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Acquiring Teacher Commitment to 1:1 Initiatives: The Role of the Technology Facilitator

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Abstract

Using mixed methods, we examined the impact of technology facilitators (TFs) on teacher commitment to 1:1 initiatives. Findings from quantitative analysis complemented by qualitative analyses suggest teachers benefitted from having TFs assist with the technological integration. Teachers from schools with a TF endorsed attitudes that were significantly more positive toward teaching and student learning with technology. Further, they reported greater use of technology for planning, reported the school infrastructure was of higher quality, and shared normative perceptions toward the school infrastructure. Results suggest that as ubiquitous technology-related initiatives continue to proliferate, schools should consider employing qualified TFs to assist the transition. (Keywords: technology facilitator, one-to-one, 1:1, teacher commitment, technology coach, correlational analysis)

The education landscape has seen an influx of classrooms wherein each student has an Internet-ready device, which "seems to be a harbinger of things to come" (Zucker, 2004, p. 372). Indeed, many schools have fostered 1:1 (one Internet-ready device for each student and teacher) environments that involve infusion of technology into teaching practices and student learning and necessitate fundamental changes to traditional classrooms and schools (Spires, Oliver, & Corn, 2012). Obstacles associated with these changes are among the often-cited complications to which critics allude when questioning the efficacy of the 1:1 model (e.g., Cuban, 2001; Oppenheimer, 2003). Some research has provided support for the 1:1 model (e.g., Bebell & O'Dwyer, 2010; Suhr, Hernandez, Grimes, & Warschauer, 2010). However, critics remain (Weston & Bain, 2010), and ever more pertinent are calls for empirical evidence (e.g., Penuel, 2005; Zucker, 2004) that supports the effectiveness of 1:1 initiatives and identifies factors that influence the extent to which important student, teacher, and school outcomes are realized.

Identifying factors that impact the effectiveness of 1:1 models informs policies and decisions about 1:1 implementation and maximizes positive outcomes offered to various stakeholders (e.g., students, teachers, and administrators). Accordingly, the purpose of this research study was to examine one potential factor that pertains to an important stakeholder: namely, the extent to which a technology facilitator (TF), a technology professional responsible for supporting and coaching teachers, impacts teacher commitment to 1:1 integration. We used a mixed-methods approach to glean an understanding of teachers' perspectives. We analyzed quantitative data to examine whether having a full-time TF impacted various indicators of affective and behavioral commitment. In addition, we analyzed qualitative data to supplement the quantitative analysis. Assessing teachers' perspectives is vital for understanding the impact TFs have on 1:1 initiatives (Solomon, 2005). Teachers are key stakeholders in school initiatives, and their commitment is an important determinant of 1:1 effectiveness (Sarama, Clements, & Henry, 1998).

1:1 Initiatives: A Brief Background

Educators are seeking ways to offer 21st-century education, develop future-ready schools, and prepare future-ready students (North Carolina State Board of Education, 2006). Many schools are adopting models that incorporate educational technologies, including mobile learning (Roschelle, 2003), bring your own device (BYOD; Alberta Education, 2012), and 1:1 computing. The latter-most model has been adopted by numerous states, including Maine (Silvernail & Harris, 2003; Silvernail & Lane, 2004), Pennsylvania (Peck, Clausen, Vilberg, Meidl, & Murray, 2008), and Virginia (Zucker & McGhee, 2005). In fact, nearly 1,000 schools in the United States had adopted this model by the 21st century (Johnstone, 2003). The 1:1 model involves equipping each student and teacher with an Internet-ready device, with an aim of ultimately enhancing teaching and learning (Penuel, 2006). These aims have received some support from research on 1:1 initiatives, including evidence of pedagogical changes and enhanced teaching practices (e.g., Donovan, Hartley, & Strudler, 2007; Mouza, 2008) as well as improved student outcomes (Bebell & O'Dwyer, 2010; Suhr et al., 2010). However, critics still exist (Weston & Bain, 2010), and researchers have alluded to various impediments.

Adoption of the 1:1 model requires change (Spires et al., 2012), and obstacles are inevitable with change initiatives. Decision makers must address both individual (e.g., teacher) and systemic or institutional (e.g., infrastructure) needs to increase the likelihood of success for technology integration (Ertmer & Ottenbreit-Leftwich, 2010; Solomon, 2005). Obstacles in past initiatives have included unsupportive cultures, policies that impeded change, and a lack of school capacity (Blumenfeld, Fishman, Krajcik, Marx, & Soloway, 2000; Fishman, Soloway, Krajcik, Marx, & Blumenfeld, 2001). Additionally, the sufficiency of teacher training and support has been questioned (e.g.,

Cuban, Kirkpatrick, & Peck, 2001; Ertmer & Ottenbreit-Leftwich, 2010). The novelty of 1:1 initiatives, coupled with inevitable shifts in norms and expectations, presents a challenge for teachers trying to adapt (Penuel, 2006). Teachers must assimilate the new technologies, adapt to systemic changes, and modify their teaching practices.

One personnel strategy that may address some of these individual and systemic needs is the employment of a qualified TF—a professional who provides leadership, guidance, and opportunities for professional development (PD). The TF may help teachers augment their technology-related knowledge and skills, enhance teacher commitment to the initiative, contribute to the school's implementation capacity by fortifying the school infrastructure, and create a culture that is supportive of technology adoption (Hofer, Chamberlin, & Scot, 2004; ISTE, 2011).

The Technology Facilitator as Change Agent

According to ISTE (2011), TFs are responsible for helping schools manage change processes. Effective change initiatives require stakeholder commitment (Herold, Fedor, & Caldwell, 2008), and teachers are key stakeholders in the implementation of academic innovation (Ertmer & Ottenbreit-Leftwich, 2010; Sarama et al., 1998). Stakeholders must believe in and commit to the initiative. Important determinants of teacher commitment to technology initiatives include the adequacy of the technological infrastructure as well as the availability of PD, just-in-time technical assistance, and strategic support (Solomon, 2005). These factors increase knowledge, confidence, and normative perceptions toward the initiative, which enable teachers to integrate the technology into their classrooms (Ertmer & Ottenbreit-Leftwich, 2010). The employment of a qualified TF who helps teachers navigate the challenging implementation of a 1:1 initiative and who facilitates the attitudinal and behavioral transition may affect teacher commitment and, ultimately, influence the success of the initiative (Hofer et al., 2004).

