



# Teaching and Learning with Technology in Linguistically Diverse Classrooms

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# Executive Summary



**A** mixed-methods analysis of how features of technology-enhanced classrooms affected students with linguistically and culturally diverse backgrounds was undertaken at an urban secondary school with a strong ongoing commitment to student-centered uses of technology. The study used ethnographic and quantitative classroom observations to explain variation in English learner students' academic achievement and language development while taking into account the immense variability among immigrant students and their classrooms. We conducted this study because so little is known about how the needs and strengths of immigrant students are engaged through technology, particularly as it is embodied by one-to-one devices such as iPads and Chromebooks.

Key findings suggest that:

- The features of technology-enhanced classrooms that best supported language development and subject-area content mastery were aligned with student-centered learning and strengths-based teaching, explaining substantial variation in emergent bilingual students' Growth in English Proficiency and Academic Achievement. Quantitative analysis revealed a range of student centeredness across 10 classrooms while qualitative analysis described common practices.
- Our findings also bring to light some of the unique factors from the lived experience of immigrant students that affected how they interacted with technology in their classroom: These include technology use at home, academic engagement, and language use with friends, as well as being overage for their grade, experiencing family poverty, and whether they worked.

- While most students evaluated their experiences using the one-to-one devices in their classrooms extremely positively (80.9%), some were not convinced that they added value to their learning (19.1%). Both perspectives are valid given the range of teaching practices observed in just one school and the ways that those practices aligned with immigrant students' realities outside of school.

Implications for policy and practice follow:

- English learners, a diverse and demographically significant group, had experiences outside of school that were often markedly different from mainstream students as well as from one another. To effectively integrate technology into linguistically and culturally diverse classrooms, policy and practice need to account for both the commonalities of the immigrant experience and the astonishing variation between individuals.
- Although technology is a powerful lever for innovation in teaching and learning, it is resource-intensive for teachers and students to integrate into linguistically and culturally diverse classrooms effectively. Rapidly changing global and digital technologies necessitate constant innovation and continued investment. Technology can be part of a complex and resource-intensive transformation of teaching and learning toward strengths-based, student-centered classrooms when schools, teachers, students, and their families are willing to invest in changes.
- Technology is at the heart of a nationwide equity issue. Research is needed to understand how we can leverage its potential for teaching promising yet vulnerable youth, particularly those who are still learning English. Our study has made an important contribution by beginning to map the variety of individual and classroom factors that affect learning in technology-enhanced classrooms for English learners and their teachers.

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# Introduction



In response to a globalizing workplace and standards-based school reforms that mandate knowledge of multimodal texts and technology, schools across the United States are rapidly introducing global and digital technologies into the classroom (Selwyn, 2013; Warschauer, 2011; West, 2012). At the same time, classrooms have never been so diverse: More than 20 percent of children speak a language other than English at home (NCES, 2015), and most classrooms today are part of a “new mainstream” noteworthy for its cultural and linguistic heterogeneity (Enright, 2011). Currently, 4.4 million students are classified as having limited proficiency in English (NCES, 2015) and improving their academic outcomes is already a focus for policy and practice. The new global reality of people and technology crossing borders in record numbers to create hybrid and interconnected spaces and identities is manifest in our classrooms (Suarez-Orozco & Qin-Hillard, 2004; Vertovec, 2007).

The use of technology in linguistically and culturally diverse classrooms is a concern for teachers, families, and schools, but little is known about how technology-enhanced environments affect adolescent English learners, their learning, or instructional practice despite their demographic importance. One-to-one devices in particular offer numerous possible benefits to teachers and students and just as many potential disadvantages: Technology can individualize learning and foster independence and creativity. But technology can be distracting, take time and resources away from tried and true learning activities, and present yet another set of hurdles for disadvantaged students. The use of technology with vulnerable populations is an equity issue; increasing academic demands coupled with ineffective technology use could exacerbate the well-documented achievement gap between English learners and English-proficient students (Carhill-Poza, 2017; Chun, Kern & Smith,

2016). Additionally, scaffolding language and content learning through multimodal and digital practices is not commonly part of teachers' pedagogical knowledge (Bunch, 2013), leaving schools and teachers to innovate teaching practice.

Whether teachers view technology with enthusiasm or trepidation, it is an inseparable part of today's classrooms. For teachers of English learners, the impact of technology is doubly important because it affects both language use and content learning. Research is needed to better understand the possibilities of technology in the classroom for English learners and their teachers. In particular, one-to-one devices offer a potent area for inquiry into the benefits and constraints of technology for linguistically and culturally diverse students because of their prevalence in schools across the United States and because their use integrates many forms of technology.

## Theory and Research

Three educational theories guide this study: sociocultural theory (Vygotsky, 1978) as the basis for student-centered learning, multimodal literacies (Kress, 2003) as a sophisticated framework for literacy in the 21st century, and culturally responsive teaching (Gay, 2000) as a strengths-based pedagogical approach to teaching multilingual students. In sociocultural theory, learning is socially constructed and mediated through interaction (Vygotsky, 1978). Applied to English learners, this theory emphasizes the beneficial role of active engagement and social interaction in second language acquisition, including peers and peer scaffolding (Brooks & Donato, 1994; Swain & Lapkin, 1998); more advanced conversation partners (Aljaafreh & Lantolf, 1994; Nassaji & Swain, 2000); and the native language to explore form-meaning relationships and mediate cognitive activity (Lantolf & Thorne, 2006; Lantolf & Poehner, 2014).

Theories of multiliteracy (New London Group, 1996) and multimodality (Kress, 2003) ascribe value to all modes of communication in use in a classroom (e.g., written, visual, audio, gestural, and spatial) (New London Group, 1996). Multimodal pedagogy is a central feature of technology-enhanced learning environments (LaBanca, Worwood, Schauss, LaSala, & Donn, 2013; Jewitt, 2008), deconstructing artificial boundaries between traditional classroom literacies and the range of communication tools in use outside school walls. Research has described the many ways youth use technology outside of school in sophisticated social and literacy practices including texting, instant messaging, gaming, blogging, and video production (Coiro, Knobel, Lankshear, & Leu, 2008; Mesch & Talmud, 2010; Peck et al., 2015). However, the use of technologies is hardly a yes or no question. While many youth are "digital natives" (Mills, 2010), many are not, and little research exists to suggest where immigrant students fall in this spectrum. Even adolescents who use technologies fluently outside the classroom may need the guidance of teachers to apply those technologies to academic tasks (Vasudevan, 2006).

Linguistically and culturally diverse students are often limited in what knowledge and skills they can draw on to demonstrate knowledge and learning in school (Gutiérrez, Morales & Martinez 2009; Moll, Amanti, Neff, & Gonzalez, 1992). Culturally responsive teaching is a framework for achieving equity by holding high expectations for all students and building on the strengths students bring to school from their homes and communities (Gay, 2000). It may very well be the case that the skillful use of technology is an asset many immigrant students possess. Research has shown that immigrant youth

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can engage a variety of technologies to create complex and linguistically hybrid multimodal texts in order to negotiate transnational relationships (Farr, 2006; Sanchez, 2007), develop advanced literacy skills (McLean, 2010; Sanchez & Salazar, 2012), and affiliate with communities and access resources (Lam, 2009; Yi, 2009). Technologies also provide the means to integrate materials and perspectives that reflect the lives of immigrant students beyond school walls in new ways, including drawing on community partnerships and home literacy practices, largely untapped resources in many classroom settings.

Many educators see technology as a means to innovate practice in ways that address some of the challenges adolescent emergent bilinguals encounter in schooling. Research in mainstream adolescent technology-enhanced classrooms has shown that the use of technology—including videos and iPad applications—supported better comprehension and use of key vocabulary (Assaf, Ash, & Saunders, 2011; Smythe & Neufeld, 2010; Tan, Ng, & Saw, 2010). For adults learning English for academic study, online communication tools have been shown to support language learning and improve attitudes toward learning as well as increasing participation and self-confidence using the new language (Bonk & Graham, 2006; Groot, 2000; Kern, 1995; Zapata & Sagarra, 2008).

Technology is no panacea, however. The presence of technology in a classroom does not guarantee more or better opportunities for language learning or more student-centered, asset-based teaching practices (Peck, et al., 2015; Phillip & Gracia, 2013). Some research has shown little impact from ambitious school-wide technology initiatives (Cuban, Kirkpatrick & Peck, 2001; Li, 2007). In other cases, remedial computer programs and using computers to complete worksheets has resulted in negative outcomes for students already at-risk (Peck et al., 2015). These and other studies suggest that how technology is used in the classroom is more important than whether technology is present (Bulfin & North, 2007; Chenoweth & Murday, 2003; Neumeier, 2005; Stepp-Greany, 2002). Research is needed to describe the processes of teaching and learning that emerge for linguistically and culturally diverse students and their teachers as technologies are introduced into schools and classrooms.

