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Promoting Educational Opportunity and Achievement Through 1:1 iPads

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The digital divide between technology-mediated instruction for students in low versus high socio-economic schools is a serious equity issue with repercussions for student learning. While there is a growing body of research on 1:1 mobile devices, including the iPad in K-12 schools, there is little research on the potential of iPads to reduce the disparity of access to high quality instruction and technology experienced by low income, racially and linguistically diverse students.

This three-year, mixed-method study investigated the degree to which a 1:1 iPad initiative in a high poverty, diverse urban high school reduced the disparity of technology access and instructional use and improved student learning across race, class, gender, and academic needs. The technology initiative at Urban High School (pseudonym) was designed to improve access to technology tools and resources and result in improved student attendance and academic achievement by providing an iPad to each student. The study focused on four research questions: 1. What factors influenced student technology access? 2. What factors influenced students' experience and use of technology? 3. How did students use iPads in the classroom? 4. What was the impact of access to an iPad on students' attendance and GPA? The analysis in this article builds on previously reported research from the initial year of the study (Thieman, 2014).

LITERATURE

The district in this study cited the iPad's affordability, ease of use, free and low-cost educational applications and versatility in its grant application [1], justifying its 1:1 iPad investment as a way to address the digital divide in a school where "nearly 80% of the students qualify for free and reduced lunch, 30% meet the federal definition of homeless, 68% are from an identified minority group, and only 37% are completing the necessary credits for graduation" (District, 2010, p. 5). Using an iPad enables students to view teacher-created instructional materials and videos, manipulate and annotate text, take notes, communicate with the teacher, collaborate, create and publish content online. Teachers can monitor student progress and control content-specific applications to meet students' instructional needs (Perry & Steck, 2016).

The Digital Divide

To date there is little research on how iPads can narrow the digital divide in high-quality technology instruction and access experienced by low income, racially and linguistically diverse students (Cotton, Hale, Moroney, O’Neal, & Borch, 2011; Dolan, 2015). Johnson, Adams Becker, Cummins, Estrada, Freeman and Ludgate (2013) forecasted mobile learning as a “near-term horizon” technology to have a large impact and mainstream use in K-12 education and cited the importance of access to these devices as the equalizer for low-income students. According to the U.S. Department of Education (2016) “a digital use divide continues to exist between learners who are using technology in active, creative ways to support their learning and those who predominantly use technology for passive content consumption” (p.5). While this study focuses on a 1:1 iPad initiative, much of the literature on instructional use of digital devices includes other mobile devices as well as laptops.

Despite near universal access to high-speed Internet connections in most public school classrooms (NCES, 2011), the digital divide between the instructional opportunities for students in low and high socio-economic status (SES) classrooms remains. The socioeconomic status of students is a key factor in the gap in how technology is actually used by teachers and student (Banister & Reinhart, 2011; Reinhart, Thomas, & Toriskie, 2011). Researchers found the curriculum and technology taught by teachers in higher SES schools was more intellectually rigorous and provided more opportunity for students to engage in creativity and higher-order thinking such as problem solving and data analysis than curriculum in lower SES schools (DeWitt, 2007; Valdez & Duran, 2007) where teachers tended to use technology for direct instruction (Boser, 2013; Ritzhaupt, Hohlfeld, Wilson, & Dawson, 2016).

The Impact of Technology on Student Learning

More research is also needed on the potential of technology and its measureable impact on K-12 student learning. According to recent federal guidelines (U.S. Department of Education, 2016), the ultimate result of technology integration must be an increase in student achievement. Despite the accelerating purchase of iPads for use in K-12 schools (Cavanaugh, 2014), there has been little rigorous, long-term scholarship on the effectiveness of iPads for learning and teaching (Government of Alberta Minister of Education, 2011; Sung, Chang, & Liu, 2016; Zheng, Warschauer, Lin, & Chang, 2016). Norris, Hossain and Solloway (2012) examined 1:1 laptop initiatives and reported that when computing devices are used as “essential” curriculum tools, student achievement increased; however, when the devices are “supplemental” there is no impact on student learning. Most of the research on 1:1 iPad initiatives in K-12 education focuses on teacher reports of instructional applications of iPads and student reports of engagement and satisfaction (NAACE, 2012; Reid & Ostashewski, 2011; Virginia Department of Education, 2011; Sung et al., 2016). According to a large study of 1:1 initiatives in 19 European

countries, “only a very few identified improved learning outcomes as a project rationale” (Balanskat, Bannister, Hertz, Sigillo, & Vuorikari, 2013, p. 19). However, in a more recent meta-analysis of ten studies on the impact of 1:1 laptop programs, Zheng et al. (2016) found significantly positive average effect sizes in English, writing, math, and science.