The Role of the Technology Facilitator

TF standards developed by ISTE and the National Council for Accreditation of Teacher Education (NCATE) specify that TFs should "teach technology applications; demonstrate effective use of technology to support student learning of content; and provide professional development, mentoring, and basic technical assistance" (ISTE, 2011). According to ISTE, areas of responsibility include planning and designing learning environments and experiences; teaching, learning, and the curriculum; and leadership and vision (see Table 1). According to the North Carolina Department of Public Instruction and State Board of Education, TF responsibilities include three overarching functions: (a) planning and facilitating teaching and learning, (b) planning and facilitating information access and delivery, and (c) planning and facilitating program administration. Specific responsibilities include collaborating

Table 1. ISTE Technology Facilitator Standards

Area of Responsibility	Summary Description
Technology operations and concepts	In-depth understanding of technology operations and concepts
Planning and designing learning environments and experiences	Plan, design, and model effective learning environments and multiple experiences supported by technology
Teaching, learning, and the curriculum	Apply and implement curriculum plans that include methods and strategies for utilizing technology to maximize student learning
Assessment and evaluation	Apply technology to facilitate a variety of effective strategies for assessment and evaluation
Productivity and professional practice	Apply technology to enhance and improve personal productivity and professional practice
Social, ethical, legal, and human issues	Understand the social, ethical, legal, and human issues surrounding the use of technology and assist teachers in applying that understanding in their practice
Procedures, policies, planning, and budgeting for technology environments	Promote the development and implementation of technology infrastructure, procedure, policies, plans, and budgets
Leadership and vision	Contribute to the shared vision for technology integration and fortify an environment and culture conducive to the achievement of the vision

with teachers to develop curricula and lesson plans, modeling technology use and integration, providing access to technology resources, and planning and designing the technology infrastructure. The TF's responsibilities are integral to the effectiveness of technology progression in education settings (ISTE, 2011).

Assessing Teacher Commitment

Scholars characterize commitment as "psychological alignment with, or attachment to, the change rather than just reflecting a favorable disposition toward it" (Herold et al., 2008, p. 347). Change commitment is multifaceted, consisting of affective and behavioral dimensions (Herscovitch & Meyer, 2002; Piderit, 2000; Straub, 2009). Accordingly, to assess teacher commitment, we measure multiple facets of affective commitment: (a) attitudes toward technology in regard to both teaching and student learning, (b) technology-related self-efficacy, and (c) normative perceptions of the technology infrastructure. We also measure two facets of behavioral commitment: (a) technology use for planning and (b) technology use for instruction.

Affective commitment. Affective commitment refers to the attitudinal, motivational, and emotional aspects of commitment, and it is exemplified by individuals who "have the skills needed to implement [the change], are empowered to implement it, are motivated to do so . . . and share the vision exemplified by the change" (Jaros, 2010, p. 81). Affective commitment is evident when teachers have positive attitudes toward the initiative, feel capable

of engaging in change-related behaviors, and undergo a goal- or value-congruence process (Coetsee, 1999).

Attitudes influence the success of change initiatives, which is why "researchers and practitioners have focused on the importance of change implementation processes in shaping employees' attitudes" (Herold et al., 2008, p. 348). Further, "teachers' attitudes and beliefs about technology's role in the curriculum can influence how and when teachers integrate computers into their instruction" (Penuel, 2006, p. 333). TFs may help teachers understand the role that technology plays in the curriculum and assuage barriers, such as a lack of sufficient training, lack of technology-related knowledge and skills, and issues with hardware and software (Corn & Osborne, 2009). In addition, TFs may provide leadership that aligns teachers' values, interests, and goals with those of the initiative. Goal congruence and value alignment are key determinants of whether an individual forms positive appraisals about an initiative and deems it beneficial (Lazarus, 1991).

Self-efficacy influences commitment to change, and resistance "is more likely when the innovation requires the use of computer technology, especially when teachers are not comfortable with the technology" (Sarama et al., 1998, p. 116). Teachers' efficacy perceptions and their confidence using the technology influence their computer use and integration decisions (Hill, Smith, & Mann, 1987; Mueller, Wood, Willoughby, Ross, & Specht, 2008; National Center for Education Statistics, 2000). Theories such as expectancy theory (Vroom, 1964) and the theory of planned behavior (Ajzen, 1991) are predicated on self-efficacy being an important determinant of intentions and behavior. An individual who perceives herself as being equipped to "execute courses of action required to deal with prospective situations" (Bandura, 1982, p. 122) is more likely to engage in, exert effort toward, and persist with an activity (Bandura, 1986). TFs are responsible for demonstrating and modeling technology integration, thus helping teachers learn by example and harness heightened technology-related self-efficacies (Bandura, 1986). In addition, the support, resources, and tools that TFs offer may mitigate situational constraints; even technologically adept teachers will doubt their agency to succeed when faced with barriers. Finally, TFs find opportunities for PD that enhance teachers' knowledge, skills, abilities, and related self-efficacies.

The technology infrastructure is critical to 1:1 success and is "a significant factor in shaping teachers' technology use in the classroom" (Penuel, 2006, p. 333). TFs are responsible for ensuring the adequacy of this infrastructure (e.g., robust Internet access) and for providing necessary resources (e.g., software and hardware). Further, the TF is responsible for cultivating a "shared vision for technology integration and fortify an environment and culture conducive to the achievement of the vision" (ISTE, 2011; see Table 1). Studies have shown this cultural aspect to influence technology adoption (e.g., Ertmer & Ottenbreit-Leftwich, 2010; Somekh, 2008), and it is particularly important for acquiring commitment to the norms and standards that accompany

institutional change. The TF is responsible for establishing an infrastructure conducive to technology adoption and for establishing a shared awareness that an adequate infrastructure is in place. Culture and shared vision are exemplified by homogeneity, or normative perceptions, among teachers toward the infrastructure.

