of Education and Human Services, University of North Florida

Co-Principal Investigators
Kara Dawson, Ph.D.
Associate Professor
College of Education, University of Florida

Shannon White, Ph.D.
Assistant Director
Florida Center for Instructional Technology

Research Assistants
Nancy Valdes
Albert Ritzhaupt
Denise Payne

Contact information:
College of Education
University of Florida
Gainesville, FL
Phone: 352-392-9191
http://etc.usf.edu/laptops4learning/

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- Miami Dade County Public Schools
- Escambia County School District
- Gadsden County School District
- Hendry County Schools
- School District of Hillsborough County
- Lake County School District
- Madison County School District
- School District of Manatee County
- Pinellas County Schools
- Seminole County Public Schools
- Taylor County School District

Executive Summary

The purpose of the *Leveraging Laptops* program was to develop effective models for enhancing student achievement through the integration of laptop computer tools for teaching and learning in the classroom. The Research Oversight Committee was appointed by the Bureau of Instruction and Innovation to collect and analyze data about how this funding impacted teaching practices and student achievement.

The program and the research involved 440 teachers across subject areas in 47 K-12 schools in 11 districts. It is estimated that the program directly reached over 20,000 students during the project period. In coming years, the resources and pedagogical skills that were brought to each district for the project will continue to benefit students in the 11 participating districts.

Each district participated in a research design consisting of five components: interviews with district project coordinators, teacher surveys, school-level observation studies of the laptop classrooms, mentored teacher inquiry (action research) into effectiveness of technology-supported teaching, and examination of project-related documents.

The findings indicate that positive changes in teaching practices and student learning were realized as a result of the infusion of professional development, support, and access to classroom technology.

Specifically:

- 78% of action research teachers documented changes in student achievement including test scores, higher level thinking skills, retention, and transfer of learning.
- Nearly 60% of action research teachers documented an increase in conditions that support learning: enjoyment, motivation, engagement, on-task behavior, and positive school experience.
- Students developed 21st Century Skills such as collaboration, computer skills, workforce skills, abilities as producers, communication skills, leadership abilities, innovation and creativity.
- Instructional practices shifted from traditional teaching strategies to ones that are student-centered and engage learners in meaningful use of computers to enhance learning.
- Significant increases were observed related to the following student-centered strategies:
    - student attention, interest and engagement;
    - project-based learning;
    - teachers acting as facilitators and coaches;
    - cooperative/collaborative learning;
    - independent inquiry/research;
    - academically focused class time;
    - computers used as a learning tool; and
    - utilization of computers to support critical thinking skills
- Significant decreases were observed related to teacher-centered, traditional practices:
    - Independent seatwork
    - Direct instruction

- Computers used as a delivery tool
    - Using the computer to support lower-level thinking

In numerous cases the results of Florida's *Leveraging Laptops* evaluation far exceeded national norms in terms of the types and amount of student-centered teaching practices observed. Evaluation results demonstrate that *Leveraging Laptops* funding has served as a catalyst for positive changes related to both teaching practices and student achievement in the 11 participating districts.

Recommendations for Policy, Practice, and Research

Based on the results of this research, we offer the following recommendations.

For the Florida Department of Education and state policymakers:

- The changes observed as a result of the 2006-2007 EETT funding to eleven small, medium, and large districts are possible in classrooms across Florida.
    - State budgets that are constructed to support the expansion of such initiatives statewide beyond the scope of single-year projects will result in educational experiences designed to prepare students for continued education and for the global workforce of coming decades.
- Instructional materials policies should be revised to include technology-related materials that support innovative districts in ensuring that appropriate technology is available to students, in particular students who do not have access to these resources outside of school.
- Systematic educator professional development such as the experiences provided through the *Florida Digital Educator* program should receive continued support.
- Broad-scale research efforts into the real effects of innovations in classrooms such as this research should continue and should be structured to facilitate longitudinal data aggregation.
    - Such coordinated efforts will magnify the benefits of both funding to districts and the research data across the state.

For teachers, administrators, and school district staff:

- Based on the significant changes in teaching practices and student performance that occurred in the spring of the project year, it is reasonable for educators to have high expectations for teaching and learning with the infusion of professional development, support, and technology.
    - Each of those three elements is necessary and must be integrated together in ways that work toward achieving school, district and state goals.
- The first year of a major change in teaching is a year for learning by teachers, administrators, and students, and it is likely that, given sustained professional development and support, the changes observed in classrooms will continue and probably magnify as teachers refine their practices and students acquire and apply technology and information skills to their academic work.
- The types of twenty-first century skills developed in this project have limited presence on current standardized tests. Teachers, administrators, and school district staff who value the benefits of integrating technology should recognize that increases in student motivation, engagement, and other affective traits that have been seen in association with project-based, community-based, and other

important forms of learning may not lead to improvements in all skills as they are assessed on current standardized tests.

- Students who are new to using technology for educational purposes and students who struggle academically may need specific instruction on how to learn with technology.
    - Students who use school computers outside of school need guidelines and information about policies for caring for their computers.

For parents and community leaders:

- Notable improvements in student performance were observed in districts that included rich community partnerships and where students had laptops for home use.
    - Schools and students need these strong relationships in order to maximize the effect of the teachers' efforts and the technology.

For researchers

- The perspectives of students and members of the community are integral to the success of school reform and be considered as important components in data collection strategies.
- Longitudinal views of the changes occurring in students' lives, their classrooms, and their schools are the most precise way to learn about how significant educational change at the scale of the EETT project happens.
- Research on classroom technology impacts requires a fine focus on student learning outcomes as defined at the lesson level.
- Continued use of validated classroom observation measures provides an accurate picture of what students and teachers can do with the important resources available to them.

Program Overview

The purpose of the *Leveraging Laptops* program was to develop effective models for enhancing student achievement through integration of laptop computer tools for teaching and learning in the classroom. The program involved 440 teachers across subject areas in 47 K-12 schools in eleven districts. It is estimated that the program directly reached over 20,000 students during the performance period: April, 2006 – June, 2007. A total of $10,836,136 was awarded among the districts.

The *Leveraging Laptops* program built on the 2004 report to Florida's Commissioner of Education, Jim Horne, prepared by the Florida Laptops for Learning Task Force. The Task Force was a group of educators from K-20 settings across the state. Their report, located at http://etc.usf.edu/L4L/Index.html, made three major recommendations. The first recommendation was that laptop initiatives conform to the following guiding principles.

