

Digitized and Decoupled? Teacher Sensemaking around Educational Technology in a Model 1:1 Program

Stacy Gherardi
University of Illinois at Chicago

This mixed-methods study utilized surveys and interviews to analyze teacher sensemaking in a widely acclaimed 1:1 laptop program in a predominantly low-income, predominantly Latino school district. Quantitative and qualitative measures found that teachers across the district used technology in similar ways and that technology strongly increased differentiated instruction, changed how students accessed knowledge, and had a positive impact on assessment practices; a negative relationship between technology and parent engagement was found. Teacher perceptions of the 1:1 program varied widely and were dependent on both personal and organizational factors. Findings suggested a sensemaking process in which teacher beliefs were often decoupled from their actions in regards to classroom technology; teacher mindset and cohesion between stated values, policy messaging, policy implementation, and administrator actions appeared to contribute to this process. The dynamic analysis of the ways in which staff interpret, implement, and evaluate policies in this setting provides new considerations for the evaluation of 1:1 implementation.

Introduction

Questions around the appropriate role of technology in schools are among the most hotly contested in education today. Ed-tech advocates advance an agenda in which technology has the power to transform instruction and disrupt outdated modes of teaching, learning, and interacting in schools (Dede, 1996; Selwyn, Gorard, & Williams, 2001; Warschauer, 2000; Weston & Bain, 2010). In contrast, many others have noted the historical impotence of technology in creating fundamental change, or cite cost and mixed results as evidence that this supposed panacea is likely to have little meaningful impact on schools (Bahrapour, 2006; Bianchi, 2004; Cuban, 2006; Hu, 2007; Means & Haertel, 2004). The passion with which some school districts have embraced technology without clear empirical evidence of effectiveness (Bebell & O'Dwyer, 2010) inspires strong opinions among stakeholders. While many assert that schools without technology are preparing students for a world that no longer exists, the investment necessary to meaningfully integrate technology into schools in an age of shrinking budgets is difficult to justify, absent concrete evidence of value added (Dunleavy, Dexter, & Heinecke, 2007).

This is especially important given what seems to be the increasingly high expectations placed on technology as a potential lever for change in school. These expectations are reflected in a shift away from understanding technology as a *resource* and toward its reframing as a lever for *paradigm change*. Leading voices in the field of educational technology have increasingly advocated for an approach to implementation which fundamentally alters the nature of teaching and learning in schools, as opposed to replicating traditional methods with new technologies (Darling-Hammond, Zielezinski, & Goldman, 2014; Puentadura, 2010; Weston & Brooks, 2008). Because educational technology, and especially 1:1 technology, has been positioned as a new

paradigm in education, the degree to which teachers reflect this shift, even in high-technology environments, is an important factor to measure in considering outcomes and sustainability.

One potential way to understand teacher paradigm changes is through sensemaking analysis. The term “teacher sensemaking” has been used to describe the complex ways in which teachers come to understand, interpret, and enact policy, both individually and collectively (Coburn, 2001; Coburn, 2004; Weick, 1995). While this represents a key framework for analysis in educational policy, it has not been directly applied to technology implementation. This study examines teacher sensemaking around technology in a highly acclaimed 1:1 program in a suburban school district in a state in the midwestern United States. It seeks to answer the following questions:

- Do the teachers in this school demonstrate a technology-supported educational paradigm shift?
- What is the relationship between teacher opinions of the program and their practices, in the areas of assessment, differentiation, parent engagement, and access to knowledge?
- What personal and organizational factors appear to account for shift or the lack thereof, on teachers’ parts?

These answers provide critical knowledge on the relationship between teacher perceptions and the implementation of technology, the potential for technology to bring about a paradigm shift in teacher thinking, and factors that support or impede such a shift.

Theoretical Framework

These research questions and the theoretical framework for this analysis are largely based upon a modification of a framework proposed by Weston & Brooks (2008), which sought to apply the notion of *paradigm shift* (Kuhn, 1996) to technology. Weston & Brooks (2008) wanted to identify educational constructs likely to be impacted by high-technology environments which might contribute to such a paradigm shift. They proposed that five *critical constructs* could be used to assess paradigm shifts; these included differentiated instruction, ubiquitous access to information, accommodation-learning modality preference, feedback about performance, and engagement of parents (Weston & Brooks, 2008, p. 285). The current study consolidated this framework in order to align the constructs with the commonly used terms at the study site, and terms were modified to reflect a more neutral stance (see Table 1). Weston & Bain (2010) describe the Weston & Brooks (2008) framework using similarly modified categories.

Table 1
Modification of Weston & Brooks Framework

Original Category	Revised Category
Differentiated Instruction	Differentiation
Accommodation Learning Modality Preference	Access to Information
Ubiquitous Access to Information	Assessment
Feedback About Performance	Parent Engagement
Engagement of Parents	

The goal of the current study was to apply knowledge of teacher sensemaking processes to measure potential technology-informed paradigm shifts. Specifically, the study sought to understand whether, in a 1:1 program recognized for its implementation of high-technology practices, teachers made sense of the program and their practices in a way which reflected a paradigm shift in the ways they perceived technology use in the classroom, or, conversely, whether their sensemaking around technology reflected *decoupling* of their paradigm and their practices. Figure 1 aligns the critical constructs, paradigms, and potential sensemaking pathways in the conceptual framework which served as the foundation for this study.