Behavioral commitment. Behavioral commitment to the 1:1 model refers to teachers incorporating educational technologies into planning and instruction. TFs are responsible for staying current with best practices related to technology use and for assisting with planning and implementation of learning environments (ISTE, 2011; see Table 1). TFs are also responsible for collaborating with teachers to develop materials and lesson plans, and they should "assist teachers in using technology to improve learning and instruction" (ISTE, 2011). TFs are responsible for providing just-in-time technical support; indeed, "perceptions among teachers that there is limited access to timely technical support . . . can hinder their integration of technology into the curriculum" (Penuel, 2006, p. 304). Lastly, TFs are responsible for ensuring the availability of resources and PD, both of which help teachers assimilate new technologies into their instructional methods.

Research Questions: Technology Facilitator and Teacher Commitment

Teachers are key stakeholders in the 1:1 model, and their commitment to technology integration is an important determinant of its eventual success. Herein we examine one factor that may affect teacher commitment: whether having a full-time TF at the school influences teachers' affective and behavioral commitment to 1:1 implementation. Accordingly, four key research questions drive this research:

Research Question 1 (RQ 1): To what extent does having a TF influence teachers' attitudes toward teaching and learning with technology?

Research Question 2 (RQ 2): To what extent does having a TF influence teachers' technology-related self-efficacies?

Research Question 3 (RQ 3): To what extent does having a TF influence teachers' normative perceptions toward the school's technology infrastructure?

Research Question 4 (RQ 4): To what extent does having a TF influence teachers' self-reported use of technology for planning and instruction?

Methods

Sample and Procedures

We selected a subset of four schools from a total of 18 high schools that participated in the North Carolina Learning Technology Initiative (NCLTI) because they each employed a full-time TF at T1 and did not employ a full-time TF at T2. The 18 schools included a diverse and representative set of

high schools from across the state of North Carolina, with approximately 9,500 students and 600 school staff. NCLTI was a 1:1 initiative in which every teacher and student received a laptop computer with productivity software (e.g., word-processing tools, presentation software, and monitoring software). Further, the infrastructure included wireless Internet access throughout the schools, and teachers received PD. The objective of the 1:1 initiative was to enhance teaching practices, increase student learning and achievement, and better prepare future-ready students. The focus of this article, examining the impact of TFs on teacher commitment to the 1:1 initiative, furthers our understanding of which factors help schools transition effectively into 1:1 environments.

The sample of four high schools included 75 teachers from spring 2009 (T1; $n = 38$) and spring 2010 (T2; $n = 35$). For all four schools, the 1:1 implementation began 2 years prior to this study, and the schools distributed laptops in November 2007. All four schools were early college high schools (ECHSs), which are schools that blend high school with college, enabling students to simultaneously attain high school diplomas and associate's degrees (Alaie, 2011). We selected these schools because all employed a full-time TF at T1 and, because of budget constraints, none employed a full-time TF at T2. These schools underwent no discernible changes (e.g., change in leadership, teacher turnover) other than the loss of the full-time TF. The four schools are geographically dispersed across North Carolina. The socioeconomic statuses of the districts were generally low—the percentages of students on free or reduced-price lunch generally ranged from 30% to 79%.

We selected all teachers from each of the four schools to participate in the study. We were able to obtain data from 73 of the 75 teachers (97%). The level of education for the sample included bachelor's degree (50.7%), master's degree (39.7%), and one doctorate (1.4%). Teaching experience ranged in years from 1 to 39 ($M = 14.3$, $SD = 11.1$). For gender, 66% identified as female, 23% as male, and 11% as unspecified. In addition to the 11% who did not respond, 69% self-identified as White/Caucasian, 15% as Black/African American, and 1.4% for each of the remaining options (American Indian/Alaskan native, native Hawaiian/other Pacific Islander, Hispanic/Latino, and multiracial).

Measures

Attitudes. We assessed attitudes toward the 1:1 initiative with an 18-item instrument (see Appe) formatted on a 5-point Likert-type agreement scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Nine of the 18 items measured attitudes toward teaching with technology ($\alpha = .94$). This factor consisted of a lead-in ("Please indicate your degree of agreement with the following statements about teaching and laptops"), followed by items such as: "My teaching benefits from laptop use." The remaining nine items assessed attitudes toward learning with technology ($\alpha = .95$).

An example item is: "My students are better able to meet learning objectives when using the laptops."

Self-efficacy. We assessed teachers' technology-related self-efficacies with a 15-item instrument (see Appendix) formatted on a 4-point summated rating scale: (1) I have never done this, (2) I can do this with some help, (3) I can do this by myself, and (4) I can show someone how to do this. Six of the 15 items measured confidence in basic technology skills ($\alpha = .87$), which consisted of a lead-in ("Please indicate your comfort level with the following skills using your laptop provided through the 1:1 project"), followed by items such as: "Format a text document (e.g., set tabs/margins, insert page breaks/tables)." The remaining nine items measured confidence with advanced technology skills ($\alpha = .93$), which are more advanced, sophisticated technology skills. Example items include: "Create and update a Web page" and "Create and update a blog."

Infrastructure (normative perceptions). We assessed technology infrastructure ($\alpha = .88$; see Appendix) with a 5-item Likert-type agreement scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The instrument measured perceptions about the adequacy of the school infrastructure and the degree to which the school provided the necessary support. The scale consisted of a lead-in ("Please indicate your degree of agreement with the following statements about technology infrastructure"), followed by items such as: "The technology infrastructure at my school is adequate to support my laptop use."