## The Current Study

Previous research with this school showed that teaching and learning with technology took shape in many different ways across classrooms; innovative teaching practices—often referred to as “flipped learning”—varied in their use of technology and student centeredness as well as the specific activities and strategies used (Carhill-Poza & Gounari, 2015). We also know that English learner (EL) students are an incredibly diverse group and that meeting their needs requires understanding how such differences affect language and content learning in classrooms. Research is needed to better understand the potential of technology for adolescent English learners while accounting for the immense variability among students and classrooms, two central aspects of this innovative approach to education.

Taking variability in classrooms and immigrant-origin students as our starting point, this exploratory study examines how teaching practices in technology-enhanced classrooms relate to the learning experiences and outcomes (both language and content) of diverse adolescent English learner students. The study is the first to document the features of technology-enhanced classrooms and student characteristics in accounting for EL student learning. The project builds on our existing partnership with an urban public school in order to support their ongoing work and ensure the research is relevant to practice and policy. The study aims to address a series of quantitative and qualitative research questions:

1. Features of technology-enhanced classrooms:
  - a. What features of technology-enhanced classrooms support language and content learning for EL students?
  - b. How do student learning practices (e.g., student participation and student talk) exemplify classroom features associated with positive educational outcomes and experiences for EL students?
2. Diverse English learners:
  - a. What EL student characteristics mediate associations between features of technology-enhanced classrooms and language and content learning outcomes?
  - b. How do diverse EL students experience technology as part of their learning?





# Research Design



**A** complementary mixed methods approach to data collection and analysis supported the project's aims by linking emic and etic approaches, incorporating multiple data sources, and embedding emerging findings within a situated framework (Tashakkori & Teddlie, 1998). This study employed a nonexperimental design and analyzed data collected in a large urban public school using descriptive statistics and hierarchical linear modeling (Raudenbush & Bryk, 2002) as well as thematic and participatory procedures (Torres & Reyes, 2012). This combination of methods helped us identify factors in technology-enhanced classrooms and among students that supported language and content learning for diverse adolescent English learners.

## Study Setting and Participants

Patriot High School is demographically typical of the secondary schools adolescent English learners encounter in urban environments and it is also the site of an innovative initiative to improve the educational outcomes of its diverse students through the use of technology in student-centered classrooms. Students in this school face many of the hurdles common to immigrant-origin students as they learn academic English and academic content simultaneously (see Table 1). More than half of the 1,850 students speak a language other than English at home (60%) and many students are classified as economically disadvantaged (38%) (Massachusetts Department of Elementary and Secondary Education, 2016). We entered into partnership with PHS to explore the affordances of their approach to teaching and learning for emergent bilingual students during the first year of full implementation of the new instructional model in 2013–14, and we continued our investigation through the 2016–17 school year.

**Table 1. School Characteristics in Percent of Total, 2016**

	Patriot High School	Greater Boston Schools	Massachusetts Schools
Total Enrollment	1,837	54,312	953,748
Economically Disadvantaged	38.4	80.6	30.2
<b>Race:</b>			
African American	4.7	33.6	8.9
Asian	5.7	8.5	6.3
Hispanic	54.1	40.9	19.4
White	32.7	13.8	61.3
First Language not English	60.4	47.4	20.1
English Learners (ELs)	14.3	29.8	9.5
Attendance Rate	95.3	92.1	94.9
<b>Graduation Rate:</b>			
All Students (4 year)	90.3	66.7	86.1
EL Students (4 year)	67.3	61.4	63.9
EL Students (5 years)	87.5	68.5	70.9
<b>MCAS-Proficient or Higher:</b>			
ELA All Students	86.0	76.0	91.0
ELA EL & former-EL Students	35.0	36.0	51.0
Math All Students	71.0	64.0	78.0
Math EL & former-EL Students	29.0	39.0	37.0
EL attending 2- or 4-year College	59.1	66	81
Students per Computer	2.0	2.9	3.0
Classrooms on Internet	100	100	100

\*Data from the Massachusetts Department of Elementary and Secondary Education, 2016.

Ten ESL and sheltered classrooms were observed, including two beginning, two intermediate, and two advanced ESL classes; a sheltered biology and a sheltered history class with mixed levels of EL students; and a newcomer science and a newcomer ESL class. Class size ranged from 12 to 24 students. Classrooms in our study included a range of configurations for moving between independent, small group, and whole class work. More traditional, teacher-fronted structures included desks facing front, while less traditional configurations including horseshoes and clusters. The classes that participated in our study can all be classified as thematically organized, with a dual focus on academic content and academic language development. All the teachers in our study were highly qualified—holding initial or professional licenses in their subject area and ESL—and all teachers had been teaching for several years (3–26 years,  $M=7.2$ ).

Students in each classroom we observed were asked to take a survey about their experience in that class and their use of technology. A total of 110 students nested in 10 classrooms participated in a survey about their experiences with technology, including engagement with one-on-one devices. In addition, a sample of 13 secondary school teachers and 21 English learner students were interviewed in 2015–16. The sample consisted of 110 unique EL students (about one half of all EL students at PHS) who spoke Spanish (85.5%), Arabic (4.5%), Portuguese (9.1%), and French (0.9%) as their first language and who ranged from beginning to advanced levels of English proficiency as shown in Table 2. Survey participants were representative of the diversity within the English learner population of the school: Nearly half were female (52.7%) and the average age was 17 (SD=1.37). About half of students were overage for their grade (52.7%) and 6 had missed more than three months of schooling. About a third of students in this sample were beginning to learn English (WIDA levels 1 and 2) (35.5%), while 42 percent had intermediate levels of English proficiency and 22 percent were advanced. The majority of participants were newcomers who had arrived in the US within the last 3 years (56%).

**Table 2. Sample Description (n=110)**

	Mean/Percent	SD/Counts	Minimum	Maximum
Age in Years	16.97	1.37	14	20
Years in the US	1.81	1.46	0	8
Family Poverty	58.18%	64	0	1
Gender (Male)	47.3%	52	0	1
Overage for Grade	52.7%	64	0	1
Interrupted Education	5.6%	6	0	1
English Proficiency Level	3.59	1.34	1.5	6.0

## Research Methods

### *Data Collection*

Research was carried out during the third and fourth year of the technology-enhanced initiative at Patriot High School (PHS), between September 2015 and December 2016. Building on an established relationship with the school community, we spent 68 days at the school conducting ethnographic fieldwork. During this time, we completed approximately 315 hours of school- and classroom-based observation in a total of 52 80-minute block class periods, including sheltered Biology, sheltered Physics, English (ESL), sheltered History, the newcomer academy, advisory, and AP English classes. We also attended parent-teacher conferences, a school rally, and teachers’ meetings, and we carried out informal observations in the hallways and in the library study area called the Learning Commons. We generally sat in the back of classrooms taking notes but also availed ourselves of opportunities to have informal conversations with students and teachers when the situation presented itself.

Student interview data collected in Fall 2016 was used to hone research instruments and to contextualize quantitative findings. We conducted pilot interviews with 15 students to better understand student perspectives on flipped learning and to pilot quantitative measures of

student academic engagement, use of technology, language use, and demographic information. The semi-structured interviews were 22 to 45 minutes long ( $M=34$  mins) and were conducted in the Learning Commons. Cross-cultural research with immigrant youth challenges traditional social science assumptions around validity and reliability (McLoyd & Steinberg, 1998). Given that questions and prompts that are valid for one group may not be valid nor culturally and linguistically unbiased when used with another, we sought to develop a protocol that would be relevant and equivalent across groups. Scale development was informed by bilingual and bicultural researchers and ethnographic fieldwork.

In AY 2015–16, we recruited teachers from 10 classrooms of adolescent EL students (including in the newcomer academy, beginning and intermediate ESL classrooms, and sheltered content classrooms) to participate in the study. *Classroom observations* were scheduled two to three times (4–6 hours) during what each teacher considered a typical series of classes. Classroom observations were video-recorded for quantitative coding of classroom teaching and learning activities. At the same time, we also conducted ethnographic classroom observations, developed fieldnotes, and collected artifacts in each classroom. The CLASS-S was used to code 20 hours of classroom video generating four 20-minute cycles from each classroom. Two trained observers independently watched the videos while taking detailed notes about student and teacher behaviors, then rated the segment on a scale of 1 to 7 on each of 12 dimensions. Certification for observers consisted of a two-day workshop to learn the CLASS-S system and passing a reliability test within two weeks of beginning coding for this project. All observations were double coded, reaching interrater agreement of 94 percent. All differences greater than 1 point were resolved through discussion and cycle scores were averaged for each class to produce the final scores.