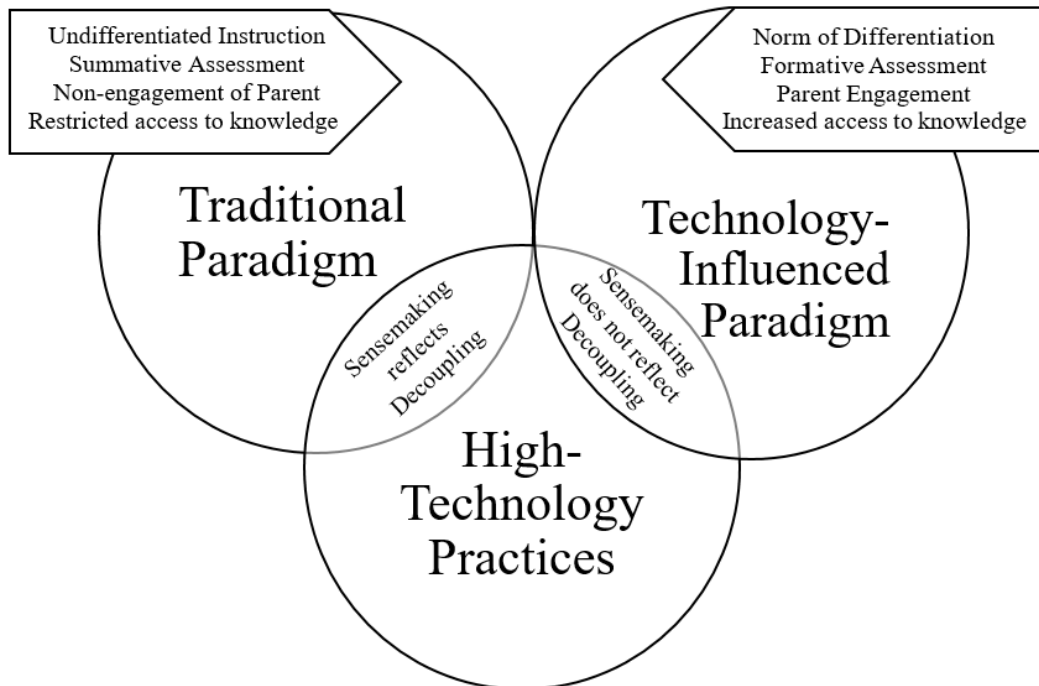


Figure 1. Conceptual Framework

Literature Review

Organizational theory provides several potential mechanisms which seek to explain the relationship between teachers, policies, practices, and attitudes/ beliefs. The model of the “decoupled” or “loosely coupled” classroom has historically served to explain the difficulty with fundamentally changing classroom practice. In this model, individual classrooms and teachers often close themselves off from what are perceived as change-oriented pressures at the school level. Within this framework, teachers may avoid implementation entirely or only *appear* to implement changes in order to meet mandates (Firestone, 1984; Orton & Weick, 1990; Tyack & Cuban, 1995).

Subsequent applications of organizational theory to educational policy questioned or complicated the notion of decoupling. Whereas Bidwell (2001) emphasized the importance of inter-faculty ties, Coburn (2001) explained how teacher responses to policy can reflect a process of “collective sensemaking.” Coburn (2004) argued that decoupling was an over-simplified explanation for a sensemaking process which reflected a complex interaction between teacher

beliefs, practices, and policy messages. And Hallett (2010), found evidence that institutional beliefs and practices can “recouple” themselves in response to new policy environments. These approaches have emphasized the complex ways in which teachers come to understand, interpret, and enact policy both individually and collectively (Coburn, 2004). It is this range of teacher responses to policy that can be broadly referred to as *sensemaking*.

While these studies reflected nuanced models of the relationship between policy, perceptions, and practices, much of the literature around teacher implementation of technology continues to rely upon the notion of a decoupled classroom to explain variability, focusing on what teachers are doing, rather than how they are understanding policy. Implementation studies have situated training, support, monitoring, and clear expectations for technology use as central to success (Apple Computer, 2005; Blazer, 2008; Cooley, 2001; Dunleavy, Dexter & Heinecke, 2007; Dynarski et al., 2007; Penuel, 2006), and it is difficult to argue that these practices are not critical to effective implementation of technology for teachers and classrooms which respond to institutional mandates to adopt technology-oriented instruction.

What is not yet clear is the degree to which a (favorably) technologically-informed paradigm is or must be present in teachers in order to achieve transformation of the educational environment through technology. We must ask whether a teacher who demonstrates an institutionally-mandated use of a computer or program can be said to reflect the paradigm shift that policy-makers are seeking. While Weston and Brooks (2008) found evidence that high-technology environments could reflect an *institutional* paradigm shift, the importance of a technology-influenced paradigm shift at the level of individual teachers was not necessarily established. It is known that teacher attitudes toward technology are likely to impact their use (Baturay, Gökçeşlan, & Ke, 2017; Chen, Looi, & Chen, 2009; Windschitl & Sahl, 2002). Yet, the directionality of this influence is not always clear. While Ravitz & Becker (2000) found evidence that teachers who *self-reported* more student-centered, constructivist approaches to teaching were more likely to use technology in their instruction, Judson’s (2006) *observational* study did not find a relationship between constructivist teaching practices, constructivist teaching philosophy, or practices and attitudes about technology. This finding, that teacher practices and beliefs are not inherently congruent, raises critical questions about technology implementation. While research has not answered the question of whether teachers may demonstrate high use of technology while retaining a more traditional paradigm, Judson’s (2006) works suggests that they may, and suggests the possibility that teacher sensemaking itself is loosely coupled or decoupled from teacher practices in the area of technology.

If teacher-reported beliefs do not reflect observed teacher practices, where else might we look to explain the relationship between what teachers think and do? Here, application of the psychological concept of *mindset* may be informative. Dweck’s (2016) work suggests that individuals who understand their abilities as fixed are more likely to shrink from challenges, whereas those who understand their abilities as having the potential for growth are more likely to become more willing to take risks. Educational reforms, of which technology implementation is certainly one, present one such challenge. It is likely that teacher sensemaking is informed by mindset, to some degree, and that this may help to explain variability in teacher sensemaking in the face of uniformity of practice. This, as well as other relevant factors influencing teacher sensemaking and technology, is explored in the following study.

Much of the early organizational literature around teacher implementation of technology relied upon the notion of a decoupled classroom to explain variability, emphasizing that without adequate training, monitoring, support, and buy in (Brinkerhoff, 2006; Shamburg, 2004; Zhao & Frank, 2003), teachers would fail to fully integrate technology. Teachers could potentially close the door and teach as they always had (Cuban, Kilpatrick & Peck, 2001; Tyack & Cuban, 2000), or utilize technology in ways that had only minimal impact for students (Harris, Mishra, & Koehler, 2009). Studies suggest that technology itself may not bring about changes to pedagogy although it can support teachers who are open to adopting a new approach (Inan & Lowther, 2010; Tondeur et al., 2008, Windschitl & Sahl, 2002).