Five meta-analyses of published articles on mobile learning provide an overview of research findings in the last decade (Liu, Scordino, Geurtz, Navarette, Ko, & Lim, 2014; Pollara & Broussard, 2011; Sung et al., 2016; Wu et al., 2012; Zheng et al., 2016). Most of the studies were exploratory and conducted on a small scale. Mobile phones, PDAs and laptops were the most widely used devices, and the benefits included increased student achievement, productivity, motivation, and engagement. For example, using 1:1 mobile devices increased student and teacher communication resulting in student skill improvement (Hung, Lin, & Hwang, 2010; Zheng et al., 2016) and more positive student-teacher relationships and greater student motivation (Rau, Gao, & Wu, 2008; Zheng et al., 2016). In one study, 1:1 tablets helped to reduce effects of socio-economic inequalities among elementary students (Ferrer, Belvis, & Palmes, 2011). Using digital text with an iPad supported high poverty students’ technological fluency and creation of more sophisticated learning products, provided differentiation for multiple learning styles, a more supportive reading experience and supported increased student engagement for racially diverse high school students (Lundy 2013).

METHODOLOGY

The research design involved concurrent and interactive quantitative and qualitative data (Creswell & Clark, 2011) on the impact of providing an iPad to 1075 students at Urban High School. Quantitative data sources included student technology experience and use surveys, conducted at the beginning and end of the school year (Appendix A); classroom iPad use surveys conducted throughout the year (Appendix B); and confidential student data including demographics, identified academic needs, attendance and GPA. Qualitative data, including three teacher focus groups (Appendix C) and 29 classroom observations, confirmed and contextualized the survey data and are not detailed in this article.

Participants

The sample includes all possible students who were eligible to receive 1:1 iPads over three years. Implementation of the 1:1 iPad program was different each year in terms of iPad access among students across grade levels, timing of distribution, and professional development for teachers in instructional use of iPads. Thus, the analysis focuses on three grade-level cohorts totaling 1075 students. Cohort A entered as ninth graders (n=412) in 2012-13, continuing as tenth graders (2013-14) and eleventh graders (2014-15). Cohort B entered as tenth graders (n=305) in 2012-13, continuing as eleventh graders (2013-

14) and twelfth graders (2014-15). Cohort C entered ninth grade (n=358) in 2013-14, continuing as tenth graders (2014-15).

The participants in this study were predominantly eligible for free/reduced lunch (87%), students of color (71%), English speakers (64%) and male (56%). Twenty-one percent received special education services while 30% of the students were identified as English Learners.

INSERT [Table 1 Student Demographics All Cohorts] HERE

Procedures and Data Collection

One of the requirements of the district's grant funding was to determine the impact of the 1:1 iPad project on students' access, experiences, and use of technology; students' attendance and GPA; and teachers' attitudes toward and use of technology for instruction. The researcher explained the purpose of the research project to Urban High School teachers, asking for their cooperation with student survey administration, inviting them to participate in a teacher focus group, and asking permission to observe student iPad use in classrooms.

Demographic Data.

The district provided confidential education data including student identification number, demographics, home language, special education status, GPA, and attendance rates. Incomplete district data were later matched to state data for the analyses.

Student technology experience and use survey

Students completed the online Student Technology Experience and Use Survey (Appendix A) at the beginning and end of the school year in their classrooms, including self-report of overall proficiency and satisfaction with use of the iPad. Student experiences included questions on the helpfulness and ease of using the iPad for academic tasks at school and the frequency of iPad use at school and at home for various tasks. Responses were reported on a four point Likert scale. The percent of students who completed the survey at least once ranged from 54% (n=306) in 2012-13, to 68% (n=668) in 2013-14, and 30% (n=245) in 2014-15.

Classroom iPad use survey.

Beginning in January, 2013, Urban High School teachers were encouraged to have students complete a brief online survey of their iPad use at the end of each class when iPads were used for instruction (Appendix B). The survey included 32 different iPad applications and 16 purposes for using the iPad in class. Students checked each of the iPad applications they used during the period and the purpose of using the technology, such as reading, writing, doing research, creating presentations, accessing references. In year one, 167 students completed the Classroom iPad Use Survey at least once

(response rate, 29%; 664 surveys). In year two, 305 students completed the survey at least once (response rate, 35%; 1280 surveys). These 1944 surveys provide only a snapshot of how some students used iPads. When conducting classroom observations, the researchers noted that frequently students might use iPads for classwork but did not complete the survey.

Teacher focus groups.

In spring of 2013 and 2014 eleven teachers representing English, ESOL, math, science, social studies, and technology participated in three separate 60 to 90-minute focus groups (Appendix C) after school. Five of the teachers were considered by the school administrator and technology TOSA to be early technology adopters who had explored and used iPads in a variety of ways with their students. Each confidential focus group was taped and transcribed. Questions included strengths and limitations of the iPad project; potential impact on student engagement, learning, behavior, and attendance; and the extent to which the project reduced disparity of access and promoted differentiation.