With the help of school staff, students were recruited from the 10 ESL and sheltered content classrooms we observed for survey participation. The semi-structured survey, administered online via students' iPads, asked students to describe their academic engagement, use of technology, language use, and demographic information ( $N=132$  students). A bilingual and bicultural researcher described the project to the students and distributed parental permission forms and student consent forms explaining the study in Spanish and English, Arabic and English, French and English, and Portuguese and English. Students received a \$10 Amazon gift card as a token of appreciation for their participation. In total, 110 unique students participated in the survey, about half of the EL student population at Patriot High School. On average, 72 percent ( $SD=6.8$ ) of students in the classes we recruited from participated in the survey. Surveys were completed during class time with a bilingual and bicultural researcher present to answer questions and help navigate technical bugs. Bilingual researchers met with students who needed additional one-on-one literacy support to complete the survey.

Additional one-on-one interviews were held with 13 teachers. Interviews ranged from 16 to 70 minutes, with the median length being 33 minutes. We also conducted nine individual and group interviews with a total of 11 students. Interviews ranged from 17 to 37 minutes with students (average: 25 minutes). All interviews took place in the Learning Commons. School staff helped us to identify students who would be willing to speak about their experience and could offer a wide

range of perspectives and insights into the situation facing English learners at PHS. Participants received assurance that their names would not be used in this study and that any identifying features would be modified or withheld to protect their identity. No questions were asked pertaining to legal immigration status.

Document collection at the end of the school year was used to gather student outcome measures including English proficiency scores (WIDA ACCESS), attendance records, and report cards.

## *Measures*

### **Student Variables**

**Growth in English Proficiency** was measured by comparing student's scores on the standardized English proficiency test, the WIDA Assessing Comprehension and Communication in English State-to-State for English Language Learners (ACCESS; Board of Regents of the University of Wisconsin System, 2016), administered by the school in April 2015 and 2016. The WIDA is the most widely used test of academic English proficiency in US schools today and has been normed for all groups and ages present in our sample such that scores scale across grade levels. The WIDA ACCESS assesses English proficiency across four language domains (listening, reading, writing, and speaking) using three performance criteria that measure language-specific knowledge: (a) complexity, the amount and quality of the speech; (b) vocabulary usage, the specificity of words or phrases; and (c) language control, control over mechanics, syntax, and semantics (WIDA, 2008). Reliability for the four ACCESS subtests is reported at .82 to .97 (Kenyon, 2006). Scaled scores range from 100 to 600 and proficiency levels range from 1 (Entering) to 6 (Reaching), with each proficiency level spanning approximately 100 scale score points. Our variable used a 500-point scale to align with WIDA proficiency levels. Missing data was imputed using Time in the US, Age, and Parents' English Proficiency.

**Academic Achievement** was assessed by student grades for the class we observed in the Spring of 2016. Grades were reported by the school on a 14-point scale.

**Language Use with Friends** was measured using a self-report scale that asked students how much of the time they used English and their home language with friends.

**Academic Engagement** was measured using a five-item self-report scale that focused on students' behaviors adapted from Suárez-Orozco, Suárez-Orozco, and Todorova (2008). Participants were also asked how many hours they spent on homework after school, how many times they had been late to class, and how many times they had skipped class in the last week. The items were standardized and summed to create a scale score (Cronbach's  $\alpha = .60$ ).

**Technology at Home** was measured using self-reported data about the use of computers at home coded at the interval level for not having a computer at home, having one or more, and having exclusive use of a computer at home.

**Demographic data** including Age, Age of Arrival, Time in the US, Grade-level, Overage for Grade, and Gender were collected from student interviews and verified on student transcripts. SIFE (students with interrupted formal education) was dummy-coded such that students who had missed more than 3 months of school were assigned a value of 1 and students who had missed three months or less were coded as 0. Family Poverty was dummy-coded such that students eligible for free or reduced lunch were coded as 1 and those who were not 0. Student Work was dummy-coded such that a working student was assigned a value of 1 and a nonworking student 0.

### **Classroom Variables**

The Classroom Learning Assessment Scoring System—Secondary (CLASS-S; Pianta, Hamre & Mintz, 2011) was developed for secondary schools as a measure of classroom instruction and interaction. The CLASS-S was chosen because it captures how student-centered a classroom is given a wide range of teaching strategies and styles. The CLASS-S consists of a set of global 7-point rating scales with behaviorally anchored scale points providing detailed descriptions of each dimension. The Instructional Support domain is composited from subscales for Content Understanding (reflecting teacher presentation of content within a broader intellectual framework); Analysis and Inquiry (focuses on the degree that the teacher engages students in higher-level thinking skills); Quality of Feedback (assesses the provision of feedback designed to challenge students and expand their understanding of concepts); Instructional Dialogue (capturing the distribution and use of questions and dialogue to build student understanding of content and language); and Instructional Learning Formats (which quantifies the variety of modes of presentation and activities).

### *Quantitative Data Analysis*

Quantitative data analyses were used to describe how instructional features of technology-enhanced classrooms relate to EL student academic outcomes as well as how student characteristics mediated the relationship between classroom features and outcomes for diverse EL students. Descriptive and correlational analyses were conducted initially to describe variables. Two-level hierarchical linear models (HLM) were specified using maximum-likelihood estimation to ascertain the effects of student- and classroom-level variables on emergent bilinguals' Growth in Language Proficiency and Academic Achievement; intra-cluster correlations were 11.3 percent and 29.1 percent respectively. These analyses allowed researchers to examine the roles of classroom-level features of technology-enhanced classrooms (Instructional Support) and student characteristics (Academic Engagement, Technology at Home, Language Use with Friends) relative to other predictors in the models in accounting for EL student outcomes (Growth in English Proficiency and Academic Achievement). In effect, individuals were nested within classrooms (Raudenbush & Bryk, 2002).

### *Qualitative Data Analysis*

Teacher interview data and ethnographic classroom observation data were analyzed thematically using an analytic inductive approach (LeCompte & Preissle, 1993) to develop insight into classroom teaching and learning practices not available through quantitative analysis. This study stressed developing a deeper level of understanding of the English learner experience and necessitated spending great deal of time in classrooms. We focused on understanding the pedagogical approaches and strategies taken by teachers. However, our analytical commitments were not restricted to studying pedagogy in the classrooms. Rather, we sought to better understand how the educational

context of the school and pedagogical approach of teachers were embedded within broader social, political, and economic context that converged to inform the experience of English learners at PHS. We took some of the core concepts, themes, and questions identified in previous iterations of this project and explored them in greater amounts of detail—such as ‘how’ and ‘why’ questions pertaining to the convergence of flipped learning, technology, and the lived experience of English language learners. We also developed additional themes as we completed data collection and analysis.

Classroom practices were explored as a tool for theory building in collaboration with teachers using participatory research methods (Torres & Reyes, 2011). Interview and observation data were examined on an ongoing basis to inform hypothesis generation and ongoing data collection. Fieldnotes and interview transcripts were uploaded and coded using a qualitative software package called NVivo. We analyzed data utilizing a hybrid grounded theory approach, one that was focused on identifying themes consistent with our core conceptual issues of interest while also flexible enough to allow for the emergence of new themes and sub-themes that we did not anticipate. Ten percent of interview transcripts and observation fieldnotes were thematically coded by two researchers for reliability (92% agreement). Validity was ensured through the use of multiple sources of evidence, by actively seeking to disconfirm emerging themes, and through member checking findings.



# Findings



## Technology at Patriot High School

**O**n August 8, 2016, the principal of Patriot High School sent home a letter to parents informing them that the school would be switching from iPads to Chromebooks for the upcoming academic year. Chromebooks are low-cost laptops that use Google’s native Chrome-based operating system. They are principally designed to be used while connected to the Internet in order to utilize Google’s cloud-based storage and office suite of applications for word processing, spreadsheets, and presentations. The principal’s letter said that the decision to shift to Chromebooks was one “based on teacher and student feedback and other findings which found Chromebooks to be more user-friendly, affordable, operational, and distraction-free.” All students at PHS were issued Chromebooks, along with Google Drive accounts. They used their Chromebooks inside school and took them home. The laptops were free to students as the iPads had been for the preceding three years.

Since 2014, one-to-one devices (the iPads and the Chromebooks) have constituted a universal dimension of the student experience at PHS. Peeking into any classroom, one is likely to find students using Chromebooks to take notes, write essays, watch videos, or listen to music. The school-wide initiative to integrate technology into student-centered classrooms is particularly notable as this urban public school serves a sizable proportion of immigrant students, many of whom are learning English as a second language. Most of these had immigrated to the US recently: some arrived a few years ago while others have been here for just days. English learners attend ESL, sheltered, and newcomer classes with the goal of, in time, transitioning to mainstream classes attended by the broader student body. All of their classes make some use of one-to-one devices.



But to study the practices developed around the use of technology in the classroom as solely a matter of pedagogy is to tell a partial story. To more fully understand the practices, decisions, and approaches through which technology was used by teachers and students necessitates a deeper investigation of the school and classroom contexts informing the educational experiences of English learner students. We consider this dynamic in two ways: First, we look at how the context of being an immigrant student who was still learning English shaped diverse students' experience in the classroom. Second, we investigate how this context informs the approaches taken by teachers with respect to educational practice, including features of their classrooms measured by a quantitative observation tool.