These findings support the notion that teacher sensemaking is often more complex than simple acceptance or rejection of policy mandates, and involves personal characteristics, such as mindset, as well as network and environmental factors (Coburn, 2004). Sutton and Levinson (2010) called for a sociocultural approach to policy analysis, in which policy is not understood as something that is created and implemented in distinct phases but rather something that is appropriated by teachers (and other actors) in a dynamic process. Such an approach to policy analysis demands deeper analysis of the ways in which policies are presented by administrators, and publicly acted upon and privately understood by teachers. Sensemaking analysis reflects this approach. Within this framework, decoupling or loose coupling may be viewed as one potential model for explaining sensemaking around technology, given that much of the current literature describes the challenges of implementing technology in a way that penetrates traditional teaching practices.

Methodology

Context

This study reports data on teacher sensemaking collected as part of a comprehensive case study of one school district in the Midwest. This district had been recognized as an Apple Distinguished program for their implementation of a 1:1 laptop program over the three years prior to data collection (which occurred throughout 2014). The district consisted of six elementary and two middle schools serving approximately 4,000 students, who were approximately 82% Hispanic, 11 % white, and 3% Black in terms of racial composition. Seventy-eight percent of students qualified for free and reduced lunch and 25% were classified as having Limited English Proficiency.

The district invested heavily, utilizing their reserve funds, to implement the 1:1 program. This investment provided a laptop or iPad for every student in grades k-8 and allowed students to bring their devices home. This occurred despite the reality that the district's per-pupil expenditure was about \$2,500 lower than state averages and nearly \$5,500 less than a large neighboring urban district with similar demographics. The district possessed three characteristics which made it a unique but ideal candidate for study: its demographics, which reflected a largely low-income community of color; its status as high-technology; and its recognition as an Apple

Distinguished program based on both evaluation of its implementation of the laptop program¹ and the general consensus (press attention and numerous visits by other schools and districts to learn more about implementation) that this was a “successful” 1:1 program.

The original case study employed a traditional model for an exploratory single case (Yin, 2009), analyzing sensemaking to explore the relationship between technology and inclusive education. For the purposes of the current study, data which specifically measured teacher sensemaking around the 1:1 program was extracted from the original data set, which included document analysis, an extensive teacher survey, and teacher and administrator interviews. Three relevant sections of the teacher survey and teacher interviews comprised the data set for the current study. Administrator interviews were also utilized to provide context for teacher data.

Data Sources

Survey Data. An online survey was sent to the entire teaching staff in the district. The data presented here drew from three sections of the survey: demographic information, staff use of technology, and opinions about the 1:1 program in the district. The majority of the forty questions required responses using a 5-point Likert scale with responses ranging from 1 (strongly disagree) to 5 (strongly agree). The survey also included one open-ended item asking teachers to more broadly describe their experiences with the 1:1 program, including discussing changes stemming from the program, positive effects, or challenges. Due to the exploratory nature of this survey, factor analysis was not conducted. A copy of the online survey can be found in Appendix A.

The survey was sent to 252 email addresses included on the district’s list serve of certified staff. One hundred six valid responses were obtained after screening out two duplicate responses. This response rate of 42% was higher than the average response rate (33%) for email surveys (Nulty, 2008). Sample size calculations indicate that this response rate yields a margin of error of +/-7.3 calculated at a 95% confidence level. This level of response was considered sufficient given the small population size and exploratory nature of the study. Demographics of survey respondents and comparison to district staff makeup are included in Table 2. Comparison between survey respondents and state-reported staff demographics were within the predicted margin of error for all areas except home schoolers. Because some schools were over or underrepresented in the sample, efforts were made to interview explore school-specific factors in interviews.

Staff Interviews. Survey respondents who were interested in being interviewed for the study were asked to email the investigator directly. Twenty teachers were selected out of 23 interested individuals to represent a variety of grade levels, teaching assignments, and schools; nineteen of these individuals completed the interview process. Demographic characteristics of interview participants are recorded in Table 3. Teachers represented a range of ages and years of experience, although all had worked in the district throughout 1:1 implementation. Interviews lasted 45-90 minutes and were recorded and later transcribed for coding.

¹ Apple Model program status is based on the level of deep integration of technology (Apply technology) and applications as well as teachers who are “highly proficient” in the use of (Apple) technology; they are billed as some of the most creative, innovative schools in the world (Apple Distinguished Program, n.d.)

Table 2
Percent of Survey Respondents by Demographics

Demographic Characteristic	District Staff Reported Demographics (2014 State Data)	Survey Participant Demographics
Racial/ Ethnic Background	%	%
White	91.2	84.7
Black	0.3	0.1
Hispanic/Latino(a)	8.1	10.5
Asian	0.0	0.1
Am. Indian	0.0	0.1
Other	0.0	1.9
Education		
Bachelor's Degree	38.4	32.0
Master's Degree	61.3	66.0
Position		
General Education	47.3	53.8
Special Education	21.7	19.8
ESL/Bilingual	9.2	5.7
Reading Specialist	6.5	3.8
Other Certified Staff	5.9	8.5
Grade Level		
K-1	19.1	18.9
2-3	21.7	19.8
4-5	18.4	17.0
6-8	23.8	20.8
Multiple	18.4	22.6
Current School		
A	11.9	29.2
B	12.6	18.9
C	8.7	1.9
D	9.5	13.3
E	11.5	4.8
F	12.3	12.4
G	13.0	7.6
H	13.9	7.6
Multiple	3.5	3.8

Table 3

Number of Interview Participant Demographics

Demographic Characteristic	Participants
Gender	<i>f</i>
Male	2
Female	17
Position	
ESL/Bilingual	2
General Education (not co-teaching)	4
General Education (co-teaching)	5
Special Education (self-contained)	3
Special Education (co-teaching)	5
Grade Level	
K-1	4
2-3	7
4-5	3
6-8	2
Multiple	3
Current School	
A	3
B	4
C	0
D	6
E	3
F	1
G	2
H	0
Education	
Bachelors	7
Masters	12

Data Analysis

Survey. Survey data was analyzed using SPSS. Frequency percentages for each possible response (ranging from strongly disagree to strongly agree) were reported for items which assessed teacher perceptions of the program overall or perceptions of the impact the program had on assessment, differentiation, parent engagement, or access to knowledge. One correlation between teachers' initial and current opinion of the 1:1 program was run.