Technology use. We assessed technology use with a 14-item instrument (see Appendix) formatted on a 5-point frequency scale ranging from 1 to 5 (never, once per semester, monthly, weekly, and daily). Seven of the 14 items measured technology use for planning ($\alpha = .85$), which consisted of a lead-in ("Since receiving your laptop provided through the 1:1 project, on average, how often have you used it to do the following for planning?"), followed by items such as: "Develop instructional materials (e.g., handouts, tests)." The remaining seven items measured technology use for instruction ($\alpha = .68$) with items such as: "Utilize online textbook resources."

Analysis

We first conducted exploratory factor analysis (EFA; see Table 2) and computed internal consistency reliabilities (Cronbach, 1951). All measures were structurally sound with sufficient reliability (cf. Nunnally, 1978). We then computed descriptive statistics and zero-order correlations among study variables. We estimated point-biserial correlations between study groups (i.e., T1 and T2) and study criteria to assess the impact of having a full-time TF on the respective criteria. The point-biserial correlation indexes the relationship between a dichotomous variable (TF or no TF) and a continuous variable (scale-level scores) and can be interpreted similarly to the often-used Pearson product-moment correlation.

Table 2. Factor Loadings for Study Variables

Construct	Item	1	2	3	4	5	6	7
1. Attitudes toward teaching								
	1	.850						
	2	.841						
	3	.830						
	4	.801						
	5	.823						
	6	.700						
	7	.768						
	8	.778						
	9	.809						
2. Attitudes toward learning								
	1		.917					
	2		.874					
	3		.711					
	4		.894					
	5		.872					
	6		.798					
	7		.777					
	8		.632					
	9		.836					
3. Self-efficacy (basic)								
	1			.747				
	2			.816				
	3			.752				
	4			.555				
	5			.676				
	6			.722				
	7			.548				
4. Self-efficacy (advanced)								
	1				.865			
	2				.873			
	3				.769			
	4				.866			
	5				.921			
	6				.784			
	7				.658			
	8				.430			
	9				.767			
5. Infrastructure								
	1					.847		
	2					.746		
	3					.789		
	4					.797		
	5					.665		
	6					.684		
	7					.943		
6. Use for planning								
	1						.747	
	2						.816	
	3						.752	
	4						.555	
	5						.676	
	6						.722	
	7						.548	

(*continued*)

Table 2. Continued

Construct	Item	1	2	3	4	5	6	7
7. Use for instruction								
	1							.616
	2							.772
	3							.731
	4							.616
	5							.385
	6							.722
	7							.399

Note. $N = 70$. We conducted exploratory factor analysis on all items simultaneously with promax rotation. Items loaded sufficiently ($\lambda_i > .40$) onto their respective factors without cross-loading, which supports the structural validity of the items and scales.

We conducted mean-difference tests across groups in scale- and item-level scores for various outcomes. Significant findings indicate nontrivial differences between having and not having a full-time TF. We also computed percentages of teachers in both groups that indicated agreement ($M \geq 4$) with attitudes and infrastructure, indicated high self-efficacy ($M \geq 3$), and indicated high technology use ($M \geq 4$).

TFs should help develop a culture characterized by technology integration (ISTE, 2011). Established culture manifests itself as homogeneity among group members, or within-group agreement. After determining whether attitudes toward the infrastructure were higher or lower between groups via the aforementioned mean-differences tests, we then examined homogeneity. We first computed an index of absolute consensus, $r_{WG(J)}$ (James, Demaree, & Wolf, 1984), to examine the degree to which sentiment about the infrastructure was shared among teachers. Another index, the intraclass correlation coefficient (*ICC*), is "interpreted as the proportion of observed variance in ratings that is due to systematic . . . differences compared to the total variance in the ratings" (LeBreton & Senter, 2008, p. 822) and is a function of both absolute agreement and relative consistency. Similar to r_{WG}, higher *ICC* values indicate greater homogeneity. Lastly, the average deviation (*AD*) index (Burke, Finkelstein, & Dusig, 1999) captures average deviations among raters; thus, lower values reflect less variability (i.e., greater consensus) among respondents. We calculated the *AD* index around both the mean ($AD_{M(J)}$) and the median ($AD_{Md(J)}$). In sum, the aforementioned within-group agreement indices allowed us to examine whether individual-level data were reflective of a collective perspective, thus allowing us to compare teachers' normative perceptions at T1 and T2.

Mixed-methods research involves the systematic application of both qualitative and quantitative data to capitalize on the strengths of each (Creswell & Clark, 2007; Johnson & Christensen, 2000). We conducted a within-stage mixed-model design (see Johnson & Onwuegbuzie, 2004), wherein we supplemented the quantitative analysis with a qualitative component (via open-ended survey items) in order to complement findings

from the former with corroboration from the latter. We asked teachers to (a) suggest additional support they could use, (b) provide any further comments, and (c) describe barriers and challenges. Content analysis allowed for data-driven "inferences by objectively and systematically identifying specified characteristics of messages" (Neuendorf, 2002, p. 10). This systematic examination guided the extraction of all relevant statements. It is important to emphasize that (a) nothing implicitly or explicitly prompted responses about TFs, and (b) we did not administer items to solicit information specifically about TFs.

Results

Before conducting the primary analyses, we ruled out a potential confound: group differences in computer skill. We compared arithmetic means from a self-reported overall computer skill ("How would you rate your overall skill level in the use of the laptop?"). The mean difference (3.79 and 3.69 for T1 and T2, respectively) was not significantly different from zero ($p = .26$), suggesting that group differences in skill level do not account for group differences in our measures of interest.

We provide means and standard deviations in Table 3, along with scale reliabilities (α) and zero-order correlations. There was a pattern of positive correlations between having a TF and the study criteria: The majority of correlations were within the small to medium range of effect sizes (i.e., .20–.50; Cohen, 1992). Those with a full-time TF reported more positive attitudes toward teaching ($r = .25$, $p = .018$) and learning ($r = .23$, $p = .026$), reported more positive perceptions of the quality of the infrastructure ($r = .36$, $p < .001$), and reported higher use of technology for planning ($r = .21$, $p = .042$).