## Factors affecting Growth in English Proficiency and Academic Achievement

Immigrant youth who participated in this study varied considerably in their Growth in English Proficiency and Academic Achievement as shown in Table 3. The mean raw score for Growth in English Proficiency for the entire sample was .63 points, corresponding to a standard score of 630, just over one-half of a WIDA level (SD=1.21), with some scores falling by as much as 2.20 points from the previous year and others increasing by nearly 4.00 points. On average, adolescent English learners received a 5.7 (SD=3.40), about a C-, with scores ranging from 0–13. Individual factors as well as student characteristics and classroom features were related to students' outcomes and experiences in technology-enhanced classrooms.

**Table 3. Descriptive Statistics for Academic Achievement Variables (N=110)**

	Mean/Percent	SD/Counts	Range	Intra-cluster correlations (ρ)
Growth in English Proficiency	.628	1.212	-220 – 390	29.1%
Academic Achievement	5.777	3.399	0 – 13	11.3%

### *Individual Factors: Overage, Family Poverty, Student Work*

#### **Overage: Prior Educational Experiences**

The educational experiences of immigrant youth classified at school as English learners in this sample were diverse. While many students were recent immigrants (within the last three years) (53%), others had attended school in the US since kindergarten. A small percentage (6.4%) had missed significant amounts of schooling prior to coming to PHS. Fifty-three percent of emergent bilinguals in this sample were overage for their grade, a condition also associated with lower rates of Academic Achievement ( $5.15 \pm 3.02$  vs.  $6.65 \pm 3.69$ ) and Growth in English Proficiency ( $.35 \pm 1.03$  vs.  $.94 \pm 1.33$ ) based on independent sample t-tests.

To begin to understand how age-related factors affected the student experience, we explored some of the ways emergent bilinguals became students at Patriot High School. While some were born in the US, and some moved to a different country at an early age and only recently returned, most were born outside the US and moved to the Boston area as children or adolescents. Students we met reported immigrating for a variety of reasons, such as family reunification, family loss, political violence, escaping economic insecurity, or pursuing educational and work opportunities not available in their home country.

Educational experiences varied significantly depending on the age students had come to the US and the resources available to them in their home country. While the majority came from Central and South America—particularly El Salvador, Colombia, and Brazil—students at PHS had begun their lives in Vietnam, Egypt, Eritrea, the Dominican Republic, Honduras, and Puerto Rico as well. The following narratives from the students we interviewed help to explain the various pathways of becoming students at PHS, along with some of the challenges they encountered during their transition:

"I lived with my grandparents [in Colombia], but my grandmother died so I had to come here. My mom brought me, so then I started here in Patriot High School. My mother was already here. For my father, I don't know anything about him."

"I've been here for 1.5 years. When I came here [from El Salvador], I came on a bus. I came alone. It was just me. My family helped me with the money, but I was the one who decided to come to this country. I came because I wanted to have a good future. I didn't want to stay there. I want to go to college. I want to be something important in my life, so that's why I came to this country."

"I was born in the Dominican Republic. My whole life was spent there. I came here in 2014. At the beginning, I didn't want to come because it was a huge change coming from one country to the other. And my mom was like, 'Come on we have to go here.' And I was like, 'I don't want to change schools,' but then it was like my whole family, my dad, my sister, my mom were coming so I couldn't just stay there. So I was like, 'I gotta go.' So I came here two years ago."

"I was born here [in the US]. We went to Colombia when I was 3 years old and I came back when I was 14. My father was already here so I stay with him now. My mother is still in Colombia with my sister and family."

"[To escape violence] I walked for three days and four nights. From Mexico to the United States ... And then immigration took me. They took me in the prison for two-and-a-half months. Then my cousin sent me the [immigration] papers. He's my guardian now. I live with my cousin now. I call my mother every day. And she is living better now because I send money to her. And my life is better. I think I'll never go back to El Salvador. When I come to school, I'm feeling good. In El Salvador I never went to school because I only worked because I needed to make money to give to my mom for food and for everything else you need, like a house. So now she lives better and my future is better now. I think my future is here in this school. And when I finish school, I think I want to go to college."

*"My family helped me with the money, but I was the one who decided to come to this country. I came because I wanted to have a good future."*

As these examples show, education and opportunity figure prominently in students' narratives of immigration, but so too do the challenges of being uprooted from friends, family, and school.

Schooling experiences in the home country were particularly important for success when grappling with new academic content while simultaneously learning English. Most students related the educational experience in their home country to their current schooling experience at PHS. Many drew attention to the use of technology in the classroom as a symbol of superior education quality in the US or suggested that schooling here was more serious, teachers were more committed, and opportunities to learn English were prioritized compared with schooling in their home country. The following narratives are representative of our interview data:

"I'm not saying the education in my country [Dominican Republic] is bad or something like that. But here in this country, it is better .... This school provides a lot of subjects and it has technology .... In my old school we only had one room that had technology in it. And that was the class—like if you didn't have that class then you didn't use technology at all because cell phones weren't allowed there. They also provide students with groups and clubs here and that makes the students feel more comfortable here."

"The school [in El Salvador] was much different because they don't care about you. That's the truth. They just gave you the work and you had to do it. So they didn't teach you a lot. They teach you but they don't teach you a lot. Not the individual attention. Here is different. Patriot High School is like a college in my country."

"In my opinion, the way schooling is taught here is better than in Brazil. It is definitely better. We spend more time at school. We use technology. We have different subjects. It is not like Brazil. In Brazil we have like four periods a day but we just stayed at the school for three hours in the morning and that's it. And also you can't progress very easily. There if you fail a class you have to repeat the entire year, not only that one class. Here if you fail you'll repeat that class but ONLY that class."

"I went there up through ninth grade. Then I left and came here and I had to repeat the ninth grade because I didn't finish ninth grade in El Salvador. But here it is much better than the education in El Salvador. There we didn't have computers or iPads, so when the teacher would give us homework we would have to find the internet, but I didn't have a computer or anything to get information."

*"The school [in El Salvador] was much different because they don't care about you."*

Teachers who worked with immigrant students at PHS described the importance of being aware of both the differences in educational background and the trauma that many students sustained from the immigration process. Several students described detention in immigration prisons, stunning violence in their home countries, and lack of food and shelter at times during their immigration journey that have left them feeling unsafe even once such grave issues are resolved. An ESL teacher noted that teaching needed to support students from diverse backgrounds, including when significant amounts of schooling had been missed:

"We as teachers have to be cognizant of any PTSD or socioemotional trauma that our students are coming in with. Also the fact that many of those students have spent a long time—whether it is weeks or months or years—trying to get up here and what that means, not only for them socially, but about their prior schooling [e.g., missing significant amounts of school]. So especially at the lower levels and newcomer classes, having clear routines because these students have probably not had routines for a little while. And getting them used to having a Do Now... even something as simple as that, students know what to expect."

Another important issue for educators at PHS was to recognize the academic skills and knowledge students had accrued through schooling in their country. Adolescent immigrant students often brought subject-area knowledge and academic language with them from their education in their home country. Many students described a complex mix of challenging and less-challenging subject matter, such as a 10th grader who had immigrated from Colombia two years before: "I love math, seriously, but it is so easy it is frustrating. I'm really good in it, but I get bored because [the teacher]

is explaining things that are for kindergarten or something. I'm not learning so much, because I'm learning stuff that I already know."

Some students had learned advanced mathematics and science, and some had accumulated knowledge of academic language and literary concepts in their home language. Other students had missed significant amounts of schooling or attended poorly equipped rural schools in their home country that made routine coursework at PHS even more challenging. Our conversations with students and teachers highlighted the immense variability in immigrant students' educational backgrounds that teachers and students at PHS negotiated in each classroom.

### Family Poverty

Students with family poverty tended to have lower Academic Achievement ( $4.95 \pm 3.92$  vs.  $6.32 \pm 3.07$ ) and Growth in English Proficiency ( $.58 \pm 1.36$  vs.  $.65 \pm 1.13$ ) based on independent sample t-tests. As with prior educational experiences, students' day-to-day living situations varied a great deal. While many stayed with their parents, it was just as common for immigrant students to have more complicated living situations. For instance, some had family members that they reunited with upon coming to the US, extended family living together in one domicile, or were staying with aunts, uncles, grandparents, or cousins. A few reported that they lived with acquaintances or on their own. One student explained, "I live with my sister, my aunt, and my cousin. All my family is in this country. It's just my mom who is not here." Another described paying rent to the friend of a relative. And regardless of the living situation, many described barely seeing caretakers due to heavy work schedules. An ESL teacher noted, "With ELs, sometimes kids are living without their parents or living alone, so there are times when I'll try to call home but the student will be like, 'There's no one at home.' Which doesn't help."