Interview Analysis. All interviews were coded using a twofold method for analysis. Each source was initially reviewed for relevant data in two categories: 1) The impact of technology and 2) district approaches to implementation (roll out and support). The first category was divided into sub-categories of access to knowledge, differentiation, assessment, and parent engagement, based on the Weston and Brooks (2008) model. After coding within these categories, a second review of the data took place in order to identify themes which emerged organically. These novel codes fell into the broad categories of "messaging," "training," "recognition," and "mindset,"

with sub-codes reflecting teacher opinions in each area, and were analyzed by frequency to identify key elements of the district's implementation or personal features which shaped teacher sensemaking.

Findings

General Perceptions of Technology

Survey items (Appendix A) 18-22 measured general perceptions of the 1:1 program. Frequency data indicated a relatively low number of teachers who (initially or currently) held outright negative opinions of the program and a small majority (60%) who held explicitly positive opinions. This data also reflected a modest increase (7%) in positive sentiment and a small decrease (3%) in negative sentiment from initial implementation to the time the survey was administered. Correlations were run to determine whether individuals who had more positive initial sentiments would also have more positive current sentiments (or if the opposite was true for individuals with initially low opinions). This correlation was not significant ($r=.178$), suggesting that individuals reflected a change in opinion as a result of the program that was not correlated with their initial perceptions of 1:1 technology. Frequency distributions in other areas of general perception of the 1:1 program are included in Table 4. The number of respondents for these items ranged from 101 to 103.

Table 4

Frequency Distribution: General Perceptions of the 1:1 Program

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	%	%	%	%	%
Positive opinion at introduction	3.9	13.6	29.1	24.3	29.1
Positive opinion at present	2.9	11.4	25.7	36.2	23.8
Adequate tech support/ infrastructure	4.8	16.3	30.8	28.8	19.2
Adequate training	2.9	17.1	27.6	33.3	19.0
Positive impact on academic engagement	1.9	3.9	22.3	48.5	23.3
Positive impact on critical thinking	6.8	17.5	30.1	35.0	10.7
Positive impact on collaboration	6.7	18.3	26.9	36.5	11.5

Teacher interviews suggested they saw instruction as having changed in a generally positive way, although variations in perceptions were noted. Teachers tended to avoid overall assessment of the program as either positive or negative. Instead, they tended to present their positive or negative sentiments by focusing on a particular positive or negative aspect of the program that was especially important to them. Those who appeared to have a positive sentiment would list a number of areas in which things had changed for the better:

It allows me to provide direct assistance to students who are struggling in ways that I could never have done before (Participant 3).

Having the laptops makes it possible to find reading resources, especially for low readers, that would not have been available (Participant 11).

Others were able to point out positive aspects of the program but focused their comments on areas which they saw as less influenced by technology:

Having the computers, our students are really engaged but...Giving a student a device doesn't change the challenges faced by the students in our community (Participant 8).

They help in a lot of ways but I feel like our students are losing out on other areas, especially socially, they just don't know how to interact anymore (Participant 16).

In regards to overall opinion of the 1:1 program, every participant readily identified positive outcomes and changes to their instructional practices, such as increased use of small groups or improved differentiation, as a result of technology. Still, respondents were divided as to whether these positive outcomes warranted an overall positive assessment of the program itself (ten interviewees), whether they reflected helpful but not fundamental changes (six interviewees), or whether they were a distraction from more important issues (three interviewees).

Technology and Assessment

Survey items 37-39 (Appendix A) sought to assess whether the 1:1 program had changed assessment, as well as whether it had contributed to a shift toward formative assessment. Sixty-six percent of respondents agreed or strongly agreed that technology had changed the way they assessed students, and 59% agreed or strongly agreed that the program had improved the use of formative assessment. Data suggested strong agreement that assessment had changed, with slightly less unanimity around the notion that it had become more formative in nature. Table 5 contains survey data relating to assessment. The number of respondents for the items ranged from 101 to 103.

Table 5
Frequency Distribution: Assessment

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	%	%	%	%	%
Changed how teachers assess	1.9	7.8	23.3	43.7	23.3
Improved formative assessment	5.0	11.9	24.8	39.6	18.8
Increased access to formative assessment	5.9	7.9	25.7	38.6	21.8

Open-ended survey items and interviews seemed to suggest more inclination toward the use of formative assessment than survey data. Four of the six principals interviewed strongly suggested that computers had transformed the way they saw teachers assessing student performance, noting a shift toward more project-based learning and new ways of expressing mastery. One administrator expressed frustration that most teachers in her building still relied on traditional tests (even if they were computerized) to assess students. Seventeen out of 19 teachers interviewed expressed the belief that technology had changed the way they assessed students, via the use of technology-based informal assessments such as brief Google forms. They also noted their ability to access significantly more data from instructional computer programs and through the analysis of computer-based summative assessments. In this way, even summative

assessments allowed teachers to use data to inform instruction.

Two interview participants and one open-ended survey response expressed frustration at the limitations of technology-based assessment. This was especially true of online tests which utilized a multiple choice format (as many provided by book publishers did). One teacher stated that it was too easy for students to just click an answer. Another shared a similar sentiment, noting that while she had access to tremendous amounts of data, she frequently did not see a correlation between this data and classroom performance. Some students, she noted, could perform well on a program but could not apply these skills more broadly, while others tended to “click and play” and were more capable than data suggested. Thus, while data was being used to inform instruction, doubts about its reliability were also noted by a few respondents.

Technology and Differentiated Instruction

Survey items assessing teacher perceptions of the impact of technology on differentiation (questions 30-32; Appendix A) reflected some of the highest positive responses and lowest variability of all items. Sixty-eight percent of teachers agreed or strongly agreed that technology had changed the way they differentiated instruction (10.6% disagreed or strongly disagreed), and 69% indicated that differentiation was easier (9.8% did not). Sixty-six percent felt that differentiation was more effective as a result of 1:1, whereas 13.5% did not. Table 6 contains survey data relating to differentiation. The number of respondents ranged from 102 to 103.