Classroom observations.

Twenty-nine observations were conducted in fourteen classrooms. Observation notes focused on the teacher and student role in each major activity, paying attention to when and how the teacher and/or students were using iPads or other technology. Classroom observation data provide context for the student surveys and teacher focus group data and are not reported in detail here.

Data Analysis Procedures

In addition to standard tests of differences (chi square, t-tests), linear and logistic regressions were conducted for cross-sectional analyses, and longitudinal HLM analyses (linear and logistic) were conducted for analyses with three years of data.

Research question 1 investigated the factors that influenced student access to technology each year and across three years. Chi square analyses were conducted to determine if there were significant differences by grade level, gender, race/ ethnicity, home language and identified academic needs between the two student groups: those who checked-out a Take Home iPad (THP) and those who did not. Logistic regression was used to assess the odds of a student having a THP in each year controlling for demographics and academic needs; linear regression predicted factors associated with more years of THP access.

Research question 2 explored the influence of having a THP on students' technology experience and use (Appendix A). The researchers hypothesized that students who were assigned a THP and could use it throughout the school day and at home would report greater satisfaction, proficiency, ease of use and helpfulness of the iPad than students who could only use technology in the classroom when prompted

by the teacher. A *t* test was used to compare the means for the two groups to determine if the differences reported on the survey were statistically significant. Logistic regression was conducted to predict the odds of student satisfaction and frequency of using the iPad outside of school, after controlling for THP status, student demographics and academic needs.

Research question 3 investigated the hypothesis that students who were assigned a THP would report greater use of iPads in their classes, using more applications and for a greater variety of purposes. The researchers created an index of the number of reported technology applications and an index of the number of iPad uses on the Classroom iPad Use Survey (Appendix B). A *t* test was used to compare the means for the two groups to determine if the differences in technology use reported by students who had a THP and those who did not were statistically significant. After controlling for demographic and special program categories, technology use data were regressed on Technology App Index and the Technology Use Index each year.

Research question 4 examined the influence of access to a THP on students' attendance and GPA. The researchers hypothesized that students who were assigned a THP and could use it throughout the school day and at home would have a higher GPA and higher attendance rate than did students who could only use technology in the classroom when prompted by a teacher. A series of *t* tests compared the means for the two groups to determine if the differences in average attendance rate and GPA between students who had a THP and those who did not were statistically significant. Regression analysis explored the relationship between THP access, attendance and GPA while controlling for demographic and special program categories.

RESULTS

Equity of Student Access to Technology

Distribution of 1:1 iPads differed each of the three years due to changing requirements and staff availability to support iPad checkout, differences in communication with parents and students, and administrative support. In the first year, only 30% of the ninth and tenth grade students (169) were assigned a THP; the remaining 70% were assigned an iPad on a cart in one of the humanities classes for use at teacher discretion. In the second year, iPad distribution was timely and well organized; 43% (458) of ninth through twelfth graders had a THP to use at school and at home. Similarly, in 2014-15 43% (437) of students checked out a THP.

Research Question 1 examines the factors that influenced student access to technology. The district's goal was for every student to have a Take Home iPad (THP) that could be used by the student

throughout the school day and at home. Students who lacked parent permission/fee payment for the THP could use an iPad in the classroom, when directed to do so by the teacher. Students who were eligible for free/reduced lunch could request a fee waiver, but parent permission was still a requirement to check out a THP. According to the special education case manager, access to a 1:1 iPad was frequently provided in students' IEPs. Statistical analysis was conducted to determine if there were significant differences each year between the two groups (students with and without a THP) by grade level, gender, race/ethnicity, home language, poverty rate, special education status, and enrollment stability. Table 2 shows that equitable access to a THP was inconsistent.

INSERT [Table 2 Assignment of Take Home iPads (THP) by Student Category] HERE

There were significant differences in iPad access. In all three years ninth graders were statistically more likely to have a THP than tenth graders. In years two and three, white students and those identified as academic priority (a district category and proxy for poverty) were statistically more likely to have a THP.

Logistic regression was used to assess the odds of having a THP each year after controlling for student demographics, special program status, and enrollment stability.

INSERT [Table 3 Access to a THP Across All Three Years] HERE

Across all three years, females, ninth graders, white students, those eligible for free/reduced lunch, and those with no school enrollment changes during the school year were more likely to have access to a THP. Linear regression predicted the factors associated with more years of access to THP; four variables were significant. Students who were white ($b=.209$, $p < .01$); high poverty ($b= .235$, $p < .001$); English speakers ($b= .177$, $p < .01$) and students with stable enrollment at Urban High School had more years of access to a THP ($b= .366$, $p < .001$).

Student Technology Experience and Use

Research question 2 focuses on student responses to the Student Technology Experience and Use Survey (Appendix A) administered at the beginning and end of each year (n-1219).