*"...there are times when I'll try to call home but the student will be like, 'There's no one at home.'"*

Teachers understood that they needed to attend to the likelihood that some of their students had competing needs outside of school. They noted that the adversity faced by immigrant youth can make for a difficult classroom teaching environment: Some students are there because they want to learn, while others are there because they are obliged by the state to attend, and still others, with every intention of learning, are impeded by life challenges outside of the classroom.

### Student Work

Work was an important dimension of the life of most English learners. Paid employment was intertwined with educational experience for more than a third of students who participated in our study (36%). For these students, Growth in English Proficiency tended to be higher than for students who did not work ( $.96 \pm 1.17$  vs.  $.38 \pm 1.20$ ).

Students and teachers we spoke with pointed out the ways that work complicated schooling when students work during the evenings, on weekends, and during the holidays. Teachers estimated that most of their students worked nearly full-time jobs—a discrepancy with quantitative data that teachers suggest is related to fear of being reported to federal authorities. Following up on these findings, we co-led a discussion in a sheltered history class about work. The teacher asked his 30 students, "How many people here do work after school?" Nearly every student raised their hand. Then the teacher asked, "How many people do homework after they work?" Just a couple of hands went up.

The teacher called on a student who had not raised his hand and asked, “Why don’t you do homework after work?” The student responded that it was hard because he finished work at 1 or 2 in the morning. Follow-up questions established that most students finished their jobs after 10:00 p.m., and five students finished work after midnight. Students mostly worked at grocery stores or restaurants in Boston. One student said he worked at the airport pushing carts. Another girl packed boxes at UPS. An ESL teacher pointed out that a shift ending did not mean students were home getting ready for bed:

“Many of them—especially the boys—are working at restaurants in Brookline, Brighton, Somerville that are not easy to get to from here. That is like two hours on public transportation. They are working until one in the morning. I’ve gotten emails from kids at one in the morning at a bus stop taking a picture or in a restaurant taking a picture and they’ll email saying they haven’t got their homework done.”

Our variable of student work also did not reflect unpaid work. Immigrant girls were especially likely to work inside the home taking care of siblings while parents were at work, cleaning, and preparing meals. They also reported assisting family members in accomplishing doctor’s appointments, court dates, repairs, and public services. One student, who had immigrated from El Salvador nearly three years ago, explained her day as follows: “So I wake up at six o’clock. Because sometimes I have to help my brothers get ready for school. They are younger brothers—they’re 7 and 6—so I help my younger brothers. Then I do my own personal things. Then I have to take the bus [to get to school].” Another student described the types of responsibilities she was responsible for in her home:

“Because my English is good I can help my parents with translating things . . . . For example, when they have an appointment I have to be there. I talk for them sometimes. It is hard, because they are asking me to say words that I may not know in English, but how I explain to the other people is using more and more details so that they can understand. It is hard, like the after-school things, to do for my parents, like to teach them. It is a lot of pressure.”

*“...It is hard, like the after-school things, to do for my parents, like to teach them. It is a lot of pressure.”*

While recognizing the difficulties lack of sleep and packed schedules created for emergent bilingual students, teachers were also impressed by their students’ abilities to navigate in- and out-of-school challenges as well as they did. One ESL teacher explained:

“They’re working 5 or 6 days a week. Which is why my standards are so high and my tolerance for messing around is not there. I’m not giving them homework because I understand that ‘you are busting your butt outside of school, so take these 80 minutes inside of school and work’ and I am floored at how amazing these kids are to have a full-time job, a full time student, and learning a new language . . . . They are little hustlers. They work hard!”

As this teacher and others were well aware, students were obliged to work as part of their responsibilities. They worked to pay rent, to buy food, to pay bills, and to send money back to their families in their home countries. For these reasons, work was not optional; it was an expected contribution to household economic viability. The students we met with accepted work as an inextricable—albeit exhausting—part of their life.

The quantitative data highlighted a positive aspect of paid work for the emergent bilingual students: They had opportunities to use and learn English that their peers who did not work outside the home were not experiencing. While work provided many students with a boost in their English skills, the expectation of work also affected students' ability to fully engage in their studies. Often, homework was not completed, students were absent, arrived late, or were too exhausted to be attentive during class. While they were working, they were not sleeping, doing homework, or participating in extracurricular activities—in short, the expected experience of being a of an adolescent attending high school in the US.

Work presented a challenge for the school community. As a sheltered science teacher emphasized, it can take teachers some time to understand how different 'normal' is for immigrant adolescents who need to work: "Not the 'Hey you're 16, time to get a part-time job,' but the essential 'I'm helping my family pay bills' or 'I'm here living with someone that is not a family member, paying to be here' which is [difficult] to take into account because it is so different from what our [own] realities were." The following narratives illustrate the experience of many students classified as English learners at PHS:

"I work at IHOP. I work Monday, Wednesday, and Friday from 4:00 to 11:00 p.m., and then Saturday and Sunday I work from six in the morning until four in the afternoon .... My money, I send to my mom. But I also need to give it to my cousin for food and for rent, for everything, you know."

"I work Saturday, Sunday, Monday, Tuesday, and Wednesday. I work five days a week. It is not too bad .... I like work. I don't feel bad about that. I start at 3:30 p.m. and I get out at around 12 in the middle of the night .... I work in Back Bay at a restaurant that serves French food. It is really fancy .... The money I get from the restaurant I use to pay all my bills. My phone, the rent, to send money to my mom, money to my country. So that is what I do with the money.... I don't know how I do it, that's the truth. It is really hard when you work full time five days, then you got to go to school early."

As these short reflections by immigrant students highlight, the balance of work and school was challenging for teachers and students at PHS to navigate. As quantitative and qualitative data show, however, student paid work encompassed both opportunities and challenges as many students used and developed their language skills through their work. Sometimes, despite the best efforts of students and schools, survival in the real world ultimately lead to leaving school before graduation.

### *Language Use with Friends*

Language Use with Friends was an important indicator of the opportunities emergent bilinguals had to learn their new language and was positively related to Growth in English Proficiency ( $\rho = .232$ ,  $p < .05$ ). Overall, about half of students used mostly their first language when they were spending time with friends (49.1%) while nearly a third used both English and their home language about equally (30.5%), as shown in Table 4. At school in class, the majority of students spoke mostly English (56.4%) and nearly all (83%) reported using mostly English on their iPads and Chromebooks.

**Table 4. Language Use, percent of students (n=110)**

	Mostly English	About Equal	Mostly Home Language
At home	8.2	22.7	69.1
At school in class	56.4	26.4	17.3
With friends	20.9	30.5	49.1

\*Mostly English = using English 75% of the time or more, Mostly Home Language = Using English 25% of time or less, About Equal = Using both languages about 50% of the time

The importance of friends and peer talk cannot be underestimated. A shared experience that most English learners described was feeling fear, shyness, and aloneness upon arriving to PHS. They are new students. They do not know anyone. They do not share the same language with their teachers. Many are unfamiliar with the structure of classes. Some said they feel intimidated by mainstream students and teachers, who they may feel as superior to them, despite the challenges that English learners must work to overcome. Teachers and students both noted that socially, it is an extremely difficult transition. The following exchange with a student illustrates this challenge:

- M: I was feeling really badly [when she arrived here].  
TW: In what way?  
M: I didn't know anyone.  
TW: That must've been scary.  
M: Yeah, it really was. Really scary. I was so shy. And I didn't know any teachers and I didn't have any friends.  
TW: It seems like you are a confident, intelligent person now. What helped you feel more comfortable here?  
M: Some of my teachers. One of them helped me find a friend who was an English learner like me. He had been here for longer than me. He helped translate what I was saying to my teacher and how I make friends.

As expected, students who had higher levels of proficiency in English used more English when they were in class than those at intermediate or low levels of proficiency ( $3.245 \pm 0.869$  vs.  $.1527 \pm 0.965$ ). Similarly, students with low levels of English proficiency used more native language in class and when collaborating on projects with peers ( $4.264 \pm 1.131$  vs.  $2.092 \pm 1.202$ ). The same pattern of language use was found for using iPads and Chromebooks; students who were more comfortable in English and had achieved higher levels of proficiency used English more frequently on their iPads and Chromebooks. Adding detail to this finding, students were asked to self-report the activities they were most likely to do in English and their native language on the iPad or Chromebook. While students with more advanced English skills were more likely to do most or all activities in English, the majority of students found their native language more expedient for social media and social interaction online and many also reported watching movies and listening to music in their native language.