Table 6

Frequency Distribution: Differentiation

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	%	%	%	%	%
Changed how teachers differentiate	1.0	9.7	20.4	40.8	28.2
Made differentiation easier	1.0	8.8	20.6	39.2	30.4
Made differentiation more effective	1.9	11.7	19.4	40.8	26.2

Respondents to open-ended survey items identified differentiation more often than any other area as a way in which technology had improved their instruction. Teacher interviews reflected the sense that laptops enabled them to better reach students at a variety of levels and from different linguistic backgrounds (18 out of 19 interviewees). This sentiment was not entirely based on the fact that the laptops provided access to differentiated materials that would have been impossible to use otherwise; it also reflected the idea that highly engaging independent activities on the laptop allowed teachers time to work in small groups or with individuals.

Teachers reporting a shift toward differentiation as a foundation for their instruction represented a variety of teaching positions and grade levels, even within specialized positions such as reading specialists and ESL/Bilingual teachers. However, the strongest statements regarding a shift in this direction came from special education teachers or individuals who had frequent contact with students with disabilities. For the most part, these individuals suggested that they could never provide the access to appropriate resources or the opportunities to direct instruction from a teacher as they do without access to 1:1 technology. As one teacher put it, “you would have to be

superman or an octopus in order to provide that level of tailored instruction” (Participant 7). They also noted ways they were able to provide these supports without having to segregate students based on learning needs.

Even amidst this general support for the impact of technology on teacher ability to differentiate instruction, dissenting voices were heard. One special educator felt strongly that her struggling students did not show growth from computer-based programming and needed more hands-on work. Another felt that she could not rely on technology as a pillar of instruction because the students who struggled often misused the technology.

Technology and Parent Engagement

Survey items 27-29 (Appendix A) assessed teacher perceptions of the impact of technology on parent engagement, and resulted in the most negative responses of all areas measured. Only 32% of teachers felt that the 1:1 program had a positive impact on the way parents engaged with the school, and 28.5% indicated that it had a negative impact. Thirty-seven percent of teachers disagreed or strongly disagreed that the 1:1 program had increased parent engagement and only 43.3% agreed with the idea that technology increased their ability to engage/communicate with parents. Table 7 contains survey data relating to accessing knowledge. The number of respondents for these items ranged from 104 to 105.

Table 7

Frequency Distribution: Parent Engagement

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	%	%	%	%	%
Positive impact on parent engagement	6.7	21.9	39	19	13.3
Increased parent engagement with student education	11.4	25.7	41	14.3	7.6
Increased teacher ability to engage with parents	7.7	19.2	29.8	29.8	13.5

Low levels of support for the belief that technology had increased parent engagement were evident in teacher interviews, though not voiced by administrators. Although two principals discussed the persistent challenge of getting parents involved, they also highlighted the ways in which teachers were using apps and social media to share what was taking place in the classroom with parents. While many teachers also discussed these apps and appreciated the ease of technology-based communication, discussion around whether teachers felt that parents were connected with their child’s education painted a more complex picture. It appeared that while technology increased communication between teachers and parents who were generally well-connected with the school, it did little to engage parents who may have been less connected. Two teachers suggested that technology-based communication had made it more difficult to form deep relationships with parents, and felt that it relieved parents of responsibility as they no longer interacted with school staff in person.

In regards to the ways in which bringing home a laptop impacted parent engagement, no teachers

endorsed the idea that parents were able to see or understand more in terms of their students' progress as a result of the 1:1 program. In fact, the reverse was suggested, with three teachers implying that parents knew less about the work their students were doing than before. One administrator and a majority of teachers expressed concern that parents who were not adept at using the district website or social media were less informed than they had been in the past because schools were no longer sending home paper reminders or homework. While they cited some efforts to meet with parents to help explain the new expectations that went along with the 1:1 program, the loss of paper communication between home and school was described as having a chilling effect on parent involvement for less-connected families. One teacher expressed a more critical view of the way the district had failed to engage many parents, describing the 1:1 initiative as a sort of "Americanization program" in which district leaders could take responsibility for giving technology to "little brown kids" (Participant 4). Although other voices were less critical, there little to no support for the idea that the 1:1 program had increased parent engagement broadly.

Technology and Access to Knowledge

The final aspect of the technology-supported paradigm shift explored by this study relates to the methods, people, and places through which students are able to access knowledge. Items relating to this area (33-36; Appendix A) reflected the highest level of support of any areas measured. Eighty-four percent of teachers agreed or strongly agreed that the 1:1 program had changed the way students accessed and engaged with material. More than 80% agreed or strongly agreed that students were now accessing knowledge in the classroom outside of direct instruction, while 82% agreed or strongly agreed that students were demonstrating knowledge in new ways. A slightly lower number (71%) agreed or strongly agreed that students used their laptops outside of class. Only one teacher (<1%) disagreed with the idea that their students accessed knowledge outside of direct instruction. Table 8 contains the frequency distribution for items assessing access to knowledge. The number of respondents for the items varied between 100 and 105.

Table 8

Frequency Distribution: Access to Knowledge

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	%	%	%	%	%
Changed how students access and interact with material	2.9	4.9	7.8	45.6	38.8
Students use laptops to engage outside of class	2.0	8.0	19.0	44.0	27.0
Students access knowledge outside of direct instruction	0.0	1.0	16.7	46.1	36.3
Students demonstrate knowledge in new ways	1.9	1.9	14.3	43.8	38.1

Despite the fact that quantitative data indicated generally stronger support for change in this domain than others, it was not as frequently or strongly voiced in interviews. This may have been due to what could be construed as overlap between the domains of differentiation and access to

knowledge from the teacher perspective. For example, it is not difficult to see the ways in which a shift toward a highly differentiated classroom with a large amount of independent or collaborative work using technology seems to demonstrate the ability of students to gain and demonstrate knowledge outside of the direct instruction of a teacher.

Several teachers also described approaches to “flipping” their classroom, where students accessed new information independently via their device and then collaborated with a teacher to further their understanding. While two teachers described using such an approach, several others presented it as an ideal or something they feel like they should try but had not yet due to uncertainty about whether it would work for their students. Despite strong survey support for the notion that students could access knowledge outside of direct instruction, teachers did not discuss this as a major aspect of technology-supported change, based on their experience.