Mean Difference Testing

Scale level. In Figure 1, we display mean differences between T1 and T2. In Table 4, we provide percentages of teachers who indicated agreement for attitudes toward teaching and learning with technology and for infrastructure ($M \geq 4$), proficiency for self-efficacy outcomes ($M \geq 3$), and high use for behavior outcomes ($M \geq 4$).

Addressing RQ 1, teachers' attitudes toward teaching and learning with technology were higher when having a full-time TF. Both attitudes toward teaching ($p = .018$) and attitudes toward learning ($p = .026$) were significantly higher and less variable for T1 ($M = 4.43$ and $SD = 0.61$, and $M = 4.07$ and $SD = 0.69$, respectively) than they were for T2 ($M = 4.11$ and $SD = 0.70$, and $M = 3.74$ and $SD = 0.73$, respectively). Moreover, 82% and 68% of teachers at T1 indicated positive attitudes toward teaching and learning, respectively, compared to only 68% and 47% at T2.

Addressing RQ 2, neither of the two self-efficacy dimensions was significantly different between T1 and T2. A higher percentage of teachers at T2 (76%) than at T1 (65%) had self-efficacy scale composites indicative of

Table 3. Descriptive Statistics and Correlations

		Full-Time Technology Facilitator			No Full-Time Technology Facilitator										
	Variable	*n*	*M*	*SD*	*n*	*M*	*SD*	1	2	3	4	5	6	7	8
1	Technology facilitator	38	—	—	35	—	—	—							
2	Attitudes (teaching)	38	4.44	.61	34	4.11	.70	.25*	(.94)						
3	Attitudes (learning)	38	4.07	.69	34	3.74	.73	.23*	.78**	(.95)					
4	Use (planning)	37	4.08	.43	34	3.79	.91	.21*	.43**	.33**	(.85)				
5	Use (instruction)	37	3.56	.63	34	3.50	.92	.04	.54**	.42**	.73**	(.68)			
6	Self-efficacy (basic)	37	3.23	.71	33	3.36	.60	–.10	.13	.10	.26*	.28**	(.87)		
7	Self-efficacy (advanced)	35	2.54	.89	30	2.44	.82	.06	.21*	.20	.34**	.41**	.68**	(.93)	
8	Infrastructure	37	4.60	.61	35	4.07	.74	.36**	.74**	.54**	.28**	.39**	.18	.15	(.88)

Note. $N = 65–73$. Parenthetic values are internal consistency reliabilities.
*$p < .05$. **$p < .01$.

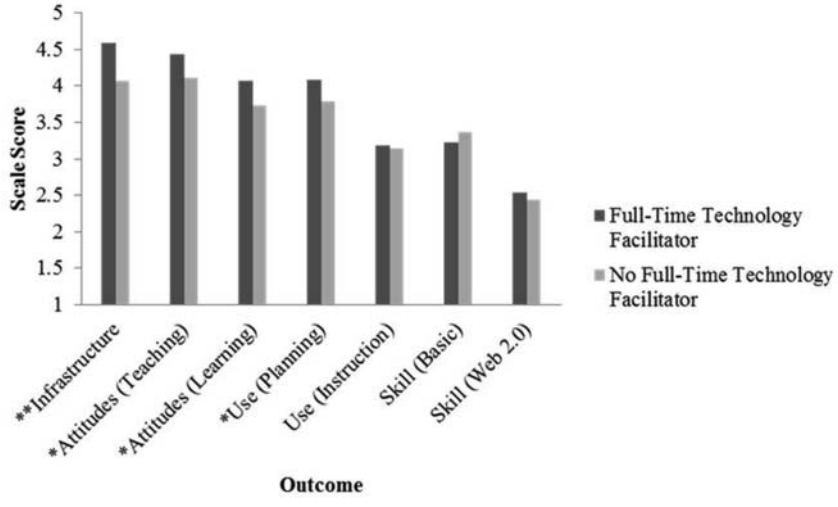

Figure 1. Mean differences in scale scores. *Note.* $N = 64–72$ (n [full-time technology facilitator] = 34–37; n [no full-time technology facilitator] = 30–35). Significance: $^{*}p < .05$. $^{**}p < .01$.

proficiency ($M \geq 3$) for basic technology skills, whereas the opposite is true for self-efficacy with advanced technology skills (T1 = 40%; T2 = 33%).

Addressing RQ 3, teachers provided significantly higher ($p < .001$) ratings for the quality of the infrastructure at T1 ($M = 4.64$, $SD = 0.54$) than at T2 ($M = 4.07$, $SD = 0.66$). This outcome was corroborated by 84% of teachers indicating agreement with infrastructure being sufficient at T1, whereas only 57% indicated agreement at T2. (See Within-Group Agreement subsection in the Results section for additional findings pertaining to RQ 3.)

Addressing RQ 4, the reported use of technology for planning was significantly higher ($p = .048$) and less variable at T1 ($M = 4.08$, $SD = 0.43$) than it was at T2 ($M = 3.79$, $SD = 0.91$); 68% of teachers indicated at least weekly use

Table 4. Percentage of Teachers Indicating Agreement, High Use, or Proficiency

	Full-Time Technology Facilitator		No Full-Time Technology Facilitator	
Variable	*n*	Percent	*n*	Percent
Attitudes (teaching)	38	82%	34	68%
Attitudes (learning)	38	68%	34	47%
Use (planning)	37	68%	34	51%
Use (instruction)	37	27%	34	38%
Self-efficacy (basic)	37	65%	33	76%
Self-efficacy (advanced)	35	40%	30	33%
Infrastructure	37	84%	35	57%

Note. $N = 65–73$.

