K-12 English Learners' Science and Math Education: A Question of Curricular Equity

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Introduction:
Academic Content and English Learner Achievement

Historically, English learner[1] (EL) academic achievement has lagged significantly behind that of both their English only and more English proficient peers. While at first glance, one might attribute these disparities to English proficiency alone, several decades of legislative (Castañeda v. Pickard, 1981; Lau v. Nichols, 1974; Sinclair, 2016) and empirical (López, McEneaney, & Nieswandt, 2015; Willig, 1985) evidence suggest that schools and educators play a crucial role in shaping EL achievement. Early EL education policy stressed the importance of ensuring content area access while students learned English (Del Valle, 2012; Hakuta, 2011; Mavrogordato, 2012), and researchers began to clearly identify various roadblocks to curricular equity. EL education policy speaks to the three legs of education: *Curriculum*, *Instruction*, and *Assessment. Curriculum* encompasses content area access and exposure; *Instruction* embodies the provision of pedagogical support; *Assessment* involves the measurement English proficiency and academic achievement, separately and combined. Woven through all three is the common theme of content area access and exposure, the backbone of curriculum, the goal of instruction, and the target of assessment. Educational equity for EL students would require equitable attention to all three areas, something the EL educational policy implementation has arguably not yet ensured.

Initial EL education policies sought to identify and classify EL students in US schools, and in doing so governed their program placement (linguistic support services), instruction, and assessment (Mahoney & MacSwan, 2005). In order to determine *which students* require

[1] In concordance with the extant literature, this report uses the term "English learner or EL" to define those students who enter U.S. schools speaking a language in addition to English, and who, upon initial assessment, are identified by the school as in need of linguistic support services. This term is used synonymously with the term English language learner/ELL, and Emergent Bilingual/EB (García, 2009b), all of which have replaced the deficit-oriented term, Limited English Proficient/ LEP (Lee-Webster & Chunlei, 2012).

linguistic support services, educators must assess the English proficiency of all students who speak a language other than English upon entry to US schools. While these support services are meant to facilitate overall academic growth and development, controversy has arisen in the empirical literature suggesting that in some contexts EL identification precludes full curricular access in the content areas. This review will synthesize research examining EL students' educational experiences through a lens of curricular equity, focusing on content area access.

Any discussion of EL content area exposure must address the centralization of academic standards, first at the state level, and now nationally, with the Common Core (2010). Recently, new instructional frameworks have emerged that promote linguistically rich teaching in science (National Research Council, 2012) and math (NGA & CCSSO, 2010) to which the research community quickly responded (Lee, Quinn, & Valdés, 2013; Moschkovich, 2012). These early responses, along with continued empirical inquiry, warn of the threat of conflating ELs' academic ability with their curricular exposure. As research and practice increasingly link ELs' language development to content area exposure, educators, researchers, and policy makers must be careful not to penalize these students for their lack of access to academically rich curriculum.

In fact, the most recent frameworks have articulated language demands that comprise considerable potential for literacy development (Kibler, Walqui, & Bunch, 2015) if EL students are in fact granted full curricular access. To fully realize this potential, for the new standards and frameworks to ensure equity, considerable efforts must be made to improve upon teachers' professional development for EL students (National Research Council, 2012; Quinn, Lee, & Valdés, 2012). In addition, if EL students are to truly access rich academic content, assessments must be developed alongside the new frameworks and standards (Bunch, Walqui, & Pearson,

2014). This is never so important as it is with respect to reclassification, or exit from EL status, which not only varies with, but also shapes ELs' content area access and exposure.

While initial EL classification is determined by a student's English proficiency, reclassification—or readiness to exit EL status and EL instructional programs and services—requires three things: evidence of English proficiency, educator approval, and grade level achievement (Mahoney & MacSwan, 2005). This report will focus on the final element, EL students' academic achievement as it relates to their content area exposure; reclassification will be addressed per its use as a metric by which to measure EL program effectiveness.

English Learner Education:

Content Area Instruction, Access, and Exposure

Historically, the bulk of research examining EL students' content area access in the elementary grades has focused on language of instruction (Baker, 2011) by comparing student achievement across various English-medium and bilingual program models (Collier, 1992; Thomas & Collier, 2002). The Supreme Court's decision in Lau v. Nichols (1974) highlighted EL students' need to access math, science, and other academic content *while* learning English. The Castañeda decision (1981) followed, requiring that schools demonstrate the effectiveness of their chosen EL instructional program models. As a result, EL student achievement and EL program effectiveness quickly became synonymous with English acquisition (Gándara & Merino, 1993; Sinclair, 2016). This perspective contributes to ongoing research and policy interest in reclassification as an indicator of EL student success. The following section will begin with an examination of the adoption of reclassification as an indicator of EL program success,

and in turn, curricular equity, followed by synthesis of research attempting to identify and measure EL students' curricular access at the elementary, then secondary levels. Finally, this section will close by turning our attention back to the original intent of EL educational policy—to ensure the provision of linguistic support services, and the final section will provide a synthesis of the research that attempts to estimate curricular, academic, and other effects of the EL label on bilingual students' comprehensive educational experiences.