Personal Factors Impacting Perceived Impact of Technology

In terms of strict demographic measurement, the most significant factor in determining staff responses to technology appeared to be a background as a special educator or work with students with disabilities. Interview and open-ended survey responses support these findings with strong evidence that, in terms of teaching position, special educators generally reflected a more positive perception of 1:1 technology than teachers in other positions. Other demographic factors did not appear to have a significant effect on overall perception of the 1:1 program.

Interview and open-ended survey responses revealed an unexpected factor impacting teacher responses to technology, namely, the degree to which teachers held a fixed or flexible understanding of what and how students should learn. No specific interview questions elicited this information. However, in the coding process, a novel code “what/how students should learn” emerged and was identified in six interviews. These participants often used the words “should” or “shouldn’t” in regards to what and how students learned, whereas other teachers reflected a sense of discovery in regards to new approaches to instruction. Interview participants who expressed a fixed conception of how they should teach, what they should teach, and what children should do in school tended to resist the notion that technology could or should fundamentally change their classroom, whereas others seemed to gain genuine delight from attempting something new with students. As one teacher shared:

At first I was like, this is not going to work...because they were always like ‘I can’t log on’...but I always try to look at what I can do better...Now, there are just so many things they can do...it’s fun. I don’t know what we used to do (Participant 5).

The emergence of these teacher responses appeared to be supported by Dweck’s (2016) work exploring fixed versus growth mindsets.

Whether this fixed or flexible mindset was a result of personality, education, professional development or all of these is difficult to assess. Code analysis by demographics suggested that neither age nor years of experience were related to mindset, while grade level did initially appear to be a factor. Teachers of early grades universally expressed concerns that 1) the amount of screen time expected was not developmentally appropriate and 2) technology use limited time for important developmental tasks such as drawing, using scissors, and interactive play. While

one could interpret these concerns as reflective of a fixed mindset, data suggests the reality was somewhat more complicated. Even some of the most flexible teachers who otherwise demonstrated a high degree of technology-supported changes in their practice voiced these worries. The question of how much screen time is appropriate for young children appeared to result from a developmentally-oriented pedagogical approach rather than a fixed mindset. Although it did not preclude teachers from adapting new practices, those that did were aware of the unknown consequences of this shift.

Organizational Factors

While this study centered on teacher perceptions of the 1:1 laptop program, several co-occurring district initiatives likely influenced teacher responses. The most significant was a district-wide shift toward center-based reading and math instruction which required the use of a small-group model of instruction. Additionally, a district-wide push to move toward standards-based grading was mentioned by two administrators as supporting the use of technology for formative assessments. Technology and these initiatives appeared to be mutually supportive.

The area of teacher training and development presented a complex picture. While survey sentiments suggested that only 51% of teachers felt they had received adequate training and support to implement 1:1, two individuals in interviews expressed dismay at the fact that *all* development opportunities had become tech-focused at the expense of other areas of learning. One administrator asserted that “No one can say that they aren’t supported in terms of technology” (Administrator 3), referring to the extensive technology-oriented workshops offered by the district. Yet teachers did feel a lack of support, especially in areas relating to curriculum design and Common Core expectations, noting that tech-focused development often taught the use of a new program or app but didn’t provide opportunities to understand or plan new curricula. Three teachers expressed the belief that too much organizational attention had been devoted to the “nuts and bolts” of using computers without an accompanying focus on deeper issues relating to changes in curriculum and the school environment. They felt they had received strong training on how to use specific programs but not in instructional approaches more broadly.

This sense of technology at the expense of other needs also appeared in the statements of teachers who felt undermined by the district’s recognition of staff for their technology use. One teacher reported receiving no positive feedback for doing “very high level work with students” without technology while receiving lavish praise for what she considered “very low level tasks” using a computer. Administrator interviews indicated that this was not an accident and that one of their key approaches to implementing the 1:1 program was to initially allow people to choose to participate and then to highlight the positive things that were happening in these classrooms in order to breed a sense of desire for the technology. While the approach appeared to have had its intended effect, the lack of attention to other areas contributed to a belief shared by seven interviewees that they were largely unrecognized in areas outside of technology.

Discussion

The school district at the center of this study was a strong example of the complexity of measuring policy outcomes on a large scale. Aggregated quantitative measures would suggest a

mild positive impact of technology on teacher perceptions and practices. However, more focused analysis suggested significant variation in this response. When individual survey responses or interview data were reviewed, they did not tend to reflect wholly positive or wholly negative sentiments with the exception of several individuals whose comments in interviews or open-ended survey items often reflected a fairly fixed idea of what and how students should learn. Outside of this group, staff demonstrated a range of responses on different items that likely varied based on their own experiences and the nuances of their position or school environment in ways that this study could not measure.

Despite this variation in perception, 61.8% of teachers reported using computers for at least 60% of their instruction, with 27.6% of those using it for at least 90% of their instruction. This suggests that variance in interpretations of the program were not directly reflective of actual practices involving technology. Patterns of technology use did not reflect a pattern of decoupling from the institutional environment. Whether they did it enthusiastically or hesitantly, teachers were relying on technology for a majority of their instruction.

How, then, can we interpret this variance in perception in the midst of a more uniform approach to implementation? It would be inaccurate to conclude that there had not been a shift toward a new educational paradigm as a result of technology in the district. It is the magnitude and consistency of this shift which is challenging to interpret. On all measures, teachers reported practice changes over the course of implementation although their sensemaking took various pathways ranging from skepticism to ambivalence to enthusiasm. Some teachers reflected dramatic changes in both practices and beliefs around technology, while others reflected no change or even a retreat from this paradigm as time went on. This reality is supported by survey findings that there was not a correlation between pre- and post-implementation opinions of the 1:1 program as a whole, suggesting that teacher perception of technology was changed by the program, but did not change in a consistently positive or negative direction. Whereas some early skeptics became strong advocates of the program, others who were initially open to the changes may have come to feel less positive sentiments.

A closer look at findings, however, suggested that sensemaking responses could be understood as somewhat systematic and even predictable, based on personal and organizational factors. First, findings supported the idea that district approaches to implementation impacted teacher sensemaking significantly and consistently. Second, this data demonstrated that individual teachers adhered to one of two distinct conceptions of what and how students should learn, and that these conceptions were strongly related to their sensemaking around the 1:1 program.