The survey included self-report of overall proficiency, satisfaction and use of the iPad for various academic tasks. A test of difference was used to compare the means for the two groups to determine if the differences between students who had a THP and those who did not were statistically significant.

INSERT [Table 4 Technology Satisfaction, Proficiency, Helpfulness and Frequency of Use Compared to iPad Assignment] HERE

Table 4 indicates that in all three years, students with a THP had significantly higher mean scores for satisfaction and proficiency with technology, helpfulness of the iPad for doing academic tasks, and

greater frequency of iPad use outside of school for academic tasks than students without an individually assigned iPad. In the second and third years of the study students with a THP also had significantly higher mean scores for ease of use of the technology, and greater frequency of use of the iPads than students without a THP.

Logistic regression confirmed that across all years students having THP access during the year, compared to those who did not, were more likely to have more positive attitudes (OR = 2.0 [1.41, 2.91]), greater ease of technology use (2.0 [1.40, 3.02]), find iPads more helpful for academic tasks (OR = 1.7 [1.17, 2.35]), use technology more frequently in school (OR = 3.4 [2.46, 4.77]), and out of school (OR = 2.2 [1.55, 3.05]), after controlling for demographics, identified academic needs, and enrollment stability at Urban High School.

Student Use of iPads in School

Research Question 3 examines how students used iPads in the classroom based on their response to the Classroom iPad Use Survey. Students reported using 32 different applications; the top seven types were web browsers; Google tools; learning management systems, presentation tools; note taking applications; and assessment applications. Students reported 16 purposes for using their iPads. Doing research and accessing references was reported most frequently, followed by reading, writing, taking notes, listening to music, and watching videos. Students also reported creating multimedia presentations and to a lesser extent working on collaborative projects. They reported using their iPads to solve math or science problems or communicate by email less often.

In both years, students who had a THP reported more uses of technology in school. Classroom observations indicated that in a 90-minute class period students often received direct instruction, collaborated with peers in a discussion or problem-solving activity and occasionally used iPads to support and differentiate their learning through online instruction. Students accessed teacher webpages to view short informational videos and were able to work at their own pace. They could follow links for definitions and more detailed information, highlight and take notes in the online texts.

INSERT [Table 5 Technology Applications and Use In School Compared to iPad Assignment]
HERE

A *t* test indicated a statistically significant difference between students who had a THP and those who did not. The mean Technology Application Index for students with a THP was twice that of students who did not have a THP and could only use an iPad from the classroom cart in 2012-13, and 43% greater for students with a THP in 2013-14. Similarly, in 2012-13, the mean Technology Use Index for students

with a THP was 85% greater and 75% greater in 2013-14 than for students without a THP. Clearly students who had a THP and completed the Classroom iPad Use Survey reported a significantly greater opportunity to use technology for learning.

Linear regression predicted the factors associated with higher Technology Application and Use indexes when controlling for THP access, demographics, and identified academic needs. In both years, linear regression indicated access to a THP was associated with a higher Technology Application index; 2012-13: (b=.824, p= <.01) and 2013-4: (b= .566, p= <.01). Linear regression also indicated access to a THP was significantly associated with a higher Technology Use index in 2012-13 (b= .606, p = <.01) and in 2013-14 (b= .719, p = <.001)

Despite the large number of Technology Use surveys (1944), in both years there was a major problem of selection bias. A minority of teachers accounted for the majority of student surveys, and these tended to be the early adopters who had explored and used iPads in a variety of ways with their students. The surveys were not conducted in 2014-15 due to lack of administrative and teacher support for the survey.

Impact of Access to iPads on Student Learning

Research Question 4 examined the impact of access to a THP on students' attendance and GPA each year and across all three years of the study. Table 6 presents the mean attendance rate of students with and without a THP each year.

INSERT [Table 6 Mean Attendance Rate by Year Compared to THP Status] HERE

In all three years, students with a THP had a significantly higher attendance rate (85% to 91%) that was three to seven percentage points higher than students without a THP. After controlling for student demographics, identified academic needs, and enrollment stability across all three years, the odds of students with access to THP attending school at least 90% of the time was twice that of students without THP access (OR = 2.0 [1.51, 2.76] after controlling for demographic characteristics, identified special needs, and enrollment stability.

Table 7 presents the mean GPA of students with and without a THP each year. In all three years, students with a THP had a slightly higher GPA (.33 to .63 on a 4-point scale) than students without a THP.

INSERT [Table 7 Mean GPA by Year Compared to THP Status] HERE

Linear regression predicted the influences on GPA across all three years. Controlling for demographics, identified academic needs, and enrollment stability at Urban High School, access to a THP was significant in 2012-13 (b=.437, p<.001) and in 2013-14 (b= .159, p= < .05). However, the impact of iPad access on GPA was not significant in 2014/15 or across all three

years.