Reclassification: Linking English Proficiency and Content Area Achievement

Framing reclassification as a measure of EL student progress inevitably conflates EL students' academic achievement with their curricular access. Importantly, if access to academic content is associated with EL students' achievement, as it is for non-ELs (Oakes, 2005), any reclassification-focused research, policy, or practice risks penalizing EL students for their lack of access to rigorous academic content. Educators have long pointed to the importance of correctly timing a student's reclassification. Specifically, reclassification by the end of the elementary grades is perceived to facilitate full content area access during the secondary grades.

In a longitudinal analysis of student-level data from Los Angeles Unified, the largest EL enrolling school district in the nation, Thompson (2017a) finds that the vast majority of EL demonstrate English proficiency within 4-7 years. However, her analyses also indicate that if an individual student misses the late elementary reclassification window, the likelihood of ever reclassifying drops significantly. In fact, a full 25% of EL students remained EL-classified after 9 years in the school system (Thompson, 2017a). The retention of students in EL status longer than necessary results in stigmatizing, negative educational experiences (Estrada & Wang, 2013; Thompson, 2015). Research has found assignment of long-term EL status to be problematic at

best, academically and linguistically detrimental to the students themselves (Calderón & Minaya-Rowe, 2011; Menken & Kleyn, 2009; Olsen, 2010). Specifically, Thompson (2015) shows how many long-term EL students "missed" their reclassification window at some point (i.e., reclassification requirements had been met, but not simultaneously). Missing the window results in 'long-term' EL status and placement in EL-isolated programs, which provide limited content area exposure (Thompson, 2015). Understanding the consequences, both individual and institutional, of EL students' unnecessary retention in EL status is critical to improving the role of reclassification, as both a marker of English proficiency and content area achievement.

To better understand the struggle to ensure rich content area access and exposure for EL students, it is critical to consider how policy makers came to treat what began as a measure of English proficiency as a measure of academic achievement and EL program success. Following the adoption of language from the Castañeda decision (1981) into the federal Equal Educational Opportunity Act (Del Valle, 2012), local and state education agencies (LEAs and SEAs respectively) were required to demonstrate the effectiveness of their EL instructional programs. To this end, reclassification rates provided a readily available and easily demonstrable measure of academic success. Originally conceptualized as an indicator of English proficiency, reclassification served to indicate a student's readiness for English-only instruction. Reclassification has evolved to require that students show: English proficiency, educator approval, and of academic achievement at grade level, generally reflected in grades and standardized test scores (Mahoney & MacSwan, 2005). It is important to note, however, that passage of the No Child Left Behind Act (2001), brought about three significant changes, First, for the first time, SEAs and LEAs were to be held accountable for EL students' academic performance. Second, assessments of the four domains of English proficiency (reading, writing,

listening, and speaking) were to be standardized at the state level and administered annually. Third, English proficiency would, over the next decade, became more closely aligned to state-level content standards (e.g., WIDA, ELPA-21). These three policy changes further bolstered the relationship between reclassification and EL students' academic achievement.

Elementary EL Education: Curricular Equity through Language of Instruction?

Historically, bilingual education researchers have framed program models, and more specifically, language of instruction as an indicator of academic content area access and exposure (August & Hakuta, 1997; Baker, 2011; García, 2009a). While this work was essential to setting the stage to understand how instructional program design could optimize bilingual students' learning outcomes, some of the earlier work did not control for a range of covariates of achievement such as social class, that are also related to a student's likelihood of placement into a given program (Collier, 1992; Thomas & Collier, 2002). More recent research has begun to examine program model effects while also accounting for nativity and other covariates of both program placement and achievement. For example, in a longitudinal analysis using 12 years of school district data, Umansky and Reardon (2014) found a relationship between the type of EL instructional program a student experiences during elementary school and exit from EL status via content area access as measured by test scores. Specifically, although students in bilingual programs (transitional, maintenance, or dual language) took more time to exit from EL status than their peers in English only programs, by the end of high school they demonstrated significantly higher reclassification rates, English proficiency, and academic achievement. These newer methodological approaches permit the analysts to accurately account for the selection of students into specific bilingual and English-medium instructional models.