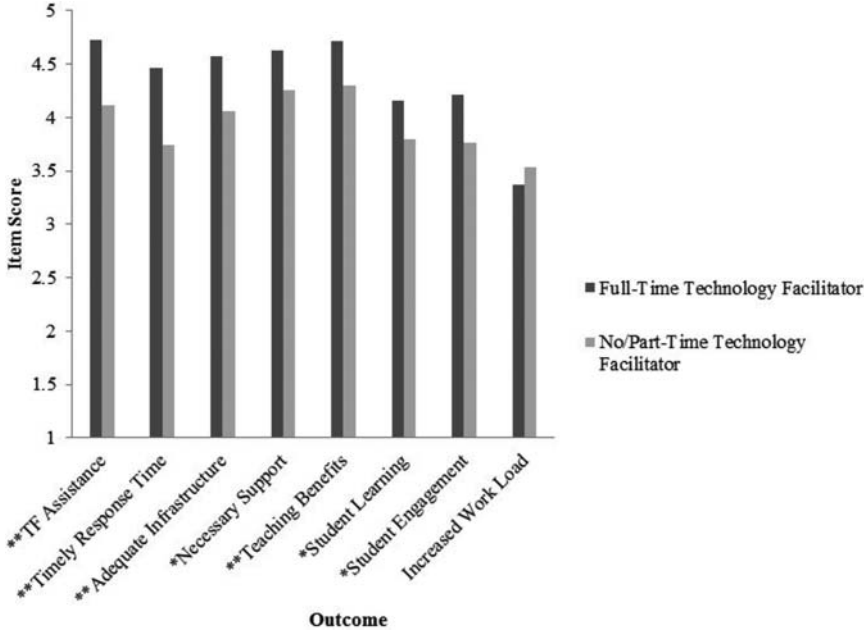

Figure 2. Mean differences in item scores. *Note.* $N = 64–72$ (n [full-time technology facilitator] = 34–37; n [no full-time technology facilitator] = 30–35). Significance: $^{*}p < .05$. $^{**}p < .01$. See Appendix for full list of items.

at T1, as opposed to 51% at T2. There was not a significant difference between T1 and T2 for use of technology for instruction. The percentage of teachers who reported at least weekly use of technology for instruction was actually higher at T2 (38%) than at T1 (27%).

Item level. We preselected items exhibiting particular relevance to the role TFs play in 1:1 schools for item-level analysis (see Appendix). We extracted some items from the scales used in the scale-level analyses, and some were independent of said scales (see Figure 2). Seven of eight items were significantly higher at T1 (full-time TF). Teachers at T1 reported higher agreement that (a) they were provided necessary assistance (T1 = 4.73; T2 = 4.11), (b) response time of technical support staff was timely (T1 = 4.46; T2 = 3.74), (c) infrastructure was adequate (T1 = 4.57; T2 = 4.06), (d) necessary support was provided (T1 = 4.62; T2 = 4.26), (e) teaching benefitted from laptop use (T1 = 4.71; T2 = 4.29), (f) students were better able to meet learning objectives (T1 = 4.16; T2 = 3.79), and (g) students were more engaged (T1 = 4.20; T2 = 3.76). There was not a significant difference between T1 and T2 for whether using laptops increased teacher workload.

Within-Group Agreement

Addressing RQ 3, not only were ratings of infrastructure higher at T1, but all four indicators of within-group agreement (i.e., $r_{WG(J)}$, *ICC*, $AD_{M(J)}$, and

Table 5. Within-Group Agreement about School Infrastructure

IRR/IRA Index	Full-Time Technology Facilitator	No Full-Time Technology Facilitator
ICC_1	.91	.83
$r_{WG(J)}$	.96	.91
$AD_{M(J)}$	.58	.73
$AD_{Md(J)}$	.41	.71

Note. $N = 72$ ($n^a = 37$; $n^b = 35$). $r_{WG(J)}$ = within-group agreement; ICC_1 = intraclass correlation coefficient; $AD_{M(J)}$ = average deviation of the mean; $AD_{Md(J)}$ = average deviation of the median.

$AD_{Md(J)}$; Table 5) reflected stronger homogeneity at T1 (full-time TF). Both $r_{WG(J)}$ and *ICC* indices were higher at T1 (.96 and .91, respectively) than at T2 (.91 and .83, respectively). Both T1 indices were of a magnitude indicative of very strong agreement (see LeBreton & Senter, 2008). $AD_{M(J)}$ and $AD_{Md(J)}$ indices also supported the presence of greater homogeneity at T1 (.58 and .41, respectively) than at T2 (.73 and .71, respectively); greater deviation from the central tendency is indicative of weaker normative perceptions.

Qualitative Analysis

We asked teachers, "What additional support could your school provide to facilitate the use of your laptop for planning and instruction?" At T1, teachers reported the criticality of keeping the TF with statements such as: "Keep the technology facilitator position at the school" and "Keep our technology facilitator here as a permanent position. Can't do this without them!" Comments also referenced the effectiveness of TFs, such as: "My school's [TF] is awesome. . . . She always gives me ideas to use and offers her help in implementing new programs." According to one teacher, the TF is "key in the success of our technology program." The comments provided at T2 complemented those at T1: "We need a full-time facilitator like we had last year," "[Teachers] would appreciate a full-time facilitator to help with trouble-shooting as well as instructional planning," and "We need a full time technology facilitator to support us and provide professional development." (See Tables 6 and 7 for extracted comments.)

In response to the item "Please describe 2–3 major barriers/challenges in using your laptop for planning and instruction," teachers again indicated the necessity of a TF. Teachers at T1 said "I foresee many issues if we lose the facilitator" and "Technology problems on individual computers that require the attention of a tech facilitator." Teachers at T2 also provided comments that alluded to the usefulness of a TF for guiding the technological integration. (See Table 8 and Table 9 for extracted comments.)