Students were asked to describe the aspects of their experience using the iPad or Chromebook for schoolwork that they liked and those that they did not. English learner students explained that many tasks were faster and easier on the digital device, something that students who were more proficient in English could use to greater effect. Students also liked the freedom to search the internet for resources and information, look up spelling and definitions, and translate words and texts from one language to another. Efficiency was also important to students who liked having access

to their schoolwork anywhere, handing in homework electronically, monitoring their own grades and assignments, and not having to worry about losing pieces of paper. They also pointed out that learning about technology was important. On the other hand, students also reported that distractions and navigating technical challenges took time away from their work. Several students mentioned that classmates who were playing around made it more difficult for them to feel motivated to work. Overall, nearly 71 percent of students in our sample thought that using iPad and Chromebooks in class motivated them to do better in school, but almost a third of students did not.

A challenge of using technology with emergent bilinguals outside of school is the dependence on written English to communicate with teachers. Findings showed that typing things out in English was frequently described as a deterrent when students had a question that required a nuanced or sophisticated response while students were still learning English. While one-to-one devices present an opportunity for dialog and more frequent communication within the classroom, they can also serve to have the opposite effect when EL students are outside the classroom. Students still grappling with learning academic English were reluctant to express themselves in texts, emails, and written assignments, or ask questions in writing. When emergent bilinguals did try, it could be difficult to comprehend their teacher's reply. As a history teacher put it:

"I have students that are emailing me and posting questions at 6 or 7 o'clock at night. I try to help them as much as I can. Some of the higher-level [English Proficiency] students I can explain, and they can get it. But it is more difficult for the lower-level kids to abstractly figure out.... I try to explain the question, pose a different way to say it [using email]. It is just easier in person."

As this teacher's comments show, language use was shaped in many ways by technology. One-to-one devices presented both opportunities for interaction and barriers to it. Language Use with Friends captured a more open set of communications with mostly bilingual peers that sometimes did and sometimes did not use technology and often drew on their native language as well as English.

### *Technology at Home*

Emergent bilingual students in our sample varied in the technologies that they had access to at home. About half of students had one or more computers in their home and nearly a third had a computer for their exclusive use as shown in Table 5. Students who had computers at home or a computer at home for their exclusive use had higher grades than students who did not ( $\rho = .427, p < .01$ ) based on one-way ANOVA. The presence of computers in the home indexed opportunities for students to understand and use technology for school-related tasks. Conversely, the presence of televisions and console gaming systems (such as Xbox or Play Station) was negatively associated with students' Academic Achievement ( $\rho = .470, p < .01$ ).

For 4.5 percent of students in our sample, internet access was not available at home at all and for 20.9 percent of students, the internet was only available sometimes at home. For this quarter of our student participants, many of the advantages of technology-enhanced learning were limited, and indeed, the expectations of using a one-on-one device were challenges.



**Table 5. Technology Use, percent of students (n=110)**

	None	In the home	Exclusive use
Computer	27.3	42.7	30.0
Television	10.9	50.9	40.0
Game System	30.0	39.1	30.9

Students with parents who could use an iPad well or very well, and who had set rules for its use were more likely to report that they liked using the iPad for schoolwork ( $\rho = .385, p < .05$ ), and were more likely to have higher grades ( $\rho = .301, p < .01$ ). In total, 62.7 percent of parents knew how to use iPads while 27.3 percent did not. Only 29.1 percent of parents had made rules for using the iPad. Most of these were vague and not often enforced, such as “don’t spend too much time on the iPad” or “only for schoolwork.” A minority of parents had more specific and enforceable rules such as not using the iPad past 9 p.m. or not using the iPad in the bedroom. Understanding how to use the iPad and making rules for its use were positively related to students’ grades ( $\rho = .470, p < .01$ ).

Qualitative findings add detail to descriptive analyses. Nearly all students we spoke with indicated that they did have internet access at their home, but many also reported lapses in connection or extremely slow connection speeds. Some had only recently received internet service at home, while others spoke of interruptions in service. Intermittent or slow internet service poses challenges for the full utilization of Chromebooks and iPads that mostly depend on the web to be an effective learning tool. Students spoke in different ways of how they navigated this challenge: Some went to the nearest Dunkin’ Donuts that offered free Wi-Fi, others went to school early to the Learning Commons to access the internet, and still others used their smartphones to log onto Google Drive and Schoology to do their homework. Students also indicated that if they needed the internet for homework, they simply would not do the assignment. For one senior who was mostly in mainstream courses where teachers were less familiar with the needs of immigrant students, she found that teachers frequently expected her to submit assignments from home. This was a challenge because she did not have internet at home. As a work-around she used her phone—a smartphone—to complete essential tasks from home. Otherwise, she made a point of arriving at school extra early to complete the assigned tasks.

The experiences of many English learners with technology was initially very limited. For many immigrant students, the iPads and Chromebooks they rented from school were the only computers in their homes. Teachers needed to teach students how to use the devices and the technologies they contained for school-based practices including basic computer usage to more complex multi-program tasks. An ESL teacher who works with newcomers described this hurdle:

“I like [Chromebooks]. I don’t want them to go away. But it is difficult in the sense that [for] a lot of my students, you can’t just say, ‘Go on Schoology,’ ‘Go to YouTube’ . . . There needs to be a lot of step-by-step explaining of how to use technology. Like ‘click on this’ or ‘look here.’ . . . Something as simple as ‘email me your project,’ that has to be a Do Now at the beginning of class or at the end of class. ‘Does everyone know how to get onto Gmail?’ So there is a lot of learning for that. I think it is important because this is the world we are living in.”

Teachers and students were aware of the diversity of experiences with technology that immigrant students brought to the classroom and worked to improve technological literacy at the same time as they used iPads and Chromebooks to learn academic content and English.

## *Academic Engagement*

Academic Engagement is a well-known predictor of Academic Achievement and, in this study, it is also a strong predictor of Growth in English Proficiency. Students in our sample who reported high levels of Academic Engagement on average had higher grades ( $\rho = .314, p < .01$ ) and tended to have higher levels of Growth in English Proficiency ( $\rho = .426, p < .01$ ) than those who were less academically engaged. Attendance, a related student-level indicator recorded by the school, was strongly correlated with our measure of Academic Engagement ( $\rho = .730, p < .001$ ).

Teachers described many aspects of their work to shape classrooms that were structured and held high expectations for students, yet were interpersonally engaging and caring in an effort to reduce the disengagement of their students. Several teachers commented on the need to motivate students to continue their schooling even when the going was tough. As one ESL teacher explained, "I've had students have to drop out because they're the breadwinner and they have to pay rent. And that is really unfortunate."

Technology was both an immediate distraction and a long-term support for Academic Engagement. Personalized forms of technology often contributed to lapses in attention in the classroom context—a beeping text message, for example, or the temptation to play music videos rather than pay attention during class. In this respect, teachers recounted that Chromebooks had better utility than iPads. Sometimes students toggled between YouTube videos and their note-taking Google Chrome applications, or propped their cellphones against their laptop so they could continue playing games or accessing social media sites on the less-restricted device. One teacher described this challenge in the following way: "You can have the best classroom management skills ... but you will always have a good 10–20 percent of your kids who have a second screen going. It could be something as harmless as they are watching a YouTube video .... It is just the way we are now."

*Technology was both an immediate distraction and a long-term support for Academic Engagement.*

Other teachers were not as tolerant, characterizing technology as a competitor for students' attention in an ongoing battle: "I think you just have to walk around the room. You have to keep checking in. And I think one of the most successful strategies is I had a sheet with their names on it and if anyone was off task when I got to their desk, I was going to give them a zero for that period of time."

Despite the annoyance of students' off-task use of technology, most students and teachers we spoke with agreed that the less restricted environment of the one-on-one device was supportive of their learning. For example, one student reflected, "I mean, I love to listen to music, but I love to do my work too. So I like to listen to music while I do my work. Many students do this." Teachers reported that using one-to-one devices required youth to demonstrate a level of self-discipline that could be difficult to maintain if not properly scaffolded. In this sense, technology represents a fulcrum for students who are at risk for disengaging, either bolstering their academic engagement or undermining it. The effective use of technology at PHS needed to take access to technology into account by carefully structuring activities that require technology in a way that gives students guidance for what they need to accomplish.

## *Classroom Instruction*

Instructional Support measured the degree to which classrooms were student-centered by looking for concrete, behavioral evidence of the types of interactions taking place in a classroom during a few typical lessons. On the seven-point amalgam scale, classrooms varied immensely, from 2.50 to 5.50 ( $M=3.651$ ,  $SD=0.860$ ). Classrooms scoring as low as a 2.5 were far more teacher-centered and rote in their approaches to engaging linguistically and culturally diverse students in learning language and content. Classrooms that were as high as 5.5 on the scale scaffolded learning using more interaction between students and teachers and students with their peers to achieve deeper and more inclusive learning with technology.