District Messaging

First, code counts in the area of implementation and a review of the areas in which there appeared to be consistent responses suggested that district-wide messaging and emphases influenced teacher sensemaking. This is illustrated by the disparate responses in the areas of differentiation of instruction and parent engagement. Differentiation, which was significantly and consistently identified as an area in which teacher practices had changed and in which a paradigm shift was most apparent, was also consistently identified in administrator interviews as a target of the policy. Indeed, the director of the 1:1 program suggested that the initial impetus was to use computers to support existing efforts at supporting diverse learners and to “level the

playing field” for them. A number of teachers described (sometimes in less than positive terms) the ways in which the district influenced implementation by selectively recognizing teachers who used technology for novel and highly individualized instructional activities. Despite the frustration some expressed with this approach, when coupled with consistent messaging from administration that differentiation was both important and expected, it seemed to yield dividends in a somewhat unified approach to understanding and action in this area.

Contrast this with findings in the area of parent engagement in which the same unity of messaging, values, and policies was not evident. Although administrators reported that parents were more engaged with the use of technology, teacher surveys and interviews suggested a different interpretation. A “one size fits all” approach emphasizing the use of social media and disregarding the realities of parental inexperience with technology, lack of resources to pay technology fees, and lack of internet (in some homes) was noted in administrative interviews and described by teachers. Efforts to make deep connections with parents or to find ways to ensure that they could engage with the new technology were limited, a reality which teachers interpreted as providing more opportunities for engagement for parents who were already highly involved, while further isolating others.

This tendency to respond to perceived misalignment between policy goals and policy outcomes with skepticism was also reflected by the three teachers who could identify positive outcomes of the 1:1 program but felt that it largely distracted from what they saw as more important priorities. For these individuals, the district’s focus on technology came at the expense of areas such as instructional cohesion or programs/policies designed to address the challenging social realities facing the district. The skepticism these teachers reflected in their sensemaking was not a result of the technology itself, but rather a result of their perception of how it did (or did not) fit in with the larger district environment. Had the district been simultaneously addressing the concerns they noted (support for struggling families, more behavioral support for students, more comprehensive approaches to instruction) in a more visible way, it is possible that their response to the program would have been less critical. The sensemaking pathways of these individuals suggested that when teachers sense a lack of alignment between the stated goal of a policy and the values and priorities reflected in the policy’s implementation, they responded with skepticism.

In this way, we might understand decoupling at the teacher level as a result of the decoupling of the expressed values or goals of a policy from the ways in which that policy is implemented. Renee, Welner, and Oakes (2010) described the reality that policy goals are often the first things lost in implementation. In this case, this phenomenon seemed to stem from a lack of coherence between expectations for implementation and the way teachers understood policy goals. For example, despite the goal that laptops going home would allow all students access to learning opportunities outside of school and engage parents in this learning, teachers were critical of the lack of attention to families’ financial realities and parent technology use in the way the program was administered. When teachers detected such a lack of cohesion between this policy goal and the realities of implementation, they responded by retreating into their existing paradigms which largely viewed technology as a resource. Where teachers were presented with a cohesive vision of goals which aligned with actual policy and programming (as appeared to be the case with the area of differentiation), they displayed a greater propensity to adopt a new paradigm which reflected technology as a fundamental lever of change.

Teacher Mindset

The above finding relates closely to the second key conclusion, that teacher mindset regarding what and how students should learn contributed significantly to the ways in which they made sense of instructional technology. For teachers in this study, their understanding of what is “good” teaching and what/how students should learn were either fixed or open to growth (flexible).

The 1:1 program was largely seen as a challenge or disruptive event, although teachers’ responses to this disruption varied. Those with a fixed mindset struggled to see changes to established norms as positive, whereas those with more flexible mindsets tended to interpret new practices not only as interesting, but as improvements. In this way, the more established a teacher’s notion of what and how students should learn (and what/how teachers should teach), the more likely they were to demonstrate decoupling via a skeptical implementation of the program. Decoupling of practice and paradigm was not reported by teachers who demonstrated a more flexible mindset.

In this area school leadership appeared to have an impact. While all administrators demonstrated a positive assessment of the 1:1 program, the ways in which they approached implementation differed. Teachers interviewed at one school generally demonstrated more fixed mindsets and a more negative assessment of the 1:1 program when compared with other schools. School leadership in this setting reflected strong but inflexible support for technology, and use was mandated. The administrator in this school described technology use as an issue of compliance, relating a decision to respond to kindergarten teachers’ concerns about the amount of screen time by giving them the oldest devices in the building. Administrators in other schools reflected a more persuasive approach to encouraging technology use, and adopted a stance of mutual learning, rewarding risk-taking and even “small steps” toward implementation.

It appeared that leaders who themselves modeled a flexible mindset were more likely to see it reflected in their teachers. It is suggested that leadership may have the capacity to influence teacher mindset, thus mediating the ways in which they made sense of policies advanced by administration. This notion is supported by research which recognizes administrators as sense-givers (Ganon-Shilon & Schechter, 2016). Administrators who model a flexible response to the inherent disruption of 1:1 technology make it easier for teachers to interpret their frustrations with a similar openness. Administrators who describe technology in terms of resistance may make it more likely for teachers to interpret the policies in these terms.

Conclusions and Implications

This study sought to provide context for the possibility that the infusion of technology, often through 1:1 and similar programs, has the potential to fundamentally change well-established paradigms in education (Miller, Becker, & Becker, 2016; Weston & Brooks, 2008; Weston & Bain, 2010). It sought to understand whether a “successfully implemented” 1:1 program resulted in such a paradigm shift among its teachers by exploring how they felt about the program generally, how they described the program’s influence on assessment, differentiation, parent engagement, and access to knowledge, and how their practices around technology were related to their perceptions. Finally, it sought to provide potential explanatory mechanisms at the personal

or organizational level which could account for the ways in which teachers made sense of the 1:1 program. Analysis of quantitative and qualitative data yielded three key conclusions: 1) Changes to teacher practices around technology are not necessarily evidence of paradigm shift (some evidence of decoupling); 2) Cohesion in stated values, policy messaging, and policy implementation influences teacher sensemaking around those policies, and 3) The adoption of flexible notions of what and how students should learn mediates a positive response to a technology-informed paradigm.