In response to the prompt, "Please use the space below to provide any further comments you wish to share," teachers replied:

> The laptops are extremely valuable in the classroom, but only for as long as we have the technical people to "fix" problems. If teachers have

Table 6. T1 Comments about Additional Support

"What additional support could your school provide to facilitate the use of your laptop for planning and instruction?"
We have a fantastic technology [facilitator] . . . none . . . needed.
Continued tech facilitator availability.
Keep the technology facilitator position at the school.
Need to keep our technology facilitator.
This year has gone smoothly. Our tech support is fantastic! They help the teachers and students to keep the laptops up and running. When a problem occurs, they are there to correct it. We are concerned that we may NOT have that support for the coming school year.
The technology facilitator is key in the success of our technology program.
We need to keep our individual technology facilitators. When we rely so much on technology and have a problem, we need someone to help us correct the error so we can move on.
Keep our technology facilitator here as a permanent position. Can't do this without them!
We need to keep our technology facilitators. Without them, we would all be forced to stop instruction 20% of the time to deal with student computer issues.
My school's technology facilitator is awesome. She even comes into my room and helps me teach lessons using the laptops. She always gives me ideas to use and offers her help in implementing new programs.

Table 7. T2 Comments about Additional Support

"What additional support could your school provide to facilitate the use of your laptop for planning and instruction?"
We need a fulltime technology facilitator to support us and provide professional development.
I understand that the teachers who have full time teaching responsibilities (academic areas) would appreciate a full time facilitator to help with trouble-shooting as well as instructional planning.
We need a technology facilitator to help the other teachers. . . . I would like to learn new things to improve my own teaching, and it would be nice to have some "quality" professional development on technology
We could use a full time tech support person.
We need a full time facilitator like we had last year. That was so helpful.
More technicians to come in the classroom and help facilitate student instruction in learning programs.
A tech facilitator.

Table 8. T1 Comments about Barriers

"Please describe 2–3 major barriers/challenges in using your laptop for planning and instruction."
I foresee many issues if we lose the facilitator.
Technical issues with the network, servers, etc. that slow down/inhibit work.
Technology problems on individual computers that require the attention of a tech facilitator.

Table 9. T2 Comments about Barriers

"Please describe 2–3 major barriers/challenges in using your laptop for planning and instruction."
Need a resource person that could help find useful sites.
Access to laptop issues from the computer technicians.

> to stop to help students "unfreeze" computers, or log into networks daily, we would be forced to return to alternate lessons NOT using technology. The technical support staff is imperative to the success of the program. (Teacher, T1)

> I really want to see the laptop program in my school continue, but it is very difficult without a technology facilitator to manage this program. . . . I wish that my school could hire someone to work with the staff—providing professional development one-on-one, team-teaching . . . and so on. We have some great teachers who just need a little encouragement and cheering on in terms of technology integration. Also, our principal has an inspiring vision, but she cannot make everything happen without an extra hand. A technology facilitator is greatly needed here. (Teacher, T2)

Discussion

Research should examine factors that explain how 1:1 initiatives affect teaching and learning (Penuel, 2005; Zucker, 2004). Using mixed-methods research, we examined whether the employment of a TF enhanced teacher commitment to 1:1 initiatives. We examined 1:1 schools in which the only discernible programmatic and school leadership difference was the removal of a full-time TF. Using quantitative methods (complemented by qualitative data), we examined four RQs. Next, we address RQs 1–3 (RQ 2 will follow RQs 1 and 3), all of which address affective commitment. Then we address RQ 4, which addresses behavioral commitment.

RQs 1 and 3 concerned attitudes toward teaching and learning with technology and normative perceptions toward the technology infrastructure, respectively. In general, affective commitment was higher at T1 (full-time TF) than at T2 (no full-time TF). Specifically, attitudes toward teaching with technology (RQ 1), attitudes toward learning with technology (RQ 1), and attitudes toward the school infrastructure (RQ 3) were significantly higher at T1. Moreover, teachers' attitudes toward the school infrastructure demonstrated greater homogeneity at T1 (RQ 3), suggesting that schools with full-time TFs share normative perceptions toward technology implementation and are aware of the infrastructural support for implementing the 1:1 initiative.

One rationale for having TFs in 1:1 settings is that they are responsible for providing continuous support and guidance for teachers. This support includes day-to-day technical support (e.g., resolving hardware or software problems) and instructional support (e.g., incorporating technology into lesson plans), as well as ongoing PD support and planning support (e.g., developing technology-rich lessons). This support should theoretically foster greater positivity toward the change initiative, as teachers grasp the benefits of change, feel capable of engaging in change-related behaviors, and feel protected from barriers and constraints that accompany change initiatives.

In addition, the TF serves a key leadership role, helping to align the values and interests of the teachers with the goals of the initiative.

RQ 2 concerned teacher self-efficacies. Neither self-efficacy with basic technology skills nor self-efficacy with advanced technology skills was significantly different between T1 and T2. The TF should theoretically instill a heightened sense of teacher confidence and self-efficacy by providing guidance and support, opportunities for PD, and resources that increase productivity and efficiency. The finding that schools with TFs did not exhibit heightened self-efficacy has several plausible explanations. First, self-efficacy with basic skills (e.g., formatting a text document) involves simple tasks on which losing a TF likely has inconsequential influence. Basic skills do not typically require technical assistance, do not require as much experience and practice to learn, and if learned at T1 are less affected by skill decay. Second, teachers likely have sufficient exposure to both basic skills and advanced skills at T1, when the TF is responsible for developing teacher skills both directly (e.g., coaching) and indirectly (e.g., providing PD opportunities). Additionally, past successes bolster efficacy beliefs (Bandura, 1986); TFs at T1 should contribute to past successes, thereby exerting enduring influence at T2.

RQ 4 concerned behavioral commitment. Technology use for planning was significantly higher at T1 (full-time TF) than at T2 (no full-time TF). TFs are responsible for helping implement best practices related to technology use and for collaborating with teachers to develop lesson plans that integrate technology. A respondent's comment exemplified this: "[The TF] helps me teach lessons using the laptops. She always gives me ideas to use and offers her help in implementing new programs" (teacher, T1). TFs are responsible for assisting teachers with planning and designing technology-rich instruction. Further, TFs are responsible for providing continuous support and guidance, ensuring that teachers are able to integrate technology into teaching practices. However, differences between T1 and T2 in technology use for instruction were non-significant. A plausible explanation for this finding is that TFs are responsible for developing teachers' technological practices both directly (e.g., demonstration, modeling, and support) and indirectly (e.g., PD opportunities); hence, teachers likely developed concrete skills at T1 that enhanced instructional practices, and this likely transferred to T2. Conversely, technology use for planning is less conducive to transfer, as it requires ongoing support to facilitate a more abstract set of behaviors (e.g., collecting formative assessment data for instructional planning); hence, the significant difference in reported technology use for planning.