Initially, primary language instruction, delivered through bilingual and dual language education program models, was intended to ensure content area access while EL students developed English proficiency (Del Valle, 2012; Mavrogordato, 2012). These most recent studies allow researchers to demonstrate how primary language instruction during the elementary grades facilitates achievement, in theory through higher rates of content area exposure and curricular equity than in English-medium instructional programs. In further analyses using 10 years of bilingual students' data in a large district, Umansky (2016) was able to disentangle some of the negative effects associated with EL status in the elementary grades. Her analyses found that only when bilingual students are placed in English-only instruction is EL classification negatively associated with academic achievement, here measured by test scores (Umansky, 2016). Even very early on, content area access shapes EL students' academic trajectories.

The theoretical foundations of bilingual education are key to understanding EL student achievement across a range of program models. Initially proposed as a solution to solve the "problem" of bilinguals' lack of English proficiency, primary language instruction emerged at the forefront of educational policy with the 1968 Bilingual Education Act (Evans & Hornberger, 2005; Ruiz, 1984). From these deficit-oriented roots, bilingual instruction was framed not as a path to rich academic development, but rather, as a means to English proficiency for those who fell short of monolingual English norms. To this day, the underlying goal of many U.S. bilingual and EL programs remains to move students to English-only instruction as quickly as possible (Ramírez, et al., 1991), as evidenced by the empirical framing of reclassification as a measure of EL instructional success. That said, even with these dubious origins, EL students educated in bilingual education programs consistently demonstrate higher levels of achievement than their peers in English-only contexts. Importantly, in a national study of state-level policies regarding

bilingual and English-medium instructional programs, López and colleagues (2015) found Latino ELs to benefit from the presence of bilingual programs in their states, even if they themselves did not receive primary language instruction.

Structured English immersion and other English-only instructional models focus on rapid reclassification on the path to English proficiency, but to questionable results. Slama's (2014) longitudinal analyses found that students who were reclassified early in elementary school (grades K-2) struggled later on, with nearly a quarter being held back a year. In later analyses of data from the state of Massachusetts, Slama, Haynes, Sacks, Lee, and August (2015) illustrate how early reclassification among ELs in English-only contexts is not only associated with retention, but also with attrition from the K-12 education system entirely. EL students' early access to academic content, notably higher in instructional program models using the primary language (Calderón, Slavin, & Sánchez, 2011; García, 2009a) clearly shapes their long-term academic trajectories. While the immediate result (early reclassification), may initially appear to mark success, the long-term consequences—retention and attrition—arguably matter more. Framing reclassification as an indicator of EL program success in line with Castañeda's third prong takes attention away from EL students' access to academic content, especially in the elementary grades.

In fact, the vast majority of bilingual and EL educational research focused on STEM content areas in the elementary grades focuses on teachers' pedagogical skills and professional development. In fact, multiple database searches[2] regarding EL students' elementary grade

[2] For example, an EBSCO search using the targeted terms "content OR curriculum" as well as a range of terms for STEM, EL students, and the elementary grade span produced 157 peer-reviewed publications covering: pedagogy/ instructional strategies (n=75), professional development (n=21), teachers' knowledge, beliefs, perceptions (n=33), curriculum development (n=7), and several other topics, none of which addressed content area access (n=15).

content area access and curricular exposure inevitably led back to questions of teacher pedagogy and practice, with no clear measures of curricular exposure and content area access, less placement in program models that employ primary language instruction to facilitate such access.

To date, no comprehensive study has systematically examined elementary EL students' curricular access or content area exposure, either at the national, state, or local level, relative to their native English speaking peers. Even in Umansky and Reardon's district, with a relatively large share of EL students enrolled in some sort of primary language instruction, nearly two-fifths (38%) received English-only instructional programs. When primary language instruction is presented as a means to ensure curricular equity, it is important to note that the vast majority of EL students will not, in fact, experience primary language instruction; even when bilingual education programs exist, a substantial share of EL students cannot access them.