DISCUSSION and CONCLUSIONS

Both the district and high school staff intended for the 1:1 iPad project to improve the quality of technology tools and reduce the disparities in technology access and instruction among low-income students by providing every ninth and tenth grade student an individual iPad in 2012-13 and every ninth through twelfth grader a THP in 2013-2015. Despite efforts to increase the number of Urban High School students who had a THP, the percentage never rose above 43%.

The effects of technology on instruction are most likely when each student has access to an individual digital device (Warschauer, 2006). In order for students to benefit from 24/7 access to technology, each must have a mobile device. Unfortunately, the district underestimated the challenge of ensuring that every student would have an individually assigned iPad. Initial communication with families focused on the financial and legal obligations associated with the iPads but did not emphasize the benefits of the iPads to support student learning during and after school. A key requirement for successful implementation is outreach to families within the school community, and neither the district or school administration seemed to follow Schnellert and Keengwe's advice: "Selling is better than telling. Everyone needs to buy into the change that technology brings" (2012, p. 42).

A major focus of the research was to identify the degree to which iPads were distributed equitably across demographic and academic needs categories. The final results on access to a THP were mixed. In each of the three years ninth graders were more likely to have an individual iPad. Teachers commented in the focus groups that having their own iPad was both a novelty and a perceived status symbol for freshman. Across all three years students eligible for free/reduced lunch were more likely to have a THP. This is a positive outcome of the district and school attention to students who live in poverty.

However, students of color were less likely to have a THP than white students. From a social justice perspective and given the district and school emphasis on "Every student succeeds regardless of race or class" (District, 2014), this is troubling. While the majority of students of color were also eligible for free/reduced lunch and potentially more likely to have a THP, when THP access data were disaggregated by race/ethnicity alone, these students were less likely to have a THP. Teachers commented in focus groups that some students of color were living in precarious environments and did not feel safe taking an iPad home. The technology TOSA also explained that school administrators had not communicated the importance of the 1:1 iPad initiative to families, least of all families of color.

The importance of this digital divide in access was clearly shown in the student surveys

when students with a THP reported significantly higher proficiency, ease of use and helpfulness of technology for academic tasks than those who did not. When controlling for THP access all years, students with a THP reported higher scores for using technology in school and outside of school for academic purposes than those without a THP. This finding is confirmed by research studies reported by Zheng et al., (2016) about higher student engagement, motivation, and persistence in one-to-one digital environments.

The benefits of having a THP also stood out in analyzing the impact of the 1:1 iPad project on attendance and GPA. In all three years, students with a THP had a higher attendance rate than students without a THP. While not significant across all three years, the mean GPA of students with a THP was .33 to .63 higher than students without a THP. Previous research into empirical studies of laptop programs by Bebell and O'Dwyer (2010) discovered significant increases in GPA relative to schools without such programs.

Several barriers to successful technology integration identified by Schnellert and Keengwe (2012) were prominent at Urban High School: inconsistent administrative support, ambivalent staff attitudes and unfamiliarity with curricular applications of iPads, and lack of technical support. The original grant that funded the 1:1 iPad project at Urban High School was written by a district administrator and did not include funding for ongoing technology training. The high school principal was not perceived to be actively involved in communicating the educational importance of the technology initiative to families or teachers. The year after the iPad grant funding ended, the initial administrators who supported the project left the district, and the 1:1 iPad project ceased. Urban High School's experience is similar to research by Warschauer et al (2011) that found an externally mandated 1:1 program with minimal funding for curriculum development, infrastructure support, and teacher professional development did not result in positive changes, and the 1:1 program was abandoned after three years.

While the majority of Urban High School teachers reported in a 2012 district survey they were familiar with iPads, felt comfortable integrating technology into their classrooms and did so at least weekly, the Classroom iPad Use surveys and observations painted a different picture. The majority of the 1944 surveys were completed in seven teachers' classrooms; many of these teachers were considered to be early adopters of technology. However, as Norris, et. al. (2012) suggest, instructional use of computing devices, e.g., iPads, needs to be an essential curriculum tool that enables students to learn on a daily basis in ways that are not well supported through traditional instruction. The teacher focus groups and classroom observations suggest that only a few teachers substantively integrated iPads into daily instructional practice at the high school.

In the focus groups, teachers expressed reluctance to devoting time to develop instructional technology activities for students when the majority did not have 1:1 iPads. Teachers commented that since a majority of students did not have a THP and they perceived (incorrectly) that a majority of students did not have a home computer or Internet access, they were less likely to assign frequent homework that required using a digital device. Instructional use of iPads varied considerably all three years and was never considered an essential tool by most teachers.

The National Education Technology Plan reaffirms, for technology “to be transformative, educators need to have the knowledge and skills to take full advantage of technology-rich learning environments” (USDOE, 2016, p. 3). The need for more technology professional development was a common refrain and substantiated other studies of technology adoptions (Bannister & Fischer, 2010; Cotten et al., 2016; Sung et al., 2016).