Finally, qualitative data provided support for the implication that a TF may be an important factor for 1:1 models. The comments suggested that teachers appreciated the value of having a TF, foresaw issues associated with losing the TF, and recognized the need in the TF's absence. Even though items made no reference to TFs, many comments were directed precisely at this need.

Implications for Practice

Many school districts spend myriad resources establishing and maintaining infrastructures capable of helping teachers and schools assimilate technology. However, access to technology in itself will not transform teaching and learning. To obtain desired results, teachers need to harness supportive attitudes toward, feel comfortable using, and actually incorporate the technology; further, an institutional culture of technology use must be established (Ertmer & Ottenbreit-Leftwich, 2010). Teachers need continuous and timely, technology-focused instructional support to allow these sustainable changes to take place (Public Schools of North Carolina, 2005). Results from this study offer empirical support for the impact that a TF may have on 1:1 implementation. According to Williamson, Redish, and ISTE (2007), in the absence of technology facilitation standards and qualified staff to implement them, "Schools and school districts will fail to realize the potential of modern technologies for learning" (p. 25).

Limitations and Future Research

One limitation was the inability to account for indiscernible changes that occurred contemporaneously with the removal of the TF. However, for each school the only discernible programmatic and school leadership change was the removal of a full-time TF due to budget constraints. Further, past 1:1 initiatives have demonstrated improvements over time (e.g., Cavanaugh et al., 2007; Corn & Osborne, 2009; Peck et al., 2008), so waning outcomes for teachers are at odds with historic trends. Though we acknowledge the possibility of viable alternatives, the most parsimonious explanation is that the absence of a TF impacted both affective and behavioral commitment.

We examined only four schools in one state. Future research should include geographically broader investigations of the implications of this study. Technology initiatives are proliferating in the United States, and several researchers have called for additional studies examining evidence of the utility of the 1:1 model (e.g., Penuel, 2005; Zucker, 2004).

The initiative that we examined was a 1:1 environment where schools provided each student and teacher with a laptop computer. Also existent are other 1:1 environments (e.g., netbooks, tablets, e-books) and technology models (e.g., BYOD). For example, the BYOD model has gained appeal because of reasons such as ubiquitous access to digital content, personal investment and attachment by owners (e.g., students and teachers), and reduced need for training (Alberta Education, 2012). Do the aforementioned benefits of the BYOD model change the dynamic and necessity of a TF? Additionally, it is typically more cost effective for schools to allow stakeholders to bring their own devices rather than deal with supplying and updating school-supplied devices (Alberta Education, 2012). From a policy standpoint, if a school reduced costs by adopting a BYOD model in lieu of a school-supplied devices model, would this free up monies for staffing a full-time TF? It is

reasonable to infer that the TF will affect teacher commitment in generally similar ways regardless of the specific initiative. However, different initiatives offer different challenges, so an important avenue of future research would be to examine the impact of TFs within and across the different models.[1]

The ultimate goal of 1:1 initiatives is to prepare future-ready students by maximizing learning through the incorporation of educational technologies. If students are not using technology and their learning is not benefiting, then the initiative fails to meet the primary objective. Accordingly, future research should examine the impact of TFs on student outcomes.

Conclusion

Effective adoption of change initiatives requires commitment to developing the purpose and process of the initiative with school stakeholders (Fullan, 2003). We found that teacher commitment (affective and behavioral) was related to the presence of a full-time TF. When schools employed a full-time TF, teachers were more positive about the benefits of 1:1 for teaching practice and student learning, were more positive about the technology infrastructure, had positive normative perceptions about the school infrastructure, and reported higher frequency of technology use for planning. These outcomes suggest that TFs may assume an important role in acquiring teacher commitment to 1:1 models. The TF offers support and guidance, provides PD opportunities and resources, and cultivates a climate of teaching and learning with technology by modeling technology use, advocating for technology integration, creating a shared vision among stakeholders, and reinforcing the perception that the fully integrated classroom of the future is not only desirable, but also manageable.

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Appendix

Attitudes toward teaching:

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

Attitudes toward learning:

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

Technology-related self-efficacy (basic technology skills):

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

Technology-related self-efficacy (advanced technology skills):

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

Infrastructure:

- The technology infrastructure at my school is adequate to support my laptop use.
- Software available on my laptop is adequate to meet my educational needs.
- The administrator(s) in my school supports teachers' pursuit of professional development activities geared towards implementing laptops into the curriculum.
- The administrator(s) in my school supports the integration of laptops into my curriculum.
- The technology facilitator in my school has assisted me in finding ways to integrate the laptops into my curriculum.
- The response time of technical support staff at my school to my technology questions or problems is timely.
- My school provided the necessary support to enable me to feel prepared to use my laptop for planning and instruction.

Technology use for planning:

- Develop instructional materials (e.g., handouts, tests).
- Develop homework assignments.
- Assess and grade student work.
- Manage student information.

- Communicate with parents and students; use e-mail and/or other forms of electronic communication to facilitate communication with parents and guardians.
- Collect formative assessment data for your instructional planning.
- Refer to the ISTE National Educational Technology Standards for Students when planning lessons that integrate software and web-based resources.

Technology use for instruction:

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

Items used for item-level analysis:

- The technology facilitator in my school has assisted me in finding ways to integrate the laptops into my curriculum.
- The response time of technical support staff at my school to my technology questions or problems is timely.
- The technology infrastructure at my school is adequate to support my laptop use.
- My school provided the necessary support to enable me to feel prepared to use my laptop for planning and instruction.
- My teaching benefits from laptop use.
- My students are better able to meet learning objectives when using the laptops.
- My students are more engaged when we are using the laptops.
- Using the laptops has increased my workload.

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