- All students must have access to appropriate tools and to challenging curriculum in order to bridge the digital divide by moving beyond basics and towards 21st century skills.
- 21st century curriculum must be infused with skills necessary for living and working in an ever-changing society. Relevant, real world education should include:
  - information and communication skills
  - thinking and problem-solving skills
  - interpersonal and self-directional skills
- Teachers must create instructional environments in which students use higher order cognitive skills to construct meaning or knowledge, engage in disciplined inquiry, and work on products that have value beyond school.
- Successful professional development:
  - must be held on a continuous basis
  - provides mentors, coaches, or peer teammates to model appropriate integration strategies in actual classrooms
  - gives teachers feedback on their own performance
  - holds teachers accountable for implementing instructional strategies and student learning
- Preservice teachers must:
  - experience good models of technology integration in all their preservice classes
  - have access to a laptop computer to support their coursework and field experiences
  - have field experiences that include an opportunity to teach in a 1:1 environment
- Students and teachers must have access to rich multimedia resources to:
  - extend their world and life experiences
  - engage their senses
  - incorporate into their own multimedia projects
  - provide building blocks of instruction

- Laptop hardware and software must be sufficient to allow students to be creators of content, not merely passive receivers of content. The laptop must be available to use as a cognitive tool wherever and whenever the student is working.
- Technology support procedures and planning must be adequate to prevent disruptions in laptop availability. Support should be handled at the lowest level practical.
  - The end-user (teacher or student) should be taught to exercise problem-solving skills in handling routine maintenance.
  - A school-based support staff should be able to handle the majority of technical issues on a timely basis and provide a loaner laptop while the repair is being made.
  - District support or other outsourcing should be available to handle major repairs.
- In addition to the testing of basic skills, students should be given the opportunity to demonstrate 21st century skills through the use of technology-infused, authentic assessments. Assessment should become more integrated with instruction.

The *Leveraging Laptops* program addressed eight of the nine guiding principles (preservice teacher preparation was not directly involved) in an intensive one-year implementation and research effort.

The eleven participating districts represented the diversity that is present in public education in Florida. The districts ranged in size from the smallest with just six K-12 schools to the largest with 317 K-12 schools. A wide array of economies was represented in the participating communities, from urban to agricultural. Correspondingly, the numbers of schools and teachers reached in this program varied across the state, as shown in Table 1.

Table 1. EETT Teachers and Schools by Funded District

District	Number of EETT Teachers per Funded District*	Number of EETT Schools per Funded District
Escambia	43	5
Gadsden	17	3
Hendry	13	2
Hillsborough	26	6
Lake	128	8
Madison	11	5
Manatee	15	2
Miami-Dade	17	1
Pinellas	62	3
Seminole	78	4
Taylor	20	2
TOTAL	430	41

Each district assessed its educational needs when identifying the schools and students to target with the program's resources. In some districts, a single grade level or subject area was the focus, while in other districts the focus was spread across many schools, subjects, and levels. A unique and laudable feature of Florida's laptop initiative was the latitude given to the districts to design models that best meet their needs. This report provides detailed descriptions of the district models and the outcomes of their efforts.

Research Overview

The Research Oversight Committee for the *Leveraging Laptops* program was appointed by the Bureau of Instruction and Innovation to collect and analyze data about the district models. The research framework is a cluster evaluation that looks across the eleven district models in order to learn lessons about their effectiveness, as well as to generate knowledge and guidance about strategies for implementation (Patton, 2001). The research has resulted in high-quality lessons learned about laptop implementation from eleven diverse contexts. These lessons have external validity due to the multiple sources of independent data being triangulated in this evaluation.

The research committee applied Hall's (1995) conception of conditions, processes and consequences to explore the 1:1 computing efforts in the 11 participating districts. This framework is very similar in theory to the "Evaluation Framework for 1:1 Computing" developed by SRI International (Zucker, 2004). We used Hall's terminology because we believe it is clear to a wide range of stakeholders; however, much of our work is informed by the SRI International evaluation framework. Table 2 outlines the components of our research within Hall's framework and distinguishes between the terminologies used by Hall and Zucker.

Table 2. Research framework

Conditions (Hall, 1995) Critical Features (Zucker, 2004)	Processes (Hall, 1995) Interactions & Immediate Outcomes (Zucker, 2004)	Consequences (Hall, 1995) Ultimate Outcomes (Zucker, 2005)
Technology used	Professional development	Student achievement
Setting	Teaching and instructional practices: student-centered and tool-based	Changes in teacher practices: student-centered and tool-based
Implementation plan	Technology deployment	Impact on parents
Goals and objectives		Sustainability

The purpose of the research activities was to learn about and report on the effective practices in use in the districts for laptop integration. The following evaluation question was developed in collaboration with officials from the Florida Department of Education, grant coordinators from the districts funded through the *Leveraging Laptops* program, and the Research Oversight Committee. Each district's project participants were engaged in setting their own goals for the project, in particular in the area of student achievement related to the classroom use of laptop computers. In this way, a developmental evaluation was undertaken that supported project development and continuous improvement in each school and district (Patton, 1994).

Research Question:

What changes in tool-based, student-centered teaching happen as a result of the infusion of technology and professional development?

As a result of the *Leveraging Laptops* program and research, educators across Florida will learn through the dissemination of results and effective practice how a range of laptop implementations contribute to student-centered teaching and classroom use of technology tools. Dissemination that has already been accomplished as well as planned dissemination efforts are described in Appendix E of this report. Multiple

methods of data collection were used to answer the evaluation questions. Table 3 summarizes how these data collection methods fit within our research framework.

1. School Observations: We used the measures developed at the Center for Research in Educational Policy (CREP) to ascertain teaching and instructional practices within schools involved in the state-funded 1:1 computing initiatives. These observations informed our knowledge of questions 2 (processes), question 3 (consequences) and question 4 (lessons learned). The School Observation component is described in detail in the "School Observation" section of this report.
2. Document Analysis: An analysis of the grant proposals, district web sites, a web survey of district stakeholders, and other artifacts will inform question 1 (conditions) and question 4 (lessons learned).
3. Interviews with Grant Coordinators: Semi-structured interviews with grant coordinators were conducted to triangulate document analysis and inform question 1 (conditions) and question 4 (lessons learned). The district implementations are described further in Appendix D of this report.
4. Teacher Inquiry: Teachers from 1:1 computing classrooms in each district conducted action research to inform question 3 (consequences) and question 4 (lessons learned). Specifically, these teachers received mentoring in using teacher inquiry to determine how their 1:1 computing efforts influenced student achievement. Teacher inquiry was chosen because of the short time frame of our research, the inherent problems using standardized test data to document the effect of technology use (Means, 2004) and the importance of documenting classroom-based student achievement (Dawson & Ferdig, 2006). This research component is described fully in the "Teacher Action Research" section of the report.
5. Teacher Survey: A survey developed by an expert in survey design was administered to all teachers participating in the state-funded 1:1 computing initiatives. This survey was used to triangulate data collected by other means and to inform question 1 (conditions), question 2 (processes) and question 4 (consequences). The results of this research component are included in the "Participating Teachers" section of this report.