Secondary EL Education: Curricular Equity via Course taking

The decentralized nature of U.S. education makes identifying, much less measuring individual students' curricular access and content area exposure difficult at best. Over the past two decades, federal educational policies have focused on Assessment, through comprehensive accountability systems designed to measure student outcomes, while Curriculum (content area adoptions) and Instruction (professional development and program design) decisions occur at the state and local levels. Historically, SEAs will identify a set number of curricular options for each content area (e.g., math, science) and for each grade span (elementary, middle, high school) from which LEAs then choose. In turn, LEAs are left to determine the program models and type of instruction that best suits their local population and resources, human and otherwise. As a result, the U.S. educational system maximizes variability in curricular access and content area exposure

across contexts. At the elementary level, bilingual and EL educational researchers have focused on program models and delivery of instruction to measure curricular equity. In contrast, secondary educational researchers have attempted to account for some of this local variability by using students' course placement as a metric of content area access and exposure. For example, 8th grade placement in Algebra I (Gamoran & Hannigan, 2000; Stevenson, et al., 1994) has long served as an indicator of an individual's access to rigorous mathematics content. Likewise, completion of Chemistry by 11th grade is used to indicate some degree of college preparatory curricular access. In the absence of a national curriculum (Apple, 1993), stratification has emerged both within and across schools, districts, and states.

Race, ethnicity, and gender: Who has access, and to what? At the high school level, course-taking provides a somewhat nuanced indicator of academic achievement and postsecondary preparation. The sequential nature of math course taking makes it a de facto gate-keeper to more rigorous math and science courses (Gamoran, 2010; Lucas, 1999; Lucas & Berends, 2002; Oakes, 2005). Specifically, Algebra II has been identified as a core indicator of preparation for higher education at the national level (Adelman, 2006). Likewise, in a study using the nationally representative High School Longitudinal Study (HSLS:2009) data, Schneider and Saw (2016) found course taking to be a stronger predictor of college-going than individual students' concrete knowledge of college itself. Here, course taking itself improves the likelihood of college going for academically marginalized youth.

The potential of course taking to improve equity is, of course, limited by the inherent variability in course placement across U.S. high schools. Race, ethnicity, and gender have all been found to be more highly associated with course placement than prior achievement or merit (Muller, et al., 2010; Riegle-Crumb, 2006; Riegle-Crumb & Grodsky, 2010). This is especially

troubling given the strong relationship between race/ethnicity and students' postsecondary mathematical qualifications (Martin, 2009). In a national analysis examining how adult wage potential is associated with high school math course taking, Battey (2013) found evidence to suggest that high school course-taking operates as a form of racially-bounded opportunity hoarding (Kelly & Price, 2011). Battey argues that differences in high school math course-taking institutionalize white Americans' economic advantages in the decades following high school graduation over their peers of Color. It is not just in the economic arena that high school course-taking has been found to have long-lasting effects. Carroll, Muller, Grodsky, and Warren (2017) find an association between high school course-taking and middle age health outcomes, even after accounting for social class, prior health, and numerous other factors. Given the academic, professional, and health consequences; high school course-taking requires empirical attention.

As a measure of curricular access, high school course-taking is highly associated with numerous individual characteristics that have little to do with students' prior achievement. Even school and community location matters when considering access to academic content. In analyses of NAEP 2005 course-taking data, Cha (2015) found that students enrolled in suburban schools had higher odds of completing advanced math coursework. Similarly, using NELS:88 data, Lleras (2008) found enrollment in predominantly black, Urban high schools to be associated with significant disadvantaged course-taking options relative to suburban districts. In an investigation of access to advanced math courses within the context of the New Latino Diaspora[3], Dondero and Muller (2012) found evidence of greater Latino-white disparities in math course taking in new Latino destination communities. Using national data (ELS:2002,

[3] The New Latino Diaspora: Research in this area examines the relatively recent (past 20 years) movement of new immigrants and Latinos into the Midwest and the US Southeast. For more information on this topic, see writings on the New Latino Diaspora (Lowenhaupt, 2016; Millard & Chapa, 2004; Wortham, Murillo, & Hamann, 2002).

SASS:1999-2000), the authors were able to take school composition, quality, and resources into account in this examination of curricular equity via math course-taking.

Access to high level math and science courses in U.S. high schools is associated with not only individuals' race, but also school racial composition (Lucas & Berends, 2007; Muller, et al., 2010; Palardy, et al., 2015). Using ELS:2002 data, Riegle-Crumb and Grodsky (2010) found that among those students who reach the highest levels of math course-taking, low-income Hispanic students and African-Americans enrolled in segregated schools struggle the most to close the race-based achievement gap. In addition, school composition may matter more for EL students. In high EL-density schools not only will only 1 in 3 students graduate (Silver, Saunders, & Zarate, 2008), but second-generation EL students experience a more concentrated negative estimated effect of ESL placement on their math and science course-taking than their foreign-born peers (Callahan et al., 2009). Although not specific to the EL population, these findings do suggest that EL students, 77% of whom are Latino Spanish speakers[4], experience limited content area access even before accounting for language. Building on these general lines of empirical inquiry, the following section will review research focused more narrowly on EL students' high school course-taking.