Instructional Support in the classroom was positively related to Growth in English Proficiency over the year ( $\rho = .233$ ,  $p < .01$ ). Three indicators of this dimension of the CLASS-S observation protocol were also significant: the level of Analysis and Inquiry, indexing the facilitation of higher-order thinking, opportunities for novel application of skills and concepts, and metacognition ( $\rho = .302$ ,  $p < .01$ ); Quality of Feedback, referencing teacher use of feedback loops, scaffolding, building on student responses, and affirmation ( $\rho = .204$ ,  $p < .05$ ); and Instructional Dialogue, including the cumulative content-driven exchanges, distributed talk, and use of facilitation strategies in the classroom ( $\rho = .259$ ,  $p < .01$ ). Findings from our quantitative classroom observation tool captured the importance of depth of student engagement with academic concepts through teacher and peer support for language development.

Instructional Support was also positively related to the student's grade in the class we observed for the year ( $\rho = .238$ ,  $p < .01$ ). Two indicators of this dimension were also positively related to Academic Achievement: The level of Instructional Learning Formats, referencing how learning targets were used and how technology, materials, and teaching strategies were employed to actively engage students ( $\rho = .225$ ,  $p < .05$ ); and the Quality of Feedback, which references the teacher's use of feedback loops, scaffolding, building on student responses, and affirmation ( $\rho = .326$ ,  $p < .01$ ). Findings demonstrated the important link between Academic Achievement and effective use of multiple modalities (rather than 'chalk and talk'), and teacher and peer support for academic concept development in the classroom.

Qualitative findings were used to better understand the classroom processes indexed by quantitative classroom observations. Instructional Support captures the degree to which classrooms used strengths-based, student-centered instructional approaches that resulted in student engagement and learning. In particular, our focus in this study is on the ways that teachers and students chose to use technology as part of their teaching and learning processes.

Most teachers facilitated project-based learning by using technology as a teaching tool, the one-to-one devices being but one of several technologies in play in the classroom. We observed students using their cell phones to make video presentations; using a cloud-based interactive game to improve English vocabulary; finding subtitled YouTube videos to demonstrate chemical reactions; or using Google Drive and Schoology to interact with lessons on smartboards and one-on-one devices. For instance, in one ESL classroom, the teacher began class with a YouTube video, one produced by the teacher herself and featuring the other ESL teachers modeling poor and good reciprocal teaching practices. After reviewing the video with students, the teacher put an internet timer of "40:00" on her smartboard and students worked in pre-established groups of three or four to review short

*Most teachers facilitated project-based learning by using technology as a teaching tool, the one-to-one devices being but one of several technologies in play in the classroom.*

books about world leaders. The group we sat with had a book on President Obama. Using reciprocal teaching, the group read the book interactively, pulling out key points, and asking and answering questions of the text. Each group included at least one student who owned an iPhone, and the groups used the iPhones to record a short video book report that they uploaded for their teacher to grade. In this example, we saw that technology was used to facilitate inquiry and collaboration in support of thematic academic content including assessment.

Findings also show a strong trend toward using technology to provide students with ownership and independence in their work. Because all students had their own laptop, they could work at their own pace while ultimately being held accountable for the work that they did. This can be seen in the cross-class example of note taking. Students color-coded, formatted, and saved notes to their personal files for each class and accessed them when they chose. In one class, for example, we sat beside a girl who allowed us to watch her as she took notes during her sheltered history class. She comfortably worked on her Chromebook making sure font-size, spacing, and formatting were appropriate and that her notes were complete, including teacher and student comments not written out on the board. Her familiarity with Schoology and Google Drive were evident in her customization of her notes and her assurance that they would be available when she needed them.

The quality of feedback that students received was also anchored in technology. A practice that demonstrated the relationship between feedback and technology were the videos produced by students and teachers across classes. In many classes, students watched instructional videos projected onto a screen at the front of the classroom while teachers facilitated discussions about the videos. However, by having their own Chromebooks, English learners had the ability to differentiate instruction and re-watch sections of a video to grasp key concepts or work through complicated language. For instance, in a biology class, the teacher's lecture focused on photosynthesis and cellular respiration. She reviewed slides on the Smartboard. Together, the teacher and the class worked through some complex definitions of these terms with multiple feedback loops and abundant scaffolding. Finally, the teacher was able to provide students with individual attention as she shifted from whole class discussion to having them use their own laptops to review material and identify their questions. In another example, the teacher began the class with a video Do Now. The video was about three minutes long and depicted two women shopping for clothes. At the same time, on the right-hand side of the screen there was a series of 10 multiple-choice comprehension questions to answer about the video, such as "What size of shirt did she need?" When students were done, they clicked "finished" and instantly received a score of correct answers out of 10. They then submitted their responses, which his teacher received instantly, and reacted to in the moment. This same type of instantaneous feedback was routinely used by teachers during Do Now activities. Since most Do Nows take advantage of a cloud-based interface, teachers can instantly tell whether students have completed the assigned task or not by simply refreshing their browsers.

*"...by having their own Chromebooks, English learners had the ability to ... grasp key concepts or work through complicated language."*

Teachers used technology to improve communication inside the classroom. One of the most important functions that technology had was to offer some conceptual clarity through visual communication that augmented spoken instructions. For example, most teachers we met with used their smartboards regularly. In an interview, one teacher described her approach in the following way: "I love the smartboard. Being able to have immediate access to the internet, the kids can share things with you, we can look at videos. There is just so much. If I was to come into school and it was

broken I would have to go home. I would not like to teach without it.” Teachers and students also took advantage of the out-of-class communications abilities of their iPads and Chromebooks to email their questions using their school-issued Google email accounts. To varying degrees, teachers also provided different internet communication platforms for real-time feedback using software functions such as WhatsApp, iMessage, or Dropbox. In an ESL AP English class for example, the teacher informed students of specific times that she would be sure to be online in front of her computer in case students had questions about the essays they were writing. She gave students instructions for how they could share their work using Google Docs and then receive feedback in real time via the “comments” function. “Essays are due on Monday,” she said. “If you need help, just email me and I can be sure to be online to help.”

In sum, one of the ways that technology served to promote student-centered learning was through its seamless incorporation in project-based learning that was responsive to the needs of immigrant adolescents still learning English. Teachers described such an approach as naturally aligned with the learning needs and strengths of English learners. As one ESL teacher noted, “We have so many different cultures coming together. Usually those cultures value collaboration .... So I feel like you already [make your class more student-focused] in an ESL classroom. You already have students collaborate.” At times, technology was a catalyst for teachers to take on more project-based approaches to teaching and learning. Another ESL teacher reflected, “Basically I do more project-based assessments. There’s a lot more group work where I’m just facilitating or aiding in their comprehension. And I like it a lot better than just rote memorization, always in rows, always by themselves. I see a value in collaborative learning.” Students also commented on the utility of the student-centered approach enabled by technology. A sophomore explained, “So maybe one person knows more about a word, or maybe they can explain that word using different words, so other people can understand that .... You have to work with three other people, so you can ask them and share ideas and you can understand more.”

Some of the advantages of technology, however, are predicated on an approach that has students take on study and preparation at home during non-school hours. But as we learned, English learners were often inundated with out-of-school responsibilities and were deterred by the challenge of expressing complex ideas in a new language. From observations and interviews, it became clear that teachers used a hybrid approach to bringing technology into their classrooms, one that aimed to respond to the constraints and opportunities of the lived experience of their English learner students. As one teacher of newcomers reflected: *“I love the idea of it and that kids have the Chromebooks .... But I try to [use them]] in a way that works for [immigrant] kids in the sense that that video they would have otherwise watched at home is going to be the Do Now at beginning of class.”*

## **Modeling the Impact of Student Characteristics and Classroom Teaching with Technology on Growth in English Proficiency**

Exploratory analysis demonstrated that a large number of individual variables were related to Growth in English Proficiency. To avoid multicollinearity and confounding factors, not all variables that were significantly related to outcome measures could be included in final models; researchers removed closely-related individual-level variables until the condition number was less than 30 and only variables that predicted Growth in Language Proficiency at  $p < .05$  at Level 1 were retained. Table 6 displays bivariate correlations among level 1 and level 2 variables used in the final model.

**Table 6. Correlations and estimate coefficients for two-level HLM for Growth English Proficiency.**

Variables	Mean	SD	Beta	P-v	1	2	3	4	5
1. Growth in English Proficiency	.628	1.212							
2. Overage	.527	.502	-0.607	0.004	-.243*				
3. Student Work	.427	.497	0.503	0.018	.234*	.118			
4. Language Use with Friends	1.718	.791	0.279	0.046	.226*	.193*	-.018		
5. Academic Engagement	20.779	3.037	0.072	0.036	.205*	-.284**	-.143	-.077	
6. Instructional Support	3.591	.542	0.452	0.140	.233*	.110	.155	.223*	-.103

Since individual students are nested within classrooms and the estimated inter-class correlation coefficient of .291 indicates that approximately 29.1 percent of the variance in Growth in English Proficiency over the year was due to classrooms, a two-level hierarchical linear regression model (HLM) was used. We used SAS PROC MIXED (SAS 9.4) to estimate Equation (3) using a maximum-likelihood approach. The estimated beta coefficients are listed in Table 13. Compared to the null model, predictors in the final model explained 9.3 percent of Level-1 variance, and 56.8 percent of Level-2 variance.