All too often, when schools mandate the use of a specific technology, teachers are left without the tools (and often skills) to effectively integrate the new capabilities into their teaching methods. The results are that the new investments are underutilized, not used at all, or used in a way that mimics an old process (Johnson, et al., 2013, p.9).

Teachers cited conflicting administrative expectations to participate in curriculum and assessment meetings that squeezed out time for technology training.

Research on successful technology integration is replete with recommendations: provide relevant, continuous, and timely professional development in small group and individual formats; provide adequate time for teachers to learn and integrate new technologies into their practice; provide high quality, timely technical support (Buckenmeyer, 2008). Ensminger and Surry (2008) and the International Society for Technology Education (ISTE, 2012) emphasize the need for positive administrative expectations, supervision, and support at all levels; expectations that all students will have equitable access to the technology; and ongoing professional development for teachers in using the technology as an integral tool for student learning.

This research focuses on an issue of digital equity that has not yet been studied in depth with 1:1 iPads. Many of the schools and districts that have purchased 1:1 mobile devices for students to take home are private schools or public schools that serve upper middle class students. This case study looks in depth at students’ access, experiences, and use of iPads to support student learning in a high-poverty, highly diverse, urban high school and suggests the potential of 1:1 technology for promoting digital equity and improving student learning. Despite multiple challenges of inequitable distribution, limited professional development, inconsistent administrative support, and ambivalent teachers, access to and use

of an individual iPad resulted in higher attendance and slightly higher GPA over three years for students who had a THP.

End Notes

[1] Portland State University provided the first author a \$14,265.00 Faculty Enhancement Grant for release time and Graduate Assistant support by the second author in 2013-14. Mount Hood Cable Regulatory Commission provided \$5,000 to the Center for Student Success at Portland State University to support final year of data collection and analysis in 2014-15. The authors wish to acknowledge the contribution of the staff of the Center for Student Success, Portland State University Graduate School of Education, in providing statistical analysis.

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Table 1
Student Demographics - All Cohorts

Student Characteristic	Cohort A (9 th : 2012-13)	Cohort B (10 th :2012-13)	Cohort C (9 th : 2013-14)	Total
Gender				
Female	177	145	161	483
Male	233	180	195	608
Total	410	325	356	1091
Race/Ethnicity				
Latino	123	100	136	359

Black	100	67	65	232
AIAN	6	9	4	19
API	23	24	21	68
Multi-Racial	22	16	29	67
White	127	83	101	311
Total	401	299	356	1056
Home Language				
English	287	177	221	685
Spanish	78	74	101	253
Other	37	48	33	118
Total	402	299	355	1056
English Learner				
No	304	207	241	752
Yes	108	98	117	323
Total	412	305	358	1075
Special Education				
No	315	243	290	848
Yes	97	62	68	227
Total	412	305	358	1075
Free/Reduced Lunch				
No	56	39	41	136
Yes	356	266	317	939
Total	412	305	358	1075
THP Ever?				
No	215	157	115	487
Yes	197	148	243	588
Total	412	305	358	1075

Note. AIAN = American Indian / Alaska Native. API = Asian and Pacific Islander.

Table 2

Assignment of Take Home iPads (THP) by Student Category

Student Category	THP	No THP	Chi-Square (χ^2)	p-value
2012-13 (N= 573)				
Grade				
9th	110 (34%)	212 (66%)	$\chi^2 (1) = 7.70$.006
10th	59 (24%)	192 (76%)		

2013-14 (N=1070)

Grade						
9 th	215	(64%)	120	(36%)		
10 th	125	(40%)	190	(60%)		
11 th	107	(49%)	113	(51%)		
12 th	11	(5%)	189	(95%)	$X^2(3)=180.51$	< .001
Gender						
Female	218	(47%)	242	(53%)		
Male	240	(41%)	348	(59%)	$X^2(1)= 4.53$.033
Race/Ethnicity						
White	157	(50%)	159	(50%)		
Non White/Hisp	301	(41%)	433	(59%)	$X^2(1)= 6.76$.009
Academic Priority						
Yes	307	(50%)	308	(50%)		
No	151	(34%)	293	(66%)	$X^2(1)=39.02$	< .001

2014-15 (N=1010)

Grade						
9 th	148	(57%)	111	(43%)		
10 th	144	(50%)	143	(50%)		
11 th	88	(36%)	157	(64%)		
12 th	57	(26%)	162	(74%)	$\chi^2(3)=57.80$	< .001
English Learner						
Not EL	402	(46%)	476	(54%)		
EL	35	(27%)	97	(73.5%)	$\chi^2(1)=17.36$	< .001
Race/Ethnicity						
White	140	(56%)	111	(44%)		
Nonwhite/Hispanic.	272	(37%)	451	(62%)	$\chi^2(1) = 25.16$	< .001
Academic Priority						
Yes	198	(54%)	171	(46%)		
No	239	(37%)	402	(63%)	$\chi^2(1) = 25.58$	< .001