EL course-taking: Content area access and curricular equity. These patterns of disparate content area access and equity have led researchers to examine the overall high school course-taking of immigrant and language minority students. At the bivariate levels, absent any controls, Callahan and Muller (2013) draw from two nationally representative longitudinal high school student datasets, the Adolescent Health and Academic Achievement (Add Health-

[4] https://nces.ed.gov/programs/coe/indicator_cgf.asp

AHAA), and the Educational Longitudinal Study (ELS:2002) to compare the high school course-taking of children of immigrant parents with that of children of native-born parents in the late

Table 1

Table 4.1 *High School Academic Achievement and Attainment, by Immigrant Status: Proportions, Means, and Standard Deviations for Averages, 1994–2001 and 2004*

		Course-Taking					
	N	Highest Math[ab]	Standard Deviation	Algebra II or Higher	Social Science Credits[ab]	Standard Deviation	College Prep Social Science[b]
Add Health							
Children of immigrants	2,445	6.34	(1.64)	0.67	3.44	(1.10)	0.34
Latino	1,198	5.67	(1.48)	0.53	3.19	(1.19)	0.27
Asian	734	7.19	(1.30)	0.83	3.53	(0.75)	0.41
Children of native-born	9,128	6.03	(2.04)	0.62	3.55	(1.44)	0.26
Latino	599	5.63	(1.75)	0.51	3.16	(1.38)	0.24
Asian	166	6.26	(1.42)	0.66	4.07	(0.81)	0.23
ELS							
Children of immigrants	2,992	6.45	(1.64)	0.68	3.54	(1.15)	0.25
Latino	727	6.07	1.72	0.60	3.36	1.28	0.19
Asian	996	7.34	1.09	0.84	3.66	0.78	0.42
Children of native-born	8,792	6.55	1.84	0.73	3.75	1.29	0.23
Latino	581	6.07	1.79	0.63	3.47	1.33	0.12
Asian	65	6.64	1.86	0.63	3.67	1.24	0.25

Source: Add Health (Bearman et al. 1997), AHAA (Muller et al. 2007), and Education Longitudinal Study (Ingels et al. 2004).

[a]Differences in means between children of immigrant and native-born parents are significant at $p \leq .01$ or less in the ELS data set.

[b]Differences in means between children of immigrant and native-born parents are significant at $p \leq .01$ or less in the Add Health data set.

Table Source: Callahan, R. M., & Muller, C. (2013). *Coming of political age: American schools and the civic development of immigrant youth*. New York: Russell Sage Foundation (Table 4.1, page 66).

1990s and early 2000s. We see that in both datasets, two-thirds of immigrant youth complete Algebra II by the end of high school, this trend is driven by the high shares of Asian immigrant youth who complete significantly higher math courses than their peers across the board, which

echoes studies finding that students who speak languages other than Spanish are more likely to be reclassified (Grissom, 2004; Thompson, 2017a). Not only do the children of immigrant parents in both datasets exit high school having completed significantly lower levels of math coursework than their peers of native-born parents, but they also complete significantly fewer social science credits overall, and are significantly less likely to take honors social science coursework.

More recent data from the HSLS:2009 high school transcript study[5] demonstrate students' course-taking patterns over a decade later, and after the onset of the national accountability movement initiated with the No Child Left Behind Act (2001). Once again disparities in course-taking emerge by student linguistic status. Table 2 compares native English

Table 2

Highest Math Course Completion by Linguistic Status Share of Student Group)

	Bilingual EL Student (N=550)	Bilingual Not in ESL (N=3000)	Native English Speaker (N=16,900
No Math	4.8%	2.8%	2.4%
Basic Math	1.1%	0.5%	0.5%
Pre-Algebra	1.1%	0.3%	0.3%
Algebra	9.7%	5.2%	4.7%
Geometry	14.5%	9.5%	8.3%
Algebra II	23.6%	17.6%	20.8%
Trigonometry/ Pre-	16.3%	21.6%	24.7%
Beyond Trigonometry	21.2%	19.9%	22.6%
Calculus	2.8%	4.6%	5.6%
Advanced Calculus	4.9%	18.0%	10.1%
	100.0%	100.0%	100.0%

Source: HSLS:2009 High School Transcript Study

[5] In accordance with NCES restricted use guidelines, all sample sizes are rounded to the nearest 50.