Table 3. Data collection methods

Conditions	**Processes**	**Consequences**
Technology used (Documents and interviews)	Professional development (Documents, interviews and surveys)	Student achievement (Teacher inquiry)
Setting (Documents and interviews)	Teaching and instructional practices: student-centered and tool-based (School observations)	Changes in teacher practices: student-centered and tool-based (School observations and surveys)
Implementation plan (Documents, interviews and surveys)	Technology deployment (Documents, interviews and surveys)	Impact on parents (Documents and interviews)
Goals and objectives (Documents and interviews)		Sustainability (All)

Data from each strategy was first analyzed independently and a descriptive profile of 1:1 computing in each district was developed. Then, we used a conditional matrix (Strauss & Corbin, 1990) to organize the wealth

of data and distinguish linkages between and among the conditions, processes and consequences of 1:1 computing across Florida. Florida's *Leveraging Laptops* initiative is particularly interesting because of the autonomy given to individual districts and because of the inclusion of a multi-university Research Oversight Committee. Such a combination has the potential to significantly contribute to our knowledge base related to 1:1 computing.

The following sections provide details about the research components, the data collected, and the results.

The State Profile

Overview of districts

Information about each district's laptop implementation model was collected using the districts' grant proposal documents, semi-structured interviews with district project coordinators, a survey of district stakeholders, and the district project websites.

Each district project coordinator was asked the following questions in a telephone interview during the Fall of 2006.

Conditions

- Describe the district's history in 1:1 computing by talking about past laptop/Palm/iPod projects in schools to give us an idea of where the district is its development of 1:1 computing programs. (setting)
- Discuss the factors that influenced your planning when you developed the current project proposal. (implementation)
- In your mind, what is the central purpose of the laptops for your students and teachers?
- Based on those intended purposes, provide insights into your decisions about the content areas, hardware, and other products (such as LCD projectors) included in your EETT program. (implementation)
- What partnerships with organizations are included in this year's program? (implementation)
    - What issues or concerns have arisen from the partnerships?
- Verify the grade levels and content areas of the teachers participating in the EETT program this year. (setting)
- How would you describe the kinds of effective teaching you expect to be happening in the laptop classrooms by the end of this school year? (goals)

Processes

- How has possible growth in the participating classrooms been handled or accommodated in the program planning? (deployment)
- What support is provided to teachers, both for their technology and for using the technology for their curriculum objectives? (deployment)
- Provide details about the deployment of hardware, software, and services acquired for this project. (deployment)
    - Give an example or two of how teachers have been using the resources they have received. (teaching)
    - What percentage/proportion of the purchased resources (hardware, software, and services) are currently deployed?
- What professional development experiences are included in the program in addition to summer institutes? (professional development)
    - What professional development are all teachers expected to participate in?

- What options have been provided?

- How have parents been involved in the project? (parents)
  - What has been the reaction of parents so far?
  - What methods have you used to get feedback from parents?

Consequences

- How many students do you expect to be directly affected in this project?
- In thinking about all aspects of the EETT program to this point, what has happened that has surprised you or been unexpected?
- To what factors do you attribute the success of the project so far? What have been the major factors in any obstacles or challenges you have experienced?
- What plans does the district have to sustain the progress of this year?
- If you were able to change one thing about the EETT program, in relation to the RFP, your proposal, your implementation, or another factor, what would it be?
- What future plans/goals does the district have for 1:1 computing programs? (sustainability)

General

- How are you evaluating the project within the schools and district?
- Are you assessing the effect of the project on student achievement?
- What anecdotes can you share about the project?
- What else would you like the evaluation team, the DOE, or the legislators to know about your project?

District profiles describing each district's project context, processes, and results are located in Appendix D of this report.

The State Profile

The following table summarizes the Conditions, Processes, and Consequences of the Laptops for Learning program. Further detail is included in the following sections of this report.

Conditions	
Technology used (Documents and interviews)	– Each district supplied laptop computers to the participating classrooms. – In addition, districts selected a range of supporting hardware, software, and web services for teacher and student use. – Hardware included handheld computers, tablet computers, digital cameras, printers, projectors, microscopes, probes, music players, and calculators. – Software included concept mapping tools, web editing tools, productivity suites, and media development tools. – Web services included content-specific subscriptions and general academic research services.

Conditions	
Setting (Documents and interviews)	– The number of participating schools in each district ranged from one to eight, with most districts focusing on between two and five schools for this project. – Fifteen of the schools were elementary schools, thirteen were middle schools, and eleven were high schools. – Three of the districts were large urban districts, four were mid-sized suburban districts, and four were small rural districts. – In each district, the number of classrooms involved ranged from 11 to 128. – All grades from 1-12 were involved, and most classroom subjects were represented. – The districts' prior experience with 1:1 classroom computing varied. Only one district had no prior laptop program. – One district had a school with nearly a 1:1 student-computer ratio. – Two districts had at least one school with 1:1 computing, and the remaining five districts had schools in which computer lab carts were used.
Implementation plan (Documents, interviews and surveys)	– District planners considered several factors in developing their project designs. – The most frequently stated factors were low academic performance of students (4 districts), the need to fill a technology gap in the district, primarily in areas of poverty in which students lacked access to technology (6 districts), and a commitment to fostering the types of student-centered project-based teaching that require increased access to technology (4 districts). – Other factors that influenced project designs were a desire to build on a history of strong professional development in technology (1 district), and the need to provide technology in a growing district (1 district). – In determining the types of technology to provide with the funding, the district planners most often considered the fit between the technology and the project goals (7 districts), but also considered the fit between the technology and broader district goals (6 districts), and the fit between the technology and the desired teaching and learning outcomes (1 district).
Goals and objectives (Documents and interviews)	– Most of the projects were designed to achieve multiple goals. – The most common goal among the districts was to promote student-centered, project-based, inquiry-oriented, or active learning (7 districts). – Other goals included improving academic performance in language arts and science (8 districts total), providing the tools students and teachers need to succeed (3 districts), improving student motivation and behavior (2 districts), and supporting community-centered learning (1 district).
Summary of state conditions: – Each district determined its own needs and goals, and then planned accordingly. – The result was a wide range of conditions within which the 1:1 projects took place. – It is noteworthy that student needs drove each design and that each district took into account multiple factors during the decision-making stages in order to succeed.	