Table 3
Access to a THP Across All Three Years

Variable	All years (n = 1270, 2393 observations)		
	OR	SE	p - value
Female	1.61 (1.15, 2.24)	0.272	p < .01
English Speaking	1.01 (0.70, 1.46)	0.189	
Grade	0.71 (0.61, 0.81)	0.051	p < .001
Free/Reduced lunch	1.82 (1.30, 2.53)	0.308	p < .001
Special Educ Status	1.07 (0.72, 1.58)	0.216	
White	2.10 (1.41, 3.12)	0.423	p < .001
Stability	2.21 (1.59, 3.07)	0.373	p < .001
Log likelihood	-1336.641		
Model Significance	Wald (design) $X^2(7) = 83.74$, p < .001		

Table 4
Technology Satisfaction/Proficiency, Helpfulness, and Frequency of Use Compared to iPad Assignment

	THP Status	n	Mean	Std. Dev.	T-Test	p-value
2012-13 (n = 306)						
Technology Satisfaction/Proficiency (1 low-8 high)	No	190	6.56	1.29	t (304) = -4.75	< .001
	Yes	116	7.19	.79		
Helpfulness (1 low-28 high)	No	190	21.48	4.57	t (304) = -3.04	.003
	Yes	116	23.02	3.76		
Frequency of iPad Use Outside School (1 low-32 high)	No	190	19.51	7.62	t (304) = -2.30	.022
	Yes	116	21.53	7.17		
2013-14 (n= 668)						
Technology Satisfaction/Proficiency (1 low-8 high)	No	300	6.47	1.40	t (666) = -6.10	< .001
	Yes	368	7.03	.97		
Ease of Use (1 low-32 high)	No	300	25.64	5.28	t (666) = -3.94	< .001
	Yes	368	26.98	3.46		
Helpfulness (1 low-28 high)	No	300	20.77	5.38	t (666) = -4.12	< .001
	Yes	368	22.22	3.70		
Frequency of iPad Use Inside School (1 low-4 high)	No	300	2.19	.85	t (666) = -8.06	< .001
	Yes	368	2.69	.74		
Frequency of iPad Use Outside School (1 low-32 high)	No	300	19.54	7.58	t (666) = -7.28	< .001
	Yes	368	23.11	5.00		

2014-15 (n= 245)						
Technology Satisfaction/ Proficiency (1 low-8 high)	No	118	6.37	1.42	t (243) = -4.02	< .001
	Yes	127	6.99	.99		
Ease of Use (1 low-32 high)	No	118	25.67	5.63	t (243) = -2.67	< .001
	Yes	127	27.26	3.51		
Helpfulness (1 low-28 high)	No	118	20.32	5.49	t (243) = -2.32	.021
	Yes	127	21.72	3.84		
Frequency of iPad Use Inside School (1 low-4 high)	No	118	2.15	.90	t (243) = -3.77	.0002
	Yes	127	2.54	.71		
Frequency of iPad Use Outside School (1 low-32 high)	No	118	20.03	7.58	t (243) = -2.54	.012
	Yes	127	22.16	5.44		

Table 5
Technology Applications and Use In School Compared to iPad Assignment

2012-13 N=165						
Tech App Index		N	Mean	Std.Dev.	t-Test	Sig.
Tech App Index	No THP	100	2.17	1.92	t (165) = -4.57	p = < .001
	THP	67	4.58	4.74		
Tech Use Index	No THP	100	5.30	4.70	t (165) = -3.32	p = .001
	THP	67	9.82	12.35		
2013-14 N= 305						
Tech App Index		N	Mean	Std.Dev.	t-Test	Sig.
Tech App Index	No THP	124	3.61	6.11	t (303) = -2.14	p = .03
	THP	181	5.19	6.45		
Tech Use Index	No THP	124	3.73	5.11	t (303) = -3.54	p = .001
	THP	181	6.55	7.81		

Table 6
Mean Attendance Rate by Year Compared to THP Status

	THP Status	N	Mean	Std. Dev.	T-Test	Sig.
Attendance Rate by THP 2012-13	No	424	85.72	13.93	t (613) = -4.96	< .001
	Yes	191	91.22	9.49		
Attendance Rate by THP 2013-14	No	453	78.05	21.02	t (918) = -5.76	< .001
	Yes	467	85.48	18.07		
Attendance Rate by THP 2014-15	No	550	83.52	19.53	t (984) = -4.31	.011
	Yes	436	86.72	19.84		

Table 7

Mean GPA by Year Compared to THP Status

	THP Status	N	Mean	Std. Dev.	T-Test	Sig.
GPA by THP 2012- 13	No	360	2.10	1.13	t (525) = -6.13	< .001
	Yes	167	2.73	1.01		
GPA by THP 2013- 14	No	288	2.13	1.01	t (693) = -4.09	< .001
	Yes	407	2.46	1.04		
GPA by THP 2014- 14	No	188	2.36	.94	t (577) = -4.31	< .001
	Yes	391	2.70	.91		

Appendix A
Student Technology Experience and Use Survey

High school staff asked students to follow a link on their iPad to complete the electronic survey at the beginning and end of the school year in 2012-13, 2013-14, and 2014-15.

What is your student ID number? _____

What grade are you in?

- 9th
- 10th
- 11th
- 12th

What type of 1:1 technology have you been assigned?

iPad,

Please rate your overall proficiency with use of the iPad:

1 Low to 4 High

Do you have a home computer?

- Yes
- No

Do you have Internet at home?

- Yes
- No

Please rate your overall satisfaction with use of the [iPad] technology?

1 Low to 4 High

What were the strengths of using the iPad? _____

What were the challenges of using the iPad? _____

How often have you used your iPad during school?

- in no classes
- in 1-2 classes a week
- in 3-5 classes a week
- in every class during the week

For the next set of questions the choices were:

- not helpful
- somewhat helpful
- helpful
- very helpful

How helpful is your iPad in doing the following: homework?

How helpful is your iPad in doing the following: writing assignments?

How helpful is your iPad in doing the following: communicating and collaborating?
How helpful is your iPad in doing the following: organizing schoolwork?
How helpful is your iPad in doing the following: doing research?
How helpful is your iPad in doing the following: accessing information?
How helpful is your iPad in doing the following: staying motivated and engaged?

For the next set of questions the choices were:

very hard to use
 hard to use
 easy to use
 very easy to use

How easy is it to use your iPad for the following: turning in homework?
How easy is it to use your iPad for the following: writing assignments?
How easy is it to use your iPad for the following: creating content?
How easy is it to use your iPad for the following: installing my own apps?
How easy is it to use your iPad for the following: adding my own music?
How easy is it to use your iPad for the following: taking care of the device?
How easy is it to use your iPad for the following: communicate (IM, email, video chat, blog)

How easy is it to use your iPad for the following: connecting wirelessly at school?

Any other comments:

For the next set of questions the choices were:

never
 once a week
 2-3 times a week
 every day

How often do you use the iPad outside of school to? do homework
How often do you use the iPad outside of school? communicate (IM,email, video chat, blog)
How often do you use the iPad outside of school? Create videos, presentations, or projects
How often do you use the iPad outside of school? Find information
How often do you use the iPad outside of school? Watch videos
How often do you use the iPad outside of school? Play games
How often do you use the iPad outside of school? Listen to music
How often do you use the iPad outside of school? Use social media (Facebook, Twitter, etc.

Appendix B
Classroom iPad Use Survey

High school staff asked students to follow a link on their iPad to complete the digital survey.

Student Number:

Class Name:

Period:

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8

After School

Which iPad Apps did you use during this period?

- 3D Game Lab
- 30 Hands
- Adobe Reader
- ATT Scanner
- Bookabi
- Class Website
- Dragon Dictation
- Dropbox
- Edmodo
- Educreations
- Email
- Explain Everything
- Google Drive
- Google Maps
- Google Translate
- Haiku Deck
- iBooks
- iTunesU
- Logger Pro
- County Library
- Notability
- Pandora
- Quizlet
- Schoology
- Show Me
- Slideshare
- Socrative
- Synergy

- WebBroser
- Youtube

How did you use the iPad?

- Created multimedia presentation
- Did research
- Took photos
- Recorded audio or video
- Worked on a writing project
- Read
- Solved math or science problems
- Watched videos
- Collaborated on a project with others
- Communicated via email
- Listened to music
- Played games
- Took notes
- Used reference tools (e.g., dictionary, thesaurus)
- Other:

Appendix C
Teacher Focus Group Protocol

The purpose of our discussion is to share your experiences using the iPads with your students and your judgment of the impact of the technology on your students' engagement and learning.

Focus Group Questions April, 2013; April 2014

1. In general, what have been the strengths of the iPad project so far?
2. What have been the limitations or frustrations of the iPad project so far?
3. What are some ways your students have used the iPads that seemed to engage them the most?
4. What are some ways your students have used the iPads that seemed to have a positive impact on their learning?
5. To what extent has student use of the iPads noticeably affected student behavior in class?
6. To what extent has student use of the iPads noticeably affected student attendance in class?
7. To what extent has the 1:1 iPad project helped to reduce disparities in access to technology for your students?
8. To what extent has student use of the iPads affected the opportunity to individualize or differentiate instruction for your students?
9. If there is one thing this high school could do differently with the iPad project, what would it be?