speakers' course-taking patterns to those of two groups of bilinguals: EL students who take ESL coursework during high school, and bilinguals not placed in ESL. Overall, the reader will note that the median course-taking trends higher as we move across the columns, with EL students overrepresented in lower level math courses, and other bilinguals and native English speakers overrepresented in the bottom half of the table. Initially, twice the share of high school EL students fail to complete any math classes during high school relative to their native English speaking peers (4.8% compared to 2.4%). In addition, the share of EL students who leave high school having completed Algebra II, a basic requirement for four-year college admission, now exceeds two-thirds (68.8%). However, in the same time span, the share of native English speaking students completing Algebra II or higher has increased by an additional ten points (83.8%), as has the share of other bilinguals (81.7%). And, at the very tail of the distribution, less that 5% of EL students complete advanced math coursework, after calculus, compared to 18% of other bilinguals, and 10% of native English speakers. These disparities in the highest levels of math course-taking remain a decade or more later, even after the implementation of a national accountability movement touted to improve curricular equity and access.

With respect to Science course-taking during high school, the story is a bit more complex; unlike Math, Science course-taking is neither linear, nor hierarchical. Again drawing on the HSLS:2009 dataset, Table 3 shows the share of students by linguistic status who complete each of the individual sciences, as well as those who complete no science at all. The far left-hand column indicates that EL students are more likely not to take any Science, and complete higher shares of lower-level, non-college preparatory Sciences (Integrated and Earth) than other bilinguals or native English speakers alike. In addition, the reader will note that while half of EL students (50.4%) complete Chemistry, a fairly standard requirement for four-year college going,

the Chemistry completion rates of both other bilinguals and native English speakers are nearly 20 percentage points higher (72.4% and 70.4%, respectively). Likewise, while nearly 12 percent of EL students take any honors-level Sciences during high school, that number is dwarfed by the 20 percent of native English speakers, and nearly 30 percent (29.3%) of other bilinguals.

Table 3

Science Course Completion by Linguistic Status

	Bilingual EL Student	Bilingual Not in ESL	Native English Speaker
	(N=550)	(N=3000)	(N=16,900
No Science	0.2%	0.0%	0.0%
Integrated Sciences	32.7%	26.6%	23.7%
Earth Science	63.2%	57.0%	63.8%
Biology	89.6%	93.3%	93.9%
Chemistry	52.0%	72.4%	70.4%
Physics	26.8%	44.5%	36.5%
Any AP, IB, or Honors	11.8%	29.3%	20.1%

Source: HSLS:2009 High School Transcript Study
Note: Cell counts are not mutually exclusive.

Another critical marker of postsecondary readiness, completion of two of the three major sciences is shown in Table 4. Here, it is important to again note disparate curricular access by linguistic status, with just over half (53.3%) of EL students completing two of the three main science, compared to nearly of quarter of bilinguals not placed in ESL and native English speakers (74.7% and 72.7%, respectively). Likewise, on average EL students exit high school having completed nearly a full year less of math (Algebra II, as opposed to Trigonometry or Pre-Calculus), and a full semester less of social studies coursework than each of the other groups.

However, it is important to keep in mind that these tables merely present descriptive statistics, shares of students; these analyses do not account for English proficiency, time in US schools, or any of the myriad issues that shape both EL status and students' overall course-taking.

Table 4

Content Area Completion by Linguistic Status			
	Bilingual EL Student	Bilingual Not in ESL	Native English Speaker
	(N=550)	(N=3000)	(N=16,900)
Highest Math Course Completed (Scale 0-9): Mean (SD)	5.21 (2.0)	6.11 (2.05)	5.94 (1.84)
Algebra II or Higher	0.689	0.817	0.837
Social Studies Credits	2.91 (1.46)	3.49 (1.46)	3.51 (1.39)
Completed 2 of 3 Main Sciences	0.533	0.747	0.727
Completed all 3 Main Sciences	0.230	0.403	0.321
Source: HSLS:2009 High School Transcript Study			

In an illustration of how these national patterns play out at the local level, Umansky and colleagues (2015) break down ten years of longitudinal data (2000-02 to 2011-12) from an unidentified district. Among other points of interest, Table 5 below shows the share of secondary EL students who are not enrolled in one of the primary content areas (Math, Science, Language Arts) at any given time. Reprinted from Umansky et al. (2015), Table 5 shows that EL students are twice as likely not to be enrolled in any Math, and four times as likely not to be enrolled in Science as their English only counterparts. The notably larger gap in English Language Arts (ELA) enrollment by linguistic status reflects the fact that ELA tends to be the last content area into which EL students are wholly integrated.