These findings represent a first step in understanding how technology programs can fundamentally shift educational paradigms. Similar studies in other settings could serve to confirm or dispute the relevance of this single case. Future research which looks more deeply at the issues of policy cohesion and administrator mindset would also provide much needed knowledge. We know quite a bit about what is needed to support teachers' use of technology. We are only just beginning to learn how the use of technology can support more fundamental shifts in education. This data seems to suggest that there is a distinction between teachers engaging in practices which may reflect a new paradigm and actual adoption of that paradigm. While this study found evidence that fundamental paradigm shifts are possible, it also suggests that traditional measures of implementation are not sufficient to measure these shifts. The notion that the proliferation of technology will spontaneously generate a revolution in teaching and learning should be replaced with a renewed focus on alignment of policy, messaging, and administrative actions in order to leverage the potential for technology to bring about change.

Author Notes

Stacy Gherardi is an Assistant Professor of Social Work at New Mexico State University.

Correspondence concerning this article should be addressed to Stacy Gherardi at sgherard@nmsu.edu.

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Appendix A: Survey Questions

1. **By completing this survey, I indicate that I have been informed of the purpose and scope of the study. I give my consent for my responses to be collected and utilized in the manner described above.**
 I agree to participate and give my informed consent
 I do not wish to participate

Demographic Information

2. **How long have you worked in District ----? Please count how many full years you have been in the district- do not include the current year.**
 0-2 years
 2-5 years
 5-10 years
 10-15 years
 15 years or more
3. **What is your current position?**
 General Education/ Classroom Teacher
 Special Education Teacher
 Specials Teacher
 Reading Specialist
 ESL/Bilingual Teacher
 Other _____
4. **How long have you been working in your current position in the district? (i.e., as a teacher, as a reading specialist, etc.)**
 0-2 years
 2-5 years
 5-10 years
 10-15 years
 15 years or more
5. **What grade are the students you work with in? (check all that apply)**
 Preschool
 K-1
 2-3
 4-5
 6-8
6. **What school do you currently work in? (check all that apply)**
 A
 B
 C
 D
 E
 F
 G
 H

7. **How long have you been working at your current school?**
 0-2 years
 2-5 years
 5-10 years
 10-15 years
 15 years or more
8. **Which of the following specific endorsements do you currently hold?**
 ESL
 Special Education
 Elementary
 Middle School
 Other: _____
9. **Which of the following student groups do you work with on a daily basis? (check all that apply)**
 Students with disabilities
 English Language learners
 Low-income students
 Students receiving academic RTI services
 Students receiving PBIS interventions
 Students with a different racial/ethnic background than my own
 Other: _____
10. **Including prior work experience, how many total years of experience do you have in your position or a similar position?**
 0-2 years
 2-5 years
 5-10 years
 10-15 years
 15 years or more
11. **What is the highest level of education you have completed?**
 Bachelor's Degree
 Bachelors plus some additional courses
 Master's Degree
 Doctoral Degree
12. **What language(s) do you speak?**
 English
 Spanish- fluent
 Spanish- conversational
 Spanish- basic
 Other: _____
13. **How would you describe your ethnic background? (check all that apply)**
 White/ Caucasian
 Black/ African American
 Hispanic/ Latino
 Asian
 Native American
 Other: _____

Student Technology Use

For the following items, please provide estimates based on your experiences with your students and technology at home and school. Choose N/A if your position does not allow you to answer the questions (i.e. you do not have assigned students or have access to technology for instruction).

- 14. What percentage of your students have regular access to a computer at home (not provided by the school)?**

0-50
 50-60
 60-70
 70-80
 80-90
 90-100

- 15. What percentage of your students have regular access to internet at home?**

0-50
 50-60
 60-70
 70-80
 80-90
 90-100

- 16. What percentage of your students take their devices home regularly?**

0-50
 50-60
 60-70
 70-80
 80-90
 90-100

- 17. What percentage of your instruction utilizes individual student devices?**

0-50
 50-60
 60-70
 70-80
 80-90
 90-100

1:1 Technology in District

- 18. I had a positive opinion about the 1:1 program when it was first introduced.**

1 Strongly Disagree
 2 Disagree
 3 Neutral
 4 Agree
 5 Strongly Agree

- 19. I felt prepared to implement the 1:1 program when it was first introduced.**

1 Strongly Disagree
 2 Disagree
 3 Neutral
 4 Agree
 5 Strongly Agree

20. **I have received adequate ongoing training to effectively implement the 1:1 program.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
21. **Our school has adequate technical support and infrastructure to effectively implement the 1:1 Program.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
22. **I currently have a positive opinion of the 1:1 program.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
23. **I have seen the 1:1 program have a positive impact on my students' academic growth.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
24. **I have seen the 1:1 program have a positive impact on my students' engagement with academic material.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
25. **I have seen the 1:1 program have a positive impact on my students' ability to think critically and engage in complex tasks.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
26. **I have seen the 1:1 program have a positive impact on my students' ability to work collaboratively.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree

27. **The 1:1 program has positively impacted the way parents engage with school.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
28. **The 1:1 program has increased my parents' engagement with their child's education.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
29. **The 1:1 program has increased my ability to engage with parents.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
30. **The 1:1 program has changed the way I differentiate instruction for students with disabilities and struggling learners.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
31. **The 1:1 program has made classroom differentiation easier.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
32. **The 1:1 program has made classroom differentiation more effective.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
33. **The 1:1 program has changed the way my students access and interact with material.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree

34. **My students use their laptops to engage with material outside of the classroom.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
35. **The 1:1 program has allowed students to access knowledge and engage with material outside of my direct instruction.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
36. **The 1:1 program has allowed students to demonstrate knowledge in new ways.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
37. **The 1:1 program has changed the way I assess student performance.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
38. **The 1:1 program has improved the ways in which I use formative assessment to drive instruction.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
39. **The 1:1 program has allowed me more access to formative assessment of my students.**
____ 1 Strongly Disagree
____ 2 Disagree
____ 3 Neutral
____ 4 Agree
____ 5 Strongly Agree
40. **Please summarize your experience with the 1:1 program. Has it changed your classroom? Your instruction? Your students? Your relationships? If so, how? What are the biggest benefits the program has brought? What are the biggest concerns you have about the program?**