On average, students gained .63 points over the year (SD=1.21). Table 7 shows that controlling for Overage, Student Work, Language Use with Friends, and Academic Engagement, with each unit increase in Instructional Support, an increase of .45 points in Growth in English Proficiency (about a half of proficiency level on the ACCESS) is expected. The relationship between Growth in English Proficiency and Instructional Support was positive although it did not reach significance in the final model.

**Table 7. Solution for Fixed Effects for Growth in Language Proficiency**

Fixed effects	Estimate	SE	DF	t Value	Pr >  t
Intercept	-2.8335	1.3327	8	-2.13	0.0662
Overage	-0.6070	0.2073	96	-2.93	0.0043
Student Work	0.5027	0.2084	96	2.41	0.0178
Language Use with Friends	0.2790	0.1383	96	2.02	0.0464
Academic Engagement	0.07209	0.03395	96	2.12	0.0363
Instructional Support	0.4520	0.3038	96	1.49	0.1402

Several student-level variables were powerful predictors of Growth in English Proficiency in this model. Controlling for all other variables in the model, a unit increase in Language Use with Friends corresponds to a .28-point increase in Growth in English Proficiency. For each unit increase in Academic Engagement, Growth in English Proficiency is expected to increase .072 points. Similarly, holding all factors constant, a student who worked after school tended to be 0.5 points higher in Growth in English Proficiency, and overage students tend to be 0.61 lower. The results indicate that the average Growth in English Proficiency for a reference student—a student who is average in Language Use with Friends and Academic Engagement, is overage for their grade, does not work, and who received average amount of Instructional Support in their classroom—was .24.

The practical significance of our results was assessed by estimating the change in proportion of variance explained at each level between the null model to the final model (Raudenbush & Bryk, 2002). At Level 1, the final model explained just 9.3 percent of variance in Growth in English Proficiency, suggesting the need to identify additional student-level variables. At Level 2, more than half of between-class variation in average Growth in English Proficiency was explained. However, chi-square statistics associated with the coefficient's variance indicate that a substantial amount of variance remained unexplained and may be attributed to classroom variables not measured here, including effects from other classrooms that students participated in throughout their day.

## Modeling the Impact of Student Characteristics and Classroom Teaching with Technology on Academic Achievement

Exploratory analysis demonstrated that a large number of individual variables were related to Achievement. To avoid multicollinearity and confounding factors, not all variables that were significantly related to outcome measures could be included in final models; researchers removed closely-related individual-level variables until the condition number was less than 30 and only variables that predicted Growth in Language Proficiency at  $p < .05$  at Level 1 were retained. Table 8 displays bivariate correlations among Level 1 and Level 2 variables used in the final model.

**Table 8. Correlations and estimate coefficients for the two-level HLM for Academic Achievement.**

Variables	Mean	SD	Beta	p-v	1	2	3	4	5
1. Academic Achievement	5.855	3.426							
2. Overage	.527	.502	-1.210	0.045	-.222*				
3. Family Poverty	.664	.475	1.383	0.024	.190*	.058			
4. Technology at Home	2.018	.766	0.940	0.015	.235*	-.001	-.008		
5. Academic Engagement	20.779	3.037	0.325	0.001	.314**	-.284**	.062	-.066	
6. Instructional Support	3.591	.542	1.650	0.005	.238*	.110	-.024	.148	-.103

Since the intra-cluster correlation for Academic Achievement is only 8.5 percent and Level 1 variation is not significant, a multiple linear regression model was used. The final model included Overage, Family Poverty, Technology at Home, Academic Engagement, and Instructional Support. The estimated coefficients are listed in Table 9. The final model explained 28.04 percent variance in Academic Achievement. On average students had grades of 5.7 points ( $SD=3.40$ ). The results indicate that the expected average value of Academic Achievement for a reference student with average levels of Academic Engagement and Instructional Support is 3.61 points. Table 9 shows that controlling for Overage, Family Poverty, Technology at Home, and Academic Engagement, each unit increase in Instructional Support, predicts an increase of 1.64 points in Academic Achievement (about a half of a letter grade).

**Table 9. Multiple Regression for Academic Achievement.**

Label	Estimate	Standard Error	t Value	Pr >  t
Intercept	-9.13954	3.04122	-3.01	0.0033
Overage	-1.21622	0.59716	-2.04	0.0442
Family Poverty	1.36910	0.60377	2.27	0.0254
Technology at Home	0.97238	0.37692	2.58	0.0113
Academic Engagement	0.33044	0.09866	3.35	0.0011
Instructional Support	1.64253	0.53651	3.06	0.0028

R-square = 28.04

Controlling for all other variables in the model, a single unit increase in Academic Engagement is expected to produce a .33 point increase in Academic Achievement. Similarly, the level of Technology at Home was associated with a .97 point increase in grades when all other variables were held constant. And all other factors being equal, a student who was overage for their grade tended to be 1.21 points lower in Academic Achievement whereas students with family poverty tended to be 1.37 points lower.

We established the practical significance our results by assessing the overall proportion of variance explained by our model, at total of 28.04 percent. Unexplained variance may be attributed to classroom variables and individual factors not measured in this study.





# Discussion



Our study asked how features of technology affected adolescent English learners, taking into account the immense variability among immigrant students and their classrooms. To develop this inquiry we used mixed methods to examine an urban secondary school with a high proportion of linguistically and culturally diverse students and a strong ongoing commitment to student-centered uses of technology in the classroom. Technology—in the form of one-to-one devices—was a source of both innovation and stasis in the classrooms we observed. The features of technology-enhanced classrooms that best supported language development and subject-area content mastery were aspects of instructional design that aligned with notions of student-centered learning and strengths-based teaching. That is to say, thoughtfully designed curriculum that accounted for English learners’ experiences outside of school was more successful than teacher-centered or rote approaches to instruction. Our findings also bring to light some of the unique factors from the lived experience of immigrant students that affected how they interacted with technology in their classroom, including technology use at home, whether students worked after school, academic engagement, and language use with friends. While most students were extremely positive about their experiences using the one-to-one devices in their classrooms, some were not convinced that they added value to their learning. Both perspectives are valid given the range of teaching practices observed in just one school.

Our findings have several implications for educators. First, English learners are a diverse group whose experiences outside of school are often markedly different from mainstream students and from each other. While some emergent bilingual students had little or no experience with complicated cloud-based applications, others had computers of their own at home and routinely used them for the types of literacy practices that transferred well to school tasks. Some students had educational backgrounds

from their home country that enabled them to do advanced mathematics and use strong academic language skills in their home language to tackle academic tasks and language learning at school. Others had missed significant chunks of schooling, were overage for their grade, and had few such resources to draw on as they tackled simultaneously learning a new language and mastering challenging secondary school content. School policy and instructional practice would do well to account for the demands of heterogeneous classrooms.

Second, although technology is a powerful lever for innovation in teaching and learning, it is resource intensive for teachers and students to integrate into classrooms effectively. The reality of technology is that it changes quickly; in our last year at PHS, teachers and students transitioned from iPads to Chromebooks, changed assignments from one application to another, rethought how to use and access the new set of resources, adapted how they crafted groups so that at least one student in each had an iPhone to make videos, and more. In a few years, Chromebooks are likely to be replaced by something else and teachers will need to adapt again, schools will need to invest in training and technology, and students and families will have to come to terms with the new approach. Continued investment in technology produced different results for different teachers: In some cases, technology provoked more thoughtful and student-centered teaching, while for others wasted efforts were avoided by simply giving a makeover to old teaching strategies. In short, technology is not a one-and-done solution to lagging academic achievement. However, it can be part of a complex and resource-intensive transformation of teaching and learning where schools, teachers, students and their families are willing to invest in the changes required.

*In short, technology is not a one-and-done solution to lagging academic achievement.*

Finally, technology is at the heart of a nationwide equity issue: How can we leverage its potential for teaching promising yet vulnerable youth, particularly those who are still learning English? More research is urgently needed to guide instructional practices for teachers of linguistically and culturally diverse students around the use of technology. Our study has made an important contribution by beginning to map the variety of individual and classroom factors that affect learning in technology-enhanced classrooms for English learners and their teachers. More inquiry about how the impact of such factors can be understood and thoughtfully engaged in classrooms is necessary to offer concrete recommendations to teachers and policy makers. We strongly recommend that research on this topic utilize mixed methods so that appropriate focus on both the patterns of student, classroom, and school factors as well as the processes and experiences that differentiate such patterns are apparent.

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Teaching and Learning with Technology in Linguistically Diverse Classrooms:  
A Mixed Methods Analysis of Adolescent English Learners in Technology-  
Enhanced Classrooms

*Report to the Nellie Mae Educational Foundation*

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