Table 5

TABLE 2. English learner (EL) and English only (EO) course-taking in middle school, per semester, in one large urban district

	ELs	EOs
Number of Classes	4.92	4.54
Number of Core Content Classes	3.10	3.36
Subject Area Enrollment		
Percentage Not Enrolled in ELA	30%	2%
Percentage Not Enrolled in Math	4%	2%
Percentage Not Enrolled in Science	8%	2%
Percentage Not Enrolled in Full Course Load*	35%	4%
Level Enrollment		
Number of Grade-Level Classes	2.42	2.32
Number of Honors Classes	0.14	0.50
Number of Remedial Classes	0.34	0.26
Percentage in Algebra by 8th Grade	34%	36%

Note: From Umansky, 2015. Data from an anonymous district; data compiled for academic years 2000-2001 to 2011-12. EL - English learner; EO - English only. *Full course load indicates enrollment in math, science and English language arts.

Table Source: Umansky, et al. (2015). Improving the opportunities and outcomes of California's students learning English: Findings from school district-university collaborative partnerships (Vol. 15). Berkeley, CA: Policy Analysis for California Education, PACE (Table 2, pg. 5).

These disparities are not new, nor do they appear to be changing drastically. In 2001, researchers reported that less than 1% of high school EL students took either AP math or science courses, compared to 3.2% of students overall (Hopstock & Stephenson, 2003). HSLS:2009 data suggest some improvement, but even then, AP courses are mixed with honors and IB classes. As a research community, we have several decades of evidence documenting disparities in EL students' curricular equity and access, despite federal requirements that EL programs must evaluated for effectiveness (Castañeda v. Pickard, 1981). By definition, bivariate and descriptive data discussed above cannot fully capture the heterogeneity among immigrant, bilingual, EL students, most notably the variation in English proficiency among those bilinguals placed, and not placed, in ESL coursework. However, even comprehensive models fail to render these basic disparities moot; for example, Kanno & Cromley (2015) note that EL students show the lowest

level of math courses taken overall by the end of high school, even net of various controls. The following section synthesizes research that attempts to examine how EL status itself shapes content area placement, academic preparation, and equity.

Unpacking the label: Linguistic status and curricular equity

The following section synthesizes researchers' attempts to examine how the EL label itself shapes secondary students' curricular equity via content area access. Under Lau (1974) and Castañeda (1981), EL identification was mean to ensure EL students' access to content area instruction through linguistic support services. Already marginalized by the racial and ethnic academic segregation characterizing high school course-taking in U.S. schools[6], EL students also appear to experience additional curricular constraints based on their linguistic status. Researchers have long been aware that EL students have less access to core academic content, especially college preparatory coursework (Callahan, 2005; Finkelstein, et al., 2009) at the secondary level, but the how and why remain a point of inquiry. While ample evidence suggests that courses designed specifically to meet EL students' needs cover less content, and frequently do so at a slower pace (Ek, 2009; Estrada & Wang, 2013; Harklau, 1994) compared to general education classes, researchers continue to strive to understand the mechanisms behind these disparities.

Estrada and Wang's (2013) analyses specify in particular how courses designed for EL students are defined by poor content area access (slower pace, less depth, rigor, and content) (Table 10, p. 61). One early investigation in this line of inquiry (2005) pitted EL students' English proficiency against their track placement. Findings from this work suggest that course-taking demonstrated a strong positive association with high school credit completion, overall

[6] In 2010, barely 1% of California ELs identified as white (Finkelstein, Huang, & Fong, 2009).

GPA, and math test scores, while English proficiency itself was only associated with reading and language arts test scores. This work led to more nuanced investigations of the relationship between ESL placement and curricular access via high school course-taking.

Later collaborative work using propensity score matching (PSM) allowed the analyses to address selection bias, and come as close as statistically possible to an experimental design while using survey data. Using the nationally representative Add Health/AHAA data, Callahan, Wilkinson, Muller, and Frisco (2009) found the estimated negative effect of ESL placement on end of high school math and science course-taking to vary by the share of immigrant students in a given school, offering evidence of both within- and across-school stratification. Focusing later on Latino students, Callahan and colleagues (2008) found a negative estimated effect of ESL course placement on students' math and science course-taking, a relationship that varied by generational status among the Mexican-origin youth in the sample. Interestingly, in high-immigrant contexts, second generation Mexican-origin adolescents appear to experience a protective, if not buffering effect, surrounded by relatively larger shares of first-generation peers.

Expanding on these previous analyses, Callahan, Wilkinson, and Muller (2010) proceeded to investigate the estimated effects of ESL placement among language minority (i.e., potential bilingual) students on their math, science, and social studies course-taking, as well as their math test scores and overall GPA using nationally representative ELS: 2002 data. Taking advantage of variation in ESL placement across schools, districts, and states prior to the passage of No Child Left Behind (2001), the authors used PSM to more closely ascertain individual bilinguals' propensity for placement into ESL coursework. Specifically, among those students *most* likely to be placed in ESL courses (i.e., the most recently arrived, least English proficient), ESL placement resulted in an estimated positive effect on both standardized math test scores, and

highest math course taken in high school. However, for bilingual youth who fit the high school EL profile less well, the results trend negative. For the more English proficient, longer-term EL students, ESL placement resulted in significant negative estimated effects on both math and science course-taking. Perhaps most striking, however, for the vast majority of bilinguals in the sample, those in the middle propensity category, ESL placement resulted in a negative estimated effect on all five academic outcomes: math, science, and social studies course-taking, GPA, and math test scores. For these latter two groups, ESL placement appears to constrain curricular equity and content area access in Math and Science in particular. In their final discussion, Callahan and colleagues emphasize that ESL coursework itself is not necessarily the problem, but rather the local policies that govern academic placement for EL-identified youth. In addition, the authors recommend careful consideration of the academic and linguistic needs of low- and middle-propensity English learners to determine which curricular experiences will be most likely to ensure their academic success. Future research is required to examine what, if anything, might be done to address the content-area specific needs of the majority of secondary ELs, the longer-term, more English proficient students who remain identified with the EL label.

In an attempt to present course-taking as a valuable program evaluation tool for secondary school leaders, Callahan and Shifrer (2016) consider linguistic status and course-taking while accounting for multiple individual and school level factors. These analyses illustrate how high schools can and do effectively address access to academic content for bilingual students not placed in ESL. Taking first linguistic background into account, then multiple social and academic controls, the left and right panels of Figure 1 show how differences in high school graduation and college preparatory course taking between bilinguals *not* placed in ESL and native English speakers are rendered insignificant across models. At the same time, it becomes

clear that even when accounting for English proficiency and multiple covariates of ESL placement, significant disparities in content area access and exposure remain for EL students relative to both other bilinguals not placed in ESL, and native English speakers. The authors

Figure 1

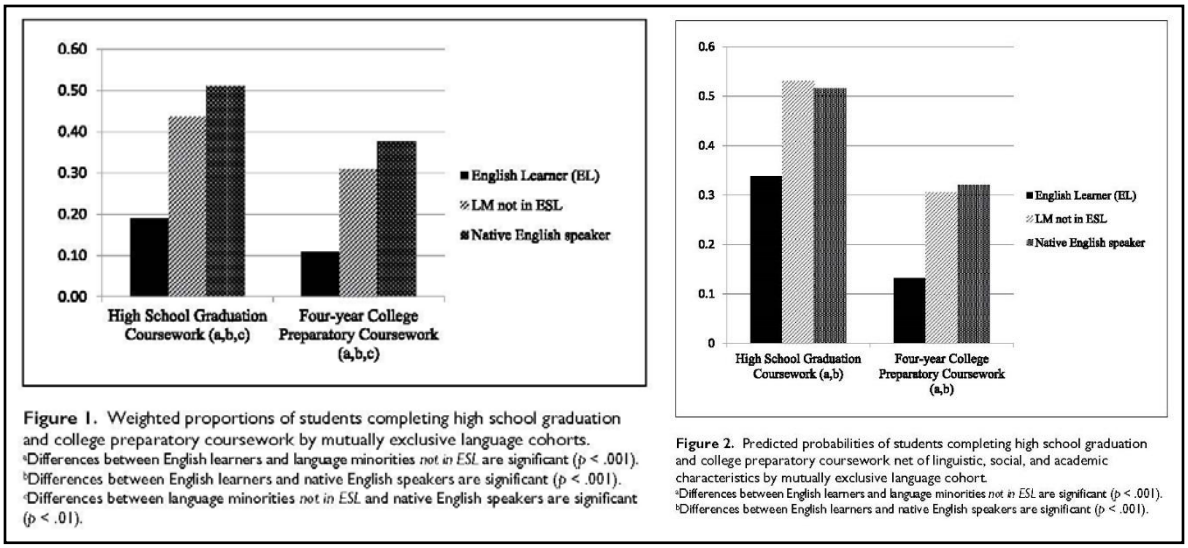

Figure 1. Weighted proportions of students completing high school graduation and college preparatory coursework by mutually exