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Florida's EETT Leveraging Laptops Initiative and Its Impact on Teaching Practices

Kara Dawson and Cathy Cavanaugh
University of Florida

Albert D. Ritzhaupt
University of North Carolina at Wilmington

Abstract

This study measures changes in teaching practices that occurred during a school year that included laptop implementation and professional development. The changes were documented through direct observations of more than 400 classrooms in more than 50 K–12 schools in 11 Florida districts. Trained observers used two valid observation instruments to measure teaching practices and technology use. The Mantel-Haentzel procedure was used to infer statistical differences between fall and spring observations. Observed percentages, means, standard deviations and effect sizes are provided. Results suggest laptop implementation and professional development can lead to increased student-centered teaching, increased tool-based teaching, and increased meaningful use of technology. This research suggests that laptop implementation coupled with professional development may have an immediate impact on instructional practices. (Keywords: laptops, teaching practices, professional development, Florida.)

INTRODUCTION

The Florida Department of Education recently funded 11 districts to implement ubiquitous computing through Enhancing Education Through Technology (EETT) funds. A primary goal of this Leveraging Laptops initiative was to change teaching practices through laptop technology and professional development. Each district was given the autonomy to meet these goals according to its needs. For example, one project focused on improving reading and writing through project-based social studies and science activities while another focused on improving middle school mathematics and science scores via project-based learning and community partnerships (Kemker, 2007). The professional development initiatives in each district involved a combination of statewide technology integration training opportunities (Barron, Hohlfeld, & Hernandez, 2007) and local efforts utilizing a myriad of strategies, including peer coaching, technology coaches, workshops, online modules, and train-the-trainer models (Cavanaugh, DiPietro, Valdes, & White, 2007).

The statewide technology integration training was a four-day Florida Digital Educator (FDE) summer institute. The institutes were offered throughout the summer at several locations around the state, and each participating teacher was required to attend one institute. The purpose of the Florida Digital Educator Program (FDEP) is to support effective integration of technology across the

K–12 curricula through collaborative experiences with student-based technology and digital tools. The intent of the program was to build a common vocabulary across the state among educators regarding the types of project-based learning and collaboration they would expect of their students. Examples of the technology topics included in the institutes were digital video, concept mapping, digital audio, digital portfolio, digital images, and map tools. Separate ongoing research examines and makes recommendations for improvement to the FDE model.

Each district was responsible for conducting a local evaluation to measure its success in meeting its grant objectives. Each district was also responsible for participating in a statewide research plan designed to measure the impact of this funding on the statewide goals. This article reports on the state-level research, focusing on the statewide goal of changing teaching practices in the laptop-infused classrooms.

CONTEXT

The Leveraging Laptops initiative continues Florida's strong tradition of educational technology excellence. Florida has been a leader in educational technology since the legislature funded the Florida Educational Computing Project in 1977 and made instructional technology a permanent division within the Department of Education in 1981 (Dawson, Swain & Baumbach, 2001). Today, the state hosts the Florida Educational Technology Conference (FETC), the largest conference of its kind in the United States. Florida is also home to the Florida Virtual School, several Florida Diagnostic and Learning Resources System (FDLRS) Centers, the Florida Center for Instructional Technology (FCIT) and the Florida Instructional Technology Resource Center (ITRC). Florida has also recently initiated the first statewide effort to offer unified professional development opportunities for teachers throughout the state via the FDE and Master Digital Educator (MDE) programs (Barron, Hohlfeld, & Hernandez, 2007).

The impetus for the Leveraging Laptops funding was a report prepared by the Laptops for Learning Task Force (2004). This Task Force made several recommendations regarding the ways in which laptops should be funded in the state to maximize outcomes, many of which were included in the Leveraging Laptops RFP sent to all 67 Florida districts. The 11 districts selected for funding represented the diversity that is present in public education in Florida. The districts ranged in size from six to 317 K–12 schools representing economies ranging from urban to agricultural.

LITERATURE REVIEW

Successful use of laptops in Australian schools catalyzed their use in the United States. Microsoft's Anytime Anywhere Learning Program (AAL) is considered the father of laptop programs in the United States (Healey, 1999), and recent figures suggest more than 54% of schools have instructional laptops (Market Data Retrieval, 2005). The ways these instructional laptops are deployed in classrooms vary significantly from concentrated use where each student has his/her own laptop for use at home and in school to classroom sets or mobile carts shared by a group of teachers to a dispersed model where there are a few laptops in certain classrooms to laptop classrooms that function similarly to computer labs (Rockman ET AL, 1997).

Likewise, the purposes for implementing laptops vary from school to school and district to district. Common goals include influencing student achievement in specific content areas or across content areas, increasing student-centered teaching practices, positively impacting the digital divide, and improving the home-school connection. Increased technology use and proficiency is the most commonly cited outcome of laptop implementation (Penuel, 2006; Silvernail & Lane, 2004; Walker, Rockman, & Chessler, 2000). Increased student engagement, motivation, attitude, and confidence (Gardner, Morrison, & Jarman, 1993; Rockman ET AL, 1998; Warschauer, 2006); better school attendance (Laptops for Learning Task Force, 2004; Stevenson, 1998); and improved student organization, study skills, and study habits (Warschauer & Sahl, 2002; Warschauer, 2006) are other factors associated with laptop implementation.

Better teacher-student relationships (Fairman, 2004), improved home-school relationships (Russell, Bebell, & Higgins, 2004), bridging the digital divide (Gravelle, 2003), and the perception that laptops provide social and academic benefits for special education students (Harris & Smith, 2004) are other benefits often associated with laptop implementation. Research also widely reports specific changes in teaching practices, including shifts toward more student-centered practices (Fairman, 2004; Henriquez & Riconscente, 1999; Rockman ET AL, 1998; Stevenson, 1998), an increased emphasis on inquiry-based practices (Fisher & Stolarchuk, 1998), an increase in cooperative learning and project-based instruction (Fairman, 2004; Warschauer & Sahl, 2002), and more differentiated instruction (Fairman, 2004).

Despite this seemingly large body of literature related to laptop implementation, few studies are published in refereed outlets (Warschauer, 2006). Most information about laptop implementation comes from evaluation reports relying heavily on perception data, self-reports and/or idiosyncratic methods. The role of the teacher is pivotal to the success of any school technology implementation. Teachers enter the classroom with a wide range of attitudes, experiences, and skills related to teaching with technology. For this reason, professional development requires as much emphasis as the technology in a school technology initiative and in the research into such initiatives. Given the fact that laptop computing initiatives are increasing in number and size (Penuel, 2006) and that public schools are struggling to sustain such programs financially (Warschauer, 2006), the need for quality research related to the effects of laptop integration is of national importance (van't Hooft & Swan, 2007).

Research Question

This article presents components of a larger investigation of the impact of *Leveraging Laptops* funding in 11 Florida districts. The following question guided this research: What changes in teaching practices happen in conjunction with the infusion of laptop technology and professional development?

METHODS

Research Framework

This research uses Hall's (1995) conception of conditions, processes, and consequences to explore the laptop 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, the SRI International evaluation framework informs much of our work. Table 1 outlines the components of our research within Hall's framework and distinguishes between the terminologies used by Hall (1995) and Zucker (2004). The shaded cells represent the research components presented in this article.

Participating Districts

This research involved 447 classrooms across subject areas in 54 K–12 schools in 11 districts. The 11 participating districts represented the diversity that is present in public education in Florida. Three of the districts were large urban districts, four were mid-sized suburban districts, and four were small rural districts.

Data Collection and Analysis

The goal of this research was to assess changes in teaching practices in schools infused with laptop technology through a district wide grant. This assessment involved two direct observations in participating districts. Baseline observations were conducted in the fall near the beginning of the funding cycle, and follow-up observations were conducted in the spring prior to the end of the funding cycle.

In total, nearly 400 hours of direct classroom observations were conducted. Observations took the form of a series of unscheduled three-hour visits to schools in which approximately 10 classrooms were randomly visited for 15 minutes each. The instruments selected were designed to give a snapshot of school practices, not individual teacher practices. The results from schools in each district were then aggregated to form district-wide profiles. This manuscript aggregates data from each district for a statewide profile of the impact of EETT funding on teaching practices. Current research is investigating differences between and among districts, technologies, and professional development strategies. In addition, current research is comparing these statewide results to national norms calculated from other studies using these instruments.

Two data collection instruments were used to conduct these classroom observations, the *School Observation Measure* (SOM) and the *Survey of Computer Use* (SCU). Both instruments are key components of the Formative Evaluation Process for School Improvement (FEPSI) developed by the Center for Research in Educational Policy (CREP) at the University of Memphis. Both are fully developed and validated with a 91–97% inter-rater reliability (Sterbinsky, Ross, & Burke, 2004). All observers attended a one-day training on these protocols and received a manual for future reference. Inter-rater reliability was established for

Table 1: Laptop Research Framework

Conditions (Hall, 1995) Critical Features (Zucker, 2004)	**Processes (Hall, 1995)** Interactions and Immediate Outcomes (Zucker, 2004)	**Consequences (Hall, 1995)** Ultimate Outcomes (Zucker, 2004)
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

these instruments with other groups of trainees taking the same training as our observers.

Florida teachers, administrators, technology specialists, faculty, and graduate students served as observers. The majority of observers were Master Digital Educators, K–12 educators selected by the Florida Department of Education to contribute to statewide technology integration and serve as statewide technology leaders. Observers were assigned to schools based on their locations and availability.

The SOM was developed to determine the extent to which common and alternative teaching practices are used throughout an entire school (Ross, Smith, & Alberg, 1999). The SOM was selected for this study because it includes research-based best practices for enhancing learning through student use of technology. The SCU is a companion instrument to SOM that is designed to capture student access to, ability with, and use of computers. When used in tandem, these two protocols provide an in-depth illustration of technology-infused teaching practices.

The observation results for both SOM and SCU are in an ordinal scale of measurement. In addition, the observations were collected twice: once in fall 2006 (pre), then in spring 2007 (post). Thus, the Mantel-Haentzel procedure was used to infer statistical differences between the pre- and post-classroom observations (Stokes, Davis, & Koch, 2000). Observed percentages, means, standard deviations, and effect sizes were also calculated.

LIMITATIONS

This large-scale study has strength in its reliance on observations rather than self reports, the pre-post design, and the use of tested observation protocols. However, as with any social science study, it is important to mention the limitations of the study:

- The study sought to investigate changes in teacher practices in schools within districts that received funding for laptop technology and professional development. Thus, we only have data related to teaching practices at the school, district, and state levels. We have no data related to the practices of individual teachers.

- The short duration of observations within each classroom may have skewed school-level observation results in some cases; however, the fact that we observed the entire population of teachers participating in the district-wide grant helps to temper this limitation. Likewise, both instruments are nationally normed and widely used, which also helps temper this limitation.
- Some of the observers were affiliated with the schools and districts being observed.
- The inter-rater reliability for the instruments was determined in previous studies involving other groups of observers. While our observers went through the exact same training given by the exact same individuals, the reliability was inferred from previous studies.

RESULTS

School Observation Measure

The SOM results from the fall and spring observations revealed changes in many teaching practices from the baseline to end-of-year observations (see Table 2, pages 149–151). Overall, the greatest baseline to end-of-year differences were seen in increased “High student attention, interest, and engagement” (ES = +1.00, p<.001) and a decrease in the use of traditional “Independent seatwork” (ES = -1.00, p<.001).

Other notable differences include greater use of “Project-based learning” (ES = + 0.93, p<.001), “Teacher acting as coach/facilitator” (ES = + 0.78, p<.002), “Cooperative/Collaborative learning” (ES = + 0.62, p=.010), “Independent inquiry/research” (ES = + 0.63, p=.001), and “High academically focused class time” (ES = + 0.61, p<.005), with a decline in the use of “Direct instruction” (ES= -0.82, p=.001).

Of particular interest are the positive changes in computer use. While use of “Computers as a delivery tool” (a teacher-centered activity) showed a decrease with a medium effect size and no statistical significance (ES= -.40, p =.097), student use of “Technology as a learning tool” (student-centered) showed an impressive increase with statistical significance (ES=+.61, p=.001).

Survey of Computer Use (SCU)

The number of classrooms with “11 or more” computers available for student use increased from 57.1% in the fall to 72.2% in the spring, with 98.1% of the computers observed in the spring considered as “Up-to-date.” There was also an increase (fall = 28.6%; spring = 51.9%) in the percentage of classrooms in which the laptops were used by “nearly all” of the students, as well as an increase in the percentage of students rated with “very good” computer literacy skills (fall = 31.4%; spring = 46.3%) and keyboarding skills (fall = 14.3%; spring = 35.2%). Laptop availability increased during the project (fall = 37.2%; spring = 74.1%).

Students were observed using a variety of computer applications during the multi-class visits, with notable increased usage of three key tools from fall to spring. Specifically, the greatest increase was seen in student use of “Internet Browsers” (fall M

Table 2: School Observation Measure (SOM) Results

The extent to which each of the following was observed in the classroom		Percent Observed			Florida EETT			Mantel-Haentzel	
		0 or 1	2	3 or 4	Mean	SD	*ES*	χ^2	*p*
Instructional Orientation									
Direct instruction (lecture)	Baseline	5.9	20.6	73.5	2.91	0.83	-0.82	10.64*	.001
	Spring	22.3	38.9	38.9	2.19	0.87			
Team teaching	Baseline	94.1	5.9	0.0	0.38	0.60	+0.15	0.52	.471
	Spring	88.9	11.1	0.0	0.52	0.69			
Cooperative/collaborative learning	Baseline	73.6	26.5	0.0	0.85	0.82	+0.62	6.72	.010
	Spring	48.2	33.3	18.5	1.46	1.06			
Individual tutoring (teacher, peer, aide, adult volunteer)	Baseline	82.3	14.7	2.9	0.62	0.85	-0.25	2.05	.153
	Spring	90.7	9.3	0.0	0.44	0.66			
Classroom Organization									
Ability groups	Baseline	85.3	5.9	8.8	0.71	1.12	0.00	.288	.592
	Spring	81.5	5.6	13.0	0.72	1.16			
Multi-age grouping	Baseline	94.1	5.9	0.0	0.21	0.54	+0.30	2.25	.133
	Spring	87.1	9.3	3.7	0.39	0.81			
Work centers (for individuals or groups)	Baseline	94.2	5.9	0.0	0.24	0.55	+0.17	.828	.363
	Spring	94.4	5.6	0.0	0.33	0.58			

(Continued)

Table 2 (cont. from p. 149)

The extent to which each of the following was observed in the classroom		Percent Observed			Florida EETT			Mantel-Haentzel	
		0 or 1	2	3 or 4	Mean	SD	*ES*	χ^2	*p*
Instructional Strategies									
Higher level instructional feedback (written or verbal) to enhance student learning	Baseline	55.9	23.5	20.5	1.35	1.20	+0.17	.865	.352
	Spring	53.7	20.4	26.0	1.61	1.16			
Integration of subject areas (interdisciplinary/thematic units)	Baseline	91.2	5.9	2.9	0.59	0.86	+0.20	2.12	.145
	Spring	79.7	7.4	13.0	0.80	1.11			
Project-based learning	Baseline	79.4	20.6	0.0	0.59	0.82	+0.93	13.6*	<.001
	Spring	50.0	18.5	31.5	1.56	1.33			
Use of higher-level questioning strategies	Baseline	61.8	20.6	17.6	1.26	1.08	+0.25	2.14	.144
	Spring	53.7	16.7	29.7	1.59	1.32			
Teacher acting as a coach/facilitator	Baseline	58.8	20.6	20.5	1.26	1.24	+0.78	9.46*	.002
	Spring	29.7	35.2	35.2	2.19	1.07			
Parent/community involvement in learning activities	Baseline	100.0	0.0	0.0	0.06	0.24	0.00	.441	.507
	Spring	98.2	0.0	1.9	0.13	0.58			
Student Activities									
Independent seatwork (self-paced worksheets, individual assignments)	Baseline	12.7	20.6	64.7	2.68	1.04	-1.00	13.1*	<.001
	Spring	46.3	31.5	22.2	1.69	1.02			
Experiential, hands-on learning	Baseline	73.5	23.5	2.9	0.85	0.89	+0.45	4.57	.033
	Spring	59.2	18.5	22.3	1.35	1.26			
Systematic individual instruction (differentiated assignments geared to individual needs)	Baseline	97.1	2.9	0.0	0.32	0.53	+0.14	.180	.671
	Spring	90.8	5.6	3.7	0.39	0.9			

Sustained writing/composition (self-selected or teacher-generated topics)	Baseline	91.2	5.9	2.9	0.47	0.75	+0.13	.636	.425
	Spring	85.2	13.0	1.9	0.65	0.78			
Sustained reading	Baseline	88.2	5.9	5.9	0.53	0.86	+0.25	.656	.418
	Spring	85.1	14.8	0.0	0.70	0.72			
Independent inquiry/research on the part of students	Baseline	85.3	8.8	5.9	0.76	0.85	+0.63	10.57*	.001
	Spring	57.4	25.9	16.7	1.43	1.02			
Student discussion	Baseline	67.7	32.4	0.0	1.00	0.82	+0.10	1.32	.250
	Spring	59.2	33.3	7.5	1.09	1.07			
Technology Use									
Computer for instructional delivery (e.g. CAI, drill & practice)	Baseline	20.5	55.9	23.5	2.09	0.90	-0.40	2.77	.097
	Spring	38.9	35.2	25.9	1.72	1.12			
Technology as a learning tool or resource (e.g. Internet research, spreadsheet or database creation)	Baseline	58.9	26.5	14.7	1.35	1.15	+0.61	10.42*	.001
	Spring	27.8	35.2	37.0	2.15	1.07			
Assessment									
Performance assessment strategies	Baseline	94.2	0.0	5.9	0.29	0.76	+0.23	0.60	.442
	Spring	87.1	7.4	5.6	0.52	0.86			
Student self-assessment (portfolios, individual record books)	Baseline	91.1	5.9	2.9	0.24	0.70	0.00	.001	.974
	Spring	98.2	1.9	0.0	0.24	0.47			
Summary Items									
High academically focused class time	Baseline	5.9	38.2	55.9	2.59	0.74	+0.61	9.49	.002
	Spring	0.0	18.5	81.5	3.04	0.64			
High level of student attention, interest, engagement	Baseline	14.7	55.9	29.4	2.18	0.72	+1.00	16.99*	<.001
	Spring	1.9	25.9	72.3	2.91	0.73			

Scale: 0 = Not Observed; 1 = Rarely; 2 = Occasionally; 3 = Frequently; 4 = Extensively.

Table 3: Computer Activities by Subject Area Results

Subject Areas of Computer Activities		Language	Math	Science	Social Studies	Other	% Not Observed
Production Tools	Fall	37.1	17.1	34.3	31.4	5.7	22.9
	Spring	74.1	29.6	44.4	40.7	9.3	5.6
Internet/Research Tools	Fall	25.7	11.4	31.4	20.0	2.9	37.1
	Spring	59.3	22.2	44.4	42.6	3.7	14.8
Educational Software	Fall	37.1	20.0	8.6	5.7	2.9	54.3
	Spring	35.2	38.9	24.1	14.8	1.9	35.2
Testing Software	Fall	20.0	2.9	2.9	8.6	0.0	74.3
	Spring	29.6	20.4	16.7	11.1	0.0	53.7

Note: Item percentages may not total 100% because of missing data or activities involving more than one subject area.

= 1.23; spring M = 2.17; ES = +0.80). Students also more frequently used "Draw, paint, and/or graphics" software (fall M = 0.23; spring M = 0.80; ES = +0.70) and "Presentation" software (fall M = 0.77; spring M = 1.50; ES = +0.58).

The use of all types of software applications increased across subject areas (see Table 3). "Production tools" and "Internet/Research Tools" were most frequently used in language followed by science and social studies while "Educational Software" was most frequently used in mathematics followed by language and science. "Testing software" was used moderately in language and sparingly in mathematics, science, and social studies.

The SCU data revealed very positive trends related to the meaningful use of technology based on the following scale (see Table 4).

1. Low level use of computers: activities in general required no critical thinking, e.g., used computer applications for copying text or free-time drawing or used educational software for drill and practice, tutorials, or games.
2. Somewhat meaningful use of computers: activities in general required very little problem-solving or critical thinking and used computer applications or educational software in a limited manner.
3. Meaningful use of computers: activities were problem-based, required some critical thinking skills and some use of computer applications to locate and/or process information or some manipulation of educational software variables to reach solutions.
4. Very meaningful use of computers: activities were based on meaningful problems, required critical thinking skills, and required appropriate use of computer applications to locate and/or process information or manipulation of educational software variables to reach solutions.

The largest gain was seen in the category "Meaningful use of computers" (fall M = 0.94, spring M = 1.87, ES = +0.83, p =.001). Additionally it should be noted that this category was observed Occasionally to Extensively in 59.3% of

Table 4: Meaningfulness of Computer Use Results

Meaningfulness of Computer Activities*		Percent Observed			Florida EETT		Mantel-Haentzel Test		
		0 or 1	2	3 or 4	Mean	SD	ES	χ^2	P
Low level use of computers	Fall	68.6	8.6	22.8	1.17	1.32	-0.36	4.05	.044
	Spring	79.6	14.8	5.6	0.78	0.90			
Somewhat meaningful use of computers	Fall	77.1	22.9	0.0	0.86	0.77	+0.42	1.33	.249
	Spring	48.1	44.4	7.5	1.28	1.05			
Meaningful use of computers	Fall	65.7	25.7	8.6	0.94	1.06	+0.83	10.78	.001
	Spring	40.7	20.4	38.9	1.87	1.26			
Very meaningful use of computers	Fall	91.4	5.7	2.9	0.31	0.72	+0.77	10.71	.001
	Spring	64.8	13.0	22.2	1.11	1.31			

Scale: 0 = Not Observed; 1 = Rarely; 2 = Occasionally; 3 = Frequently; 4 = Extensively.
Note: Item percentages may not total 100% because of missing data.

the spring observations. "Very meaningful use of computers" also had a substantial gain (fall M = 0.31, spring M = 1.11, ES = +0.77, p =.001). Conversely, a large drop was seen in "Low level use of computers" (fall M = 1.17, spring M = 0.78, ES = -0.36, $p < .05$).

DISCUSSION

Nearly 400 hours of observations within the 11 EETT districts suggest the infusion of laptop computing and professional development positively impact teaching practices in at least three ways: (1) increased student-centered teaching, (2) increased tool-based teaching, and (3) increased amounts of meaningful uses of technology. These changes are especially noteworthy given the range of contexts in which these observations occurred and the relatively short timeframe of the study. Current research is exploring how different factors such as technology implementation and professional development strategies, teacher experience, grade level, content area, and socioeconomic conditions impacted the observed changes in teaching practices. Nonetheless, positive changes occurred across a wide range of contexts in a short period of time.

Increases in project-based learning, teacher facilitation, collaborative learning, independent inquiry and decreases in independent seatwork and direct instruction suggest a transition to more student-centered teaching practices. Authentic classroom experiences, including inquiry, collaborative learning, and project-based learning, are strongly related to engagement (Marks, 2000). Thus, student engagement was also observed in significantly more instances during the spring observations. These results are particularly important given the strong correlation between engagement and student achievement (Fredericks, Blumenfeld & Paris, 2004). The fact that this research occurred within a school year suggests that laptop implementation coupled with professional development may have an immediate impact on instructional practices. Current research is exploring impact on student achievement.

Results also revealed increased use of tool-based technologies, such as Internet browsers, draw and paint programs, and presentation software. These results are not surprising given their natural fit with student-centered, project-based learning activities, but the significant shifts to using laptop computers as learning tools and for critical thinking activities are noteworthy. Using computers as learning tools leads to higher levels of student achievement (Schacter, 2000; Wenglinsky, 1998), and fostering critical thinking skills helps support acquisition of 21st-century skills (North Central Regional Educational Laboratory, 2003).

It is important to mention that some areas of instructional practices were unaffected during this study. These include changes in classroom organization and assessment. Very little evidence of differentiated instruction via centers was observed and this stands in direct opposition to Fairman's (2004) study of laptop computing. Differentiated instruction may lead to even higher levels of student-centered instruction and may enable all students to achieve at higher levels (Tomlinson & McTighe, 2006).

Likewise, alternative assessment practices (i.e., performance and self-assessments) remained stagnant throughout this study. New ways of teaching require a corresponding shift in assessment practices. Assessment is typically one of the last components of the teaching and learning process teachers consider when using technology, and explicit guidance is often required. It is also feasible that teachers are entrenched in a world of high-stakes testing, where there is neither time nor reward for the additional commitment required to implement alternative assessment strategies.

While the statewide FDE program was only one component of each district's professional development efforts, it is interesting to note that the areas where the most significant changes occurred (i.e., increased student-centered teaching, increased tool-based teaching, and increased amounts of meaningful uses of technology) were areas of focus for the statewide professional development. Conversely, areas with little to no changes (i.e., classroom organization and alternative assessment) were not emphasized in the statewide FDE training. This suggests the statewide institutes are an important component of the overall professional development efforts in these districts.

Despite the positive trends associated with student-centered and tool-based teaching and meaningful uses of technology, improvements are still needed. Initial observations revealed low levels of student-centered, tool-based teaching and meaningful uses of technology. Thus, despite significant changes observed throughout the course of this study, the overall use of technology tools was not routine. In fact, observed percentages almost always fell within "rarely" to "occasionally" on the 5-point scale.

A number of first-order barriers (Ertmer, 1999) may be at work in the participating schools, such as time for preparation, mandated schedules, the short time frame of the study, and the over-emphasis placed on explicit preparation for standardized tests in many Florida districts. The short term of the statewide professional development also may have been a contributing factor that limited the frequency with which certain teaching practices were observed. Professional development for technology integration is most effective when it extends over a long period of time (Bradshaw, 2002), is immediately relevant to the teachers' context, and is job-embedded (Christensen, 2002; Margerum-Leys & Marks, 2004). The FDE institutes, in their current form, are unable to meet these characteristics. The local professional development initiatives were intended to meet these criteria, but more research is needed to look at these district-level efforts. Likewise, longitudinal studies are necessary to reveal whether technology use continues to increase as teachers become accustomed to these new tools and the associated new teaching strategies.

CONCLUSIONS

This research suggests increased student-centered teaching, increased tool-based teaching, and increased amounts of meaningful uses of technology across a wide range of educational contexts were seen in conjunction with laptop implementation and professional development. However, more research is needed to verify this claim. Our current research is studying how different factors, such as technology implementation and professional development strategies, teacher experience, grade level, content area, and socioeconomic conditions, impacted these observed changes in teaching practices. Our current research is also studying the impact of laptop implementation on student learning, 21^{st}-century skills, behavior, motivation, and engagement. Preliminary results show positive outcomes in each of these areas and suggest the benefits of laptop computing in public schools are numerous.

Likewise, since teachers in this study did not know when they were being observed, results from this study provide insight into the everyday teaching and learning practices of teachers in laptop computing classrooms. Current research is comparing targeted observations, where teachers knew they were being observed, with the unannounced observations used in this study. This will provide valuable information regarding exemplary laptop computing practices.

Teacher educators and providers of professional development in technology should view these results as support for the critical contribution of a cohesive program of professional development to a large-scale classroom technology implementation. The changes in teaching practice indicated in this study were a result of both the presence of on-to-one computing resources and the statewide and local professional development opportunities available to each teacher.

Ideally, other states will follow Florida's lead by making commitments to fund large-scale laptop initiatives, statewide professional development, and statewide research on the impact of these efforts. Then, as a nation, we will have wide-scale research to share with local, state, and national policymakers as they make important decisions about the future of our public schools.

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Contributors

Kara Dawson is associate professor of educational technology in the School of Teaching and Learning at the University of Florida (UF). She serves as program coordinator for the face-to-face and online programs there. Her research relates to investigating innovative ways in which technology supports teaching and learning processes. (Address: Kara Dawson, 2403 Norman Hall, PO Box 117048, Gainesville, FL 32605; Phone: 352.392.9191, Ext. 261; E-mail: dawson@coe.ufl.edu).

Cathy Cavanaugh is associate professor of educational technology at the University of Florida. She has worked in professional development and higher education since 1996, specializing in distance education and technology in K–12 schools. She was a science teacher in Florida and the Caribbean for 14 years. Her publications include books and articles in science education and educational technology. (E-mail: cathycavanaugh@coe.ufl.edu).

Albert D. Ritzhaupt is an assistant professor at the University of North Carolina at Wilmington. His primary research areas focus on the development of technology-enhanced instruction, and technology integration. His publications have appeared in multiple venues, including the *Journal of Computing in Higher Education*, *Behavior Research Methods*, and *Computers in Human Behavior*. (E-mail: aritzhaupt@gmail.com).

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