Processes	
Professional development (Documents, interviews and surveys)	– Districts used several strategies for supporting teacher learning during the project. – Most of the participating teachers took part in the Florida Digital Educator summer institutes offered around the state. – Three districts provided additional targeted summer in-service experiences. – During the school year, districts provided professional development sessions focused on the project's hardware, software, teaching methods, and academic content. – Seven districts provided access to continual online professional development opportunities. – Additional professional development processes used by small numbers of districts included learning communities (3), 1:1 coaching and modeling (3), use of external trainers (1), custom consulting for teachers (3), and off-site experiences at community sites (1). – Two districts offered professional development for the school and districts administrators who were involved in the laptop project.
Teaching and instructional practices: student-centered and tool-based (School observations)	– In the first half of the year when the classrooms had just received the technology, over 90% of teachers were observed using direct instructional methods occasionally or frequently, and fewer than 30% were using cooperative/ collaborative teaching. – Only 20% were occasionally using project based teaching, about 40% were teaching as coach/facilitator, and 85% were using independent seatwork. – Nearly 80% were using technology for instruction, but only about 40% were using it as a learning tool or resource. – The next table, "Consequences," describes the changes seen in the second half of the year.
Technology deployment (Documents, interviews and surveys)	– All districts provided network/Internet access for classroom computers, either wired or wireless. – Most districts placed the hardware and software in classrooms and in shared school spaces on carts. – Three districts allowed home check out of computers.
Support (Documents, interviews, and surveys)	– All districts provided either full-time school-based or district-based technical support to the participating teachers. – Two districts prepared student technicians to support the technology. – Two districts identified teachers or coaches on assignment to provide curricular support to the teachers.
Parent involvement (Documents and interviews)	– Eight districts scheduled open houses, parent nights, or workshops for parents at the schools. – Schools in three districts used print newsletters to inform parents of the project. – All districts additionally employed some or all of the following approaches: project and classroom websites for parent communication, parent volunteers, and school technology clubs open to parents.
Summary of state processes: – Each district carefully selected and provided appropriate technology, support, and communication with stakeholders. – Innovative methods were used to meet specific local needs in these areas.	

Consequences	
Student achievement (Teacher inquiry)	– The educational results reported by the teachers were overwhelmingly positive. – Thirty-five of the forty-six teachers engaged in Action Research documented changes in student achievement including test scores, higher level thinking skills, retention, and transfer of learning. In one elementary classroom and two middle school classrooms, negative effects such as a decrease in writing scores and a high level of frustration were reported, and in each case these effects were attributed to inexperience in the students with the technology that they were learning to use simultaneously with learning the class lesson. – In all other cases, teachers reported noticeable or significant improvements in student performance, in some cases exceeding the teachers' expectations. – Twenty-six of the teachers reported increases in conditions that support learning: enjoyment, motivation, engagement, on-task behavior, and positive school experience. Thirteen teachers stated that students had demonstrated strong 21st Century Skills such as collaboration, computer skills, workforce skills, abilities as producers, communication skills, leadership abilities, innovation and creativity. – Smaller numbers of teachers documented positive changes in their teaching, changes in the classroom culture or dynamic due to unique technology affordances, and improved ability to reach students of varying abilities.
Changes in teacher practices: student-centered and tool-based (School observations and surveys)	– In the second half of the year, the following changes in teaching were observed: – Direct instructional methods decreased significantly from over 90% of teachers occasionally or frequently observed to 78% – Cooperative/collaborative teaching increased from fewer than 30% occasionally or frequently observed to 52% – Project based teaching increased significantly from 20% occasionally observed to 50% occasionally or frequently observed, and exceeded national norms – Teaching as coach/facilitator increased from about 40% occasionally or frequently observed to 70% – Independent seatwork decreased significantly from about 85% occasionally or frequently observed to 54% – Student independent inquiry and research increased significantly, and exceeded national norms – The use of technology as a learning resource or tool increased significantly from 41% occasionally or frequently observed to 72%, and exceeded national norms – The levels of student attention, interest, and engagement significantly increased from Fall to spring – Use of all types of production and Internet tool technology increased from fall to spring, and exceeded national norms in all categories – Overall meaningful and very meaningful use of technology increased significantly
Summary of state consequences: – Every district saw positive academic outcomes as a result of the project and is committed to finding ways to continue this and similar initiatives.	

A summary of key findings and conclusions are located in the Summary of Findings section of this report.

Participating Teachers

A survey was developed to collect information from teachers about their professional development and initial uses of technology in their classrooms. This information provides a picture of how technology is used by the teacher in the initial stages of the *Leveraging Laptops* project, and serves as a triangulation point for data collected by other means.

The survey developed by the Research Oversight Committee drew from the literature on technology professional development (Bradshaw, 2002; Christensen, 2002; Fulton, 1999; Hughes & Ooms, 2004; Margerum-Leys & Marx, 2004; Means & Olson, 1995; Mouza, 2003; Orr, 2001; Vannatta & Fordham, 2004).

Instrumentation

The instrument employed in this evaluation project was collaboratively developed by the research committee to measure teacher professional development experiences and perceptions, and use of computers in the classroom. The instrument also included other relevant criteria, such as a teacher's content area, pedagogy, and technology experience. As a starting place, the research team identified a survey previously used to characterize the nature of technology use in the classroom (Harmes, Kemker, Kalaydjian, & Barron, 2000; Hogarty & Kromrey, 2000). This survey was adapted to suit the needs of this evaluation program. The instrument was designed to measure four relevant domains: technology integration; support; preparation, confidence and comfort; and attitude toward computer use. In a previous validation study of this instrument, exploratory factor analyses results demonstrated psychometrically sound factors and measures of internal consistency reliability (Cronbach's alpha) exceeding 0.7 for each domain (Harmes et. al., 2000; Hogarty & Kromrey, 2000).

Revisions were made to the descriptors of the instrument to accommodate changes in information and communication technology and pedagogical practices. Additional items were added to instrument to collect more specific information, such as teacher certification areas. The final instrument included 27 unique items and was published in an online format using the Web Surveyor © software utility. The item formats included dichotomous response items (eg., Math 6-12 Certified), standard Likert scale items ranging from strongly agree (5) to strongly disagree (1), and a 5-point frequency of use scale from one to five (not at all; once a month or less; once a week; several times a week; and everyday).

The web address of the survey was provided to each district's project coordinator who sent it to each teacher. Teachers' names and schools were not requested in the survey. Follow up requests for survey completion were sent via the district coordinators on a minimum of three different occasions over a four-month period.

Respondent Sample

School district email addresses were used as keys to uniquely identify participants. A duplication analysis revealed 25 participants had completed the survey more than once. These additional responses were removed from the dataset, leaving only the initial response from the participant. This resulted in a total of 353 respondents included in the analysis, which is an 82% response rate. Table 4 illustrates the response rates by district.

Table 4. Response rates by district.

District	Participating Teachers	Teacher Respondents	Response Rate
Escambia	43	43	100%
Gadsden	17	14	82%
Hendry	13	11	85%
Hillsborough	26	20	77%
Lake	128	95	74%
Madison	11	10	91%
Manatee	16	16	100%
Miami-Dade	17	16	94%
Pinellas	62	56	90%
Seminole	78	54	69%
Taylor	20	18	90%
TOTAL	**430**	**353**	**82%**

Degrees and Certifications

Fifty-seven percent of the participants have earned a bachelors degree, 36% have an earned masters degree, and the remaining participants reported having an earned doctorate, educational specialist or other credential (eg., National Board Certified).

Most teachers in the sample had earned their degree 14.24 (SD=10.14) years ago. As shown in Table 5, the majority of the teachers included in the sample were certified to teach in the State of Florida through an approved degree program (35.16%) or a college course certification (30.77%). The remaining teachers were certified by transfer from another state (18.14%) or through a district alternative certification (14.84%) program. Teachers reported an average of 12.19 (SD=10.05) years K-12 teaching experience and an average of 13.14 (SD=10.28) years experience in the education profession. Teachers reported having used computer in their classroom for an average of 4.79 (SD=4.63) years.

The teachers involved in the *Leveraging Laptops* project held a number of Florida teaching certifications. The majority of the respondents held Elementary Education K-6 (n=103) and variety of other core subject areas in for middle school level and 6-12 grade level certifications. The teacher certifications held by the current sample are shown in Appendix A1.

Table 5. Method of initial Florida teaching certification.

Method	n	%
Approved Degree Program	128	35%
College Course Certification	112	31%
District Alternative Certification	54	15%
Transfer From Another State	67	18%

Teacher Action Research

Introduction

Teacher action research (AR), also known as teacher inquiry, is a strategy for helping educators through a systematic, intentional study of their own professional practice (Cochran-Smith & Lytle, 1993; N. Dana & Silva, 2000; Hubbard & Power, 1993). In general, action research engages teachers in the design, data collection, and interpretation of data around their questions. The process of teacher inquiry involves teachers (1) defining a question that emerges from their practice, (2) developing a research plan for data collection through such mechanisms as journals, student work, interviews with students, and field notes, (3) analyzing their collective data in relationship to their wondering to develop a picture of their learning, (4) taking action to implement what was learned through their investigation, and (5) sharing the results of their work with other professionals (Dana & Yendol-Silva, 2003).

Action research was selected as the strategy for assessing student learning during the *Leveraging Laptops* initiative because of the short time frame of our research, the inherent problems using standardized test data to document the effect of technology use (Means, 2004) and the importance of documenting classroom-based student achievement (Dawson & Ferdig, 2006).

District project coordinators and action research mentors attended a Fall 2006 seminar to introduce them to the roles and responsibilities of the AR mentor. The seminar presentation is included in the Appendix. After the seminar 46 teachers from ten of the eleven districts then completed action research in their classrooms with the guidance of an AR Mentor who was assigned to each district.

Each AR Teacher and AR Mentor received a copy of "The reflective educator's guide to classroom research" (Dana & Yendol-Hoppey, 2003) and guidelines for completing the AR process. Table 18 overviews and describes each step in the process and provides an example of what the result of each step may look like.

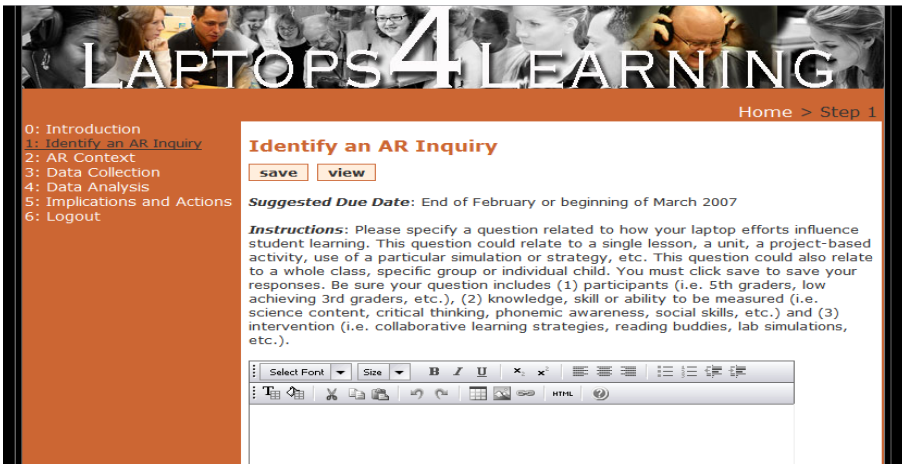
Table 18. Action research steps

Step	Description	Example
Step 1: Identify an AR Inquiry:	– AR teachers will specify a question related to how their laptop efforts influence student learning. This question could relate to a single lesson, a unit, a project-based activity, use of a particular simulation or strategy, etc. This question could also relate to a whole class, specific group or individual child.	– Will a project-based learning activity designed to facilitate 5th grade students' understanding of the plants and animals on their school campus support learning at various levels of Bloom's taxonomy?

Step	Description	Example
Step 2: Specify context	– AR teachers will provide contextual information	– Grade level(s): 5th Grade – Content area(s): Science – SSS: The student describes patterns of structure and function in living things. – Technology configuration: Small group – Years of teaching experience: 10 – Years experience teaching with technology: 3
Step 3: Data Collection	– AR teacher will specify strategies to best answer their question	– Digital photographs – Student Artifacts – Informal Interviews – Reflective Journal
Step 4: Data Analysis	– AR teachers take information collected, synthesize it and answer question	– Finding 1: Sophistication of student knowledge increased as students progressed through stages of project development.
Step 5: Implications/ Actions	– AR teachers think about broader implications of their findings & describe what actions have or will result from their AR efforts	– Laptops provide opportunities for project-based learning activities that help foster higher level thinking skills. •I am planning a workshop for my colleagues on the use of project-based in Science. – My principal is funding me to attend a conference related to science and technology.

Data Collection and Results

An online AR submission system, shown in the figure below, was developed in order to facilitate data collection. This system provided information about each of the steps in the AR Process and directions for how to submit work for each step. It allowed evaluators to easily compile results while minimizing the amount of effort required on the part of AR Teachers and Mentors.



Of the completed Action Research projects submitted, 9 projects were conducted in elementary classrooms (grades 1-5), 22 took place in middle school classrooms (grades 6-8), and 15 were carried out in high school classrooms (grades 9-12). Eighteen of the projects focused on a science topic, eleven centered on an English/ language arts topic, six were

oriented toward history or social studies, four happened in mathematics, four in speech or other exceptional education setting, and three studied general student outcomes or behavior.

The technologies used in the projects varied, and are listed by frequency in Table 19. About one-third of the projects used online services and resources, and smaller numbers of projects used other available technology. Ten of the projects focused on project-based approaches.

Table 19. Technologies used in action research projects

Technology	**Number of projects (N=46)**
Online resources	16
Media and presentation tools	11
Word processing, publishing and other productivity tools	9
Concept mapping software	6
Probes and data tools	6
Virtual labs, simulations, and games	4
Other: audio production, clickers, e-portfolios	4

The educational results reported by the teachers were overwhelmingly positive. Thirty-five of the teachers documented changes in student achievement including test scores, higher level thinking skills, retention, and transfer of learning. In one elementary classroom and two middle school classrooms, negative effects such as a decrease in writing scores and a high level of frustration were reported, and in each case these effects were attributed to inexperience in the students with the technology that they were learning to use simultaneously with learning the class lesson. In all other cases, teachers reported noticeable or significant improvements in student performance, in some cases exceeding the teachers' expectations. Twenty-six of the teachers reported increases in conditions that support learning: enjoyment, motivation, engagement, on-task behavior, and positive school experience. Thirteen teachers stated that students had demonstrated strong 21st Century Skills such as collaboration, computer skills, workforce skills, abilities as producers, communication skills, leadership abilities, innovation and creativity. Smaller numbers of teachers documented positive changes in their teaching, changes in the classroom culture or dynamic due to unique technology affordances, and improved ability to reach students of varying abilities.

Each teacher reported the long-term impacts that the Laptops for Learning program has caused in his or her professional life. Nineteen teachers expressed commitments to continue using, investigating, and learning to teach with technology. Fifteen teachers had taken leadership actions including sharing their successes with colleagues either informally or through presentations and other formal venues. Other teachers explained ways that they had become advocates for technology for students.

A few of the themes that became evident from the AR results were:

- Students need support when simultaneously learning challenging academic concepts and learning technology applications
- Students need practice with technology and academic skills to become proficient. Access to the technology is essential.

- Student comfort and skill with technology should be scaffolded and strengthened with explicit instruction and practice if students lack home access to computers or previous experience with computers, or if they are struggling learners academically.
- Classroom differentiation appears to be a critical success factor, enabling students to have the levels of social interaction, time and tools that they need.
- Teacher effort and creativity must be invested in order for positive student outcomes with technology to be achieved.
- Student choice seems to increase engagement and motivation.
- Innovation and success develop leadership and initiative in teachers, resulting in grant-seeking, mentoring, and other leadership initiatives.

The AR projects in each district are summarized in the District Profiles located in Appendix D.

Summary Of Findings

The *Leveraging Laptops* funding was intended to positively impact teaching practices and student achievement through professional development, support and access to technology. The preceding sections have addressed this program's evaluation in detail. This section summarizes the most important findings from this evaluation related to (1) Changes in Teaching Practices, (2) Student Achievement and (3) Professional Development.

Changes in Teaching Practices

- Evaluation results show promising trends in that the Florida EETT program seemed to serve as a catalyst for positive changes from traditional teaching environments to ones that are student-centered and engage learners in meaningful use of computers to enhance learning.
  - Significant increases were observed related to:
    - Student attention, interest and engagement
    - Project-based learning
    - Teachers acting as facilitators and coaches
    - Cooperative/collaborative learning
    - Independent inquiry/research
    - Academically focused class time
    - Computers used as a learning tool
    - Using computers to support critical thinking skills
  - Significant decreases were observed related to:
    - Independent seatwork
    - Direct instruction
    - Computers used as a delivery tool
    - Using the computer to support lower-level thinking

Student Achievement

- 78% of Action Research teachers documented changes in student achievement including test scores, higher level thinking skills, retention, and transfer of learning.
- Nearly 60% of Action Research teachers documented an increase in conditions that support learning: enjoyment, motivation, engagement, on-task behavior, and positive school experience.
- Students developed 21st Century Skills such as collaboration, computer skills, workforce skills, abilities as producers, communication skills, leadership abilities, innovation and creativity.

Professional Development

- 73% of *Leveraging Laptops* teachers reported their professional development opportunities focus on both technical and instructional skills required to integrate technology.

- Over 50% of *Leveraging Laptops* teachers indicated that their professional development opportunities are consistent and continual.
- Over 70% of the teachers involved with the *Leveraging Laptops* project expressed favorable (strongly agree or agree) attitudes towards their professional development opportunities in terms of:
  - encouraging them to think about how to use technology to support teaching goals (83.24%),
  - encouraging them to collaborate with other colleagues on technology integration (78.57%),
  - encouraging them to thinking about contextual factors that support or hinder technology integration efforts (73%.08),
  - helping them think about how technology may change their teaching practices (85.71%),
  - providing them relevant knowledge and skills for the classroom (74.73%),
  - encouraging them to use technology to facilitate student learning content (84.62%).
- Over 70% of the *Leveraging Laptops* teachers felt adequately supported to use technology in their classroom.

Conclusions

This research effort built upon a philosophy that centered on sharing best practice from each district with the state. A collaborative relationship among participants resulted in access to the data needed to tell the stories of the classrooms and districts. The EETT project represents a foundation from which the State of Florida learned about the key elements that contribute to desirable changes in teaching and learning. Thousands of educators and leaders have worked very hard over a two-year period to plan and implement the 11 district models. The funding made this work possible, but it was the expertise, knowledge, and effort of everyone involved that resulted in the positive outcomes documented in this report. These outcomes can and should continue. Florida's public school students and the citizens of the State have already begun to see the benefits of technology used as a learning tool in the context of student-centered teaching.

Seminole

Seventy-eight teachers from four different schools in Seminole County participated in the *Leveraging Laptops* Program, and 54 (response rate of 69%) of these teachers responded to a survey pertaining to teacher professional development experiences and perceptions, and use of computers in the classroom. Additionally, schools were observed with the School Observation Measure (SOM) and Survey of Computer Use (SCU). Classroom observations were made in the fall and spring semesters at the schools. Student performance information is provided as a result of the work of the teachers who completed classroom inquiry projects. The summaries of these projects document the effects of classroom technology on a range of students.

Setting

Teachers involved with the *Leveraging Laptops* Program from Seminole County reported an average of 22.91 (SD=3.68) students per class. The teachers reported an average of 4.08 (SD= 6.39) laptops and average of 3.24 (SD=3.48) desktops in their classrooms.

Two teachers reported teaching media/technology, 3 in special education, 24 in mathematics, 29 in science, and 5 reported other. Twenty-six teachers reported teaching 6th grade, 31 taught 7th grade, and 27 taught 8th grade.

Technology Used

Teachers in Seminole County used productivity software packages more than other software classifications. Fifty percent or more teachers reported using Word processing, spreadsheet, presentation, and Internet browsing software one or more times a week. Authoring, database, draw/paint/graphic, and concept mapping software packages were used much less frequently by teachers (25% teachers reported not at all). Forty percent or more teachers reported their students use Word processing, presentation, and Internet browsing software at least once a month or more. Nearly 50% of teachers report their student do not use spreadsheets, database, draw/paint/graphic, authoring, and concept mapping at all.

Teachers and students also used other software packages. Fifty percent or more teachers reported using planning and CD reference at least once a week. More than 40% of teachers reported not using process tools, blogging, wiki, ebooks, testing and podcasting software at all. Fifty percent of teachers or more reported that their students did not use planning, CD reference, blogging, wiki, process tool, testing, ebook or podcasting software at all. Thirty-five percent of teachers or more report their students use Drill/practice/tutorial, and problem-solving at least once a month.

When looking at digital production software, both student and teacher use is much less frequent. Forty percent of teachers or more report using digital audio, video, and graphics organizer software packages at least once a month. Forty-five percent or more teachers report never using digital audio, video and podcasting software packages. Sixty percent or more teachers report their students never use digital audio, video, podcasting, and digital story telling software. According to 36% or more of the teachers, their students use graphics organizers at least once a month.

Professional Development

Teachers involved with the *Leveraging Laptops* Program from Seminole County had different paths to professional certification. Nineteen teachers came from approved college degree programs, 21 teacher earned college course certification, 8 earned district alternative certification, and 6 transferred from other states.

Teachers reported an average of 13.56 (SD=9.56) years in the education profession, and an average of 5.65 (SD= 4.89) years of using computers in their classrooms for the delivery of instruction.

Teachers involved were certified to teach in many areas including Professional Education (1), Biology 6-12 (14), Business Education 6-12 (2), Chemistry 6-12 (2), Computer Science K-12 (1), Earth/Space Science 6-12 (1), Ed. Media Specialist PK-12 (2), Elementary Education K-6 (8), English 6-12 (1), ESOL (1), Exceptional Student Ed. K-12 (7), Guidance and Counseling PK-12 (1), Health K-12 (1), General Knowledge (1), Marketing 6-12 (1), Mathematics 6-12 (8), Middle Grade English 5-9 (2), Middle Grade Science 5-9 (21), Middle Grades Integrated Curriculum (4), Middle Grade Mathematics 5-9 (16), Physics 6-12 (1), Pre-Kindergarten/Primary PK-3 (1), and Social Sciences 6-12 (2).

Teachers reported acquiring their computer skills from a variety of sources, including as part of their college coursework, professional development, independent learning, interaction with other faculty and staff, distance learning courses, and the teaching and learning summer institutes. Table 1 shows the responses.

Table 1. Source of computing skills.

Computer Skills Source	Not at all	To a small extent	To a moderate extent	To a great extent	Entirely
As part of your college coursework	26%	26%	24%	19%	4%
Professional Development	4%	26%	32%	33%	6%
Independent learning	2%	15%	35%	37%	930%
Interaction with other faculty/staff	0%	30%	37%	28%	6%
Distance Learning courses	59%	20%	11%	6%	2%
Teaching and Learning Summer Institute	0%	26%	24%	19%	32%

Teachers were asked to provide their attitudes towards their professional development opportunities. Table 2 illustrates the responses. Overall attitudes were positive. Ninety percent or more of the teachers either strongly agreed or agreed to each of the positively stated categories.

Table 2. Teacher attitudes toward professional development opportunities.

Professional development opportunities…	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
encourage me to think about how technology can support my teaching goals.	0%	0%	0%	9%	55%
encourage me collaborate with my colleagues on technology integration.	0%	9%	0%	9%	55%

Professional development opportunities…	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
encourage me to think about the contextual factors in my school that support or hinder my technology integration efforts.	0%	0%	0%	18%	46%
help me think about how technology may change my teaching practices.	0%	0%	0%	9%	55%
provide me with relevant knowledge, skills and abilities I can immediately use in my classroom.	0%	0%	0%	9%	73%
encourage me to consider how technology can be used to facilitate student learning of content.	0%	0%	0%	0%	82%
focus on both the technical and instructional skills required to integrate technology.	0%	0%	0%	18%	64%
are traditionally in the form of after school workshops.	0%	0%	9%	46%	18%
are consistent and continual.	9%	0%	0%	27%	46%

Teaching and Instructional Practices: Student-Centered and Tool-based teaching practices

Teachers involved with the *Leveraging Laptops* Program reported the various teaching methods supported by the computers. Table 3 illustrates the responses. Fifty percent or more of teachers involved with the program in Seminole County report using computers for direct instruction, instructional delivery, and as a learning tool/resource one or more times a week.

Table 3. Instructional method supported by computers.

Teaching method	NA	Not at all	Once a month or less	Once a week	Several times a week	Every day
For direct instruction	0%	15%	22%	11%	26%	26%
For team teaching	19%	56%	13%	6%	4%	4%
For cooperative /collaborative learning	2%	15%	4,440%	20%	17%	2%
In centers	17%	44%	26%	7%	4%	2%
For project-based learning	2%	15%	48%	22%	9%	4%
For sustained writing	15%	63%	13%	4%	4%	2%
For sustained reading	15%	65%	9%	4%	2%	6%
For independent inquiry/research	0%	19%	43%	22%	7%	9%
For student discussion/ communication	4%	35%	22%	17%	15%	7%
For instructional delivery	2%	13%	15%	11%	37%	22%
As a learning tool/resource	0%	6%	30%	11%	28%	26%

Teaching method	NA	Not at all	Once a month or less	Once a week	Several times a week	Every day
For student assessment	0%	35%	17%	9%	17%	22%

Support

Teachers responded to a number of survey items pertaining to technical and instructional support. All teachers responded that their schools had on-site computer support specialists with the exception of one stating they were unsure. In the schools involved with the *Leveraging Laptops* Program in Seminole County, from one to three technical support staff members were available with most teachers reporting having one or two. Ninety-one percent of the teachers reported the staff was full-time, and only 4% percent of the teachers reported the computer support specialists were grant-funded. Responses about the type of support provided by the technical staff are shown in Table 4.

Table 4. Teacher perception of technical support.

Teacher perspective	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The on-site computer specialist adequately assists me in problem solving and trouble shooting.	6%	6%	9%	43%	35%
The on-site computer specialist is dedicated to helping teachers.	4%	6%	9%	43%	37%
I have adequate access to our on-site computer specialist.	7%	7%	15%	41%	28%
I have to contact our specialist several times before I get assistance.	19%	39%	20%	15%	6%
Our computer specialist demonstrates techniques to integrate computer technology into classroom instruction.	9%	13%	35%	32%	9%

Student Achievement

The teachers who completed classroom inquiry projects each focused on a different aspect of the effects of classroom technology on student performance. Their questions, data collection methods, and results are summarized in Table 5.

Table 5. District Classroom Inquiry (AR) Topics and Results

Context	– 6th grade science fungus with internet research and presentation
AR Question	– Does the use of in-class laptop technology enable my three Magnet classes of sixth grade science students to more effectively conduct guided internet research about the Amphibian Chytrid Fungus Crisis, and if so, does this in-class technology foster increased critical thinking skills among my students using cooperative learning strategies and the team approach to create power point reports?
Data Collection Methods	– Student Artifacts

Results	– Groups varied in their group dynamic and their skill – It is difficult to make any final judgments about this since the project was interrupted and restarted due to issues beyond my control. – I do believe it is necessary and cost-effective to have this technology, but I also know that it is going to take time to fully actualize the investment made.
Other Outcomes	– Technology and group methods will take time to refine, but are necessary. – Students vary in their preparation to do group work and technical work. – I will keep using this technology and will keep trying. I also will be looking for ways to make the process run more smoothly. – I will offer my principal my recommendations for training other teachers at my school.

Context	– 7th grade science digital stories
AR Question	– Does using laptops and Excel to complete a nutrition activity, traditionally done with paper, pencils and calculators result in increased motivation?
Data Collection Methods	– Survey
Results	– Groups using computers enjoyed the activity more. (On the survey, Group 1 did not have an attitudinal rating over 7 while group 2 had much higher ratings from 7 to 10.) – Open-ended survey responses showed that students preferred computer-related activities because the methods are new and exciting and because of the opportunity to work with friends.
Other Outcomes	– The research indicates that students remain on task better when using laptop computers. – It also indicates that they like learning new things.

Context	– 6th grade science ocean floor modeling with motion sensors
AR Question	– Does small groups of sixth grade Science students using motion detectors to map a model of the ocean floor increase the students' ability to write detailed descriptions of how sonar is used to explore the ocean?
Data Collection Methods	– Student artifacts
Results	– 29% of the students added one detail to their description of how sonar can be used. – 60% percent added two or more details to their description of how sonar can be used. – Small groups of sixth grade Science students using motion detectors to map a model of the ocean floor did increase the students' ability to write detailed descriptions of how sonar is used to explore the ocean.

Other Outcomes	– Laptops give students the opportunity to experience simulations that would not be possible without the technology and software. – These first hand experiences help provide background knowledge for students to base future learning. – Students' writings improved with the use of more vivid vocabulary and detailed descriptions. – I will offer to hold workshops to familiarize my colleagues with the use of laptops and associated hard and software to enhance learning in their classrooms.

Context	– 8th grade physical science with webquests and presentations
AR Question	– Does using laptops to gather information by completing web quests help increase 8th graders understanding of Newton's laws of motion?
Data Collection Methods	– Test scores – Student artifacts – Informal interviews – Anecdotal records
Results	– Only two students knew about Newton's first law of motion on the pre-test. – There were differences in post-test scores based on strategies used (traditional instruction =57%; Webquest =64%, Webquest & student-created presentation = 70%) – The use of laptops both to gather information and present knowledge motivated students.
Other Outcomes	– While using laptops and the Internet are helpful for both motivation and information gathering they can't entirely take the place of textbooks. – I will work with the other teachers on my team to both give them ideas and use their ideas about how to further integrate technology in my lessons.

Context	– 6th grade science weather data with Inspiration
AR Question	– Will using Inspiration improve analysis of data collection with 6th grade gifted students?
Data Collection Methods	– Test scores – Student artifacts
Results	– The students used technology to organize their data used more detail in the written portion of their test. – The average overall test score was 2% higher for the students using technology.
Other Outcomes	– Time and access to technology could be limiting factors to successful technology use.

Context	– 7th grade math with spreadsheet
AR Question	– Will the use of Microsoft EXCEL increase the ease and ability of 7th grade advanced math students in Pre-algebra to analyze data and generate a circle graph?
Data Collection Methods	– Student artifacts

Results	– Student results and attitudes regarding this activity ranged from very positive to negative. – The level of frustration was very high with some of the students who were using the laptops to complete the same activity. In part, this could be attributed to their inexperience in using Microsoft EXCEL, or that they had to share the laptops.
Other Outcomes	– I would restructure this inquiry to provide the students with some time in getting acclimated to the software.

Context	– 7th grade at-risk behavior with probes, doc cam, and laptops
AR Question	– How do the use of Laptops, Elmos and Probes increase the desired classroom behaviors of at risk students in my 7th grade level class?
Data Collection Methods	– Field notes – Reflective journal
Results	– I found that the students were enthusiastic and stayed on task. – Students viewed me as a partner taking direction as a fellow collaborator. – Students also took on ownership of their learning and started directing their own learning – My "At Risk" students who were normally disinterested became very interested in the lessons. They displayed more positive behaviors including taking on leadership roles in a group and helping others.
Other Outcomes	– Technology does reach students who normally tune out of school. – The technology does not eliminate negative behaviors but it does get the students attention – Student lessons were shared in a school fair – I plan to use the skills I have learned to create a project using laptops and other technology on Invasive species to focus learning on a critical problem that faces our state.

Context	– 4th grade gifted math with Blackboard
AR Question	– Can a cooperative group of 4 gifted students (one seventh grade, three eighth grade) achieve mastery of complex mathematical concepts through independent, accelerated study using BlackBoard?
Data Collection Methods	– Test scores – Journals – Student artifacts – Informal interviews – Reflective journals
Results	– This research demonstrates that mastery of a difficult mathematical concept (solution of quadratic equations including use of the quadratic formula and its discriminant) can be attained through independent, accelerated group study. – The availability of assistive technology such as laptops with wireless internet access and the TI 84 calculator proved invaluable in helping these students achieve high results (mid to upper nineties) on their unit tests. – This level of mastery is compared to the results in the rest of the class (teacher assisted learning) which, for any comparable group of 4 students, was 6 to 8 points lower on a simpler test.

Other Outcomes	– Wireless networked laptop assistive technology made it feasible to look at BlackBoard as a vehicle to enable independent study in the appropriate setting during regular class time. – There is still a time investment requirement by the teacher to set up the modules in BlackBoard. However once that is complete, only maintenance will be required for future classes. – I will develop a series of independent study modules in BlackBoard for the acceleration of the mathematically talented students in my Algebra I Honors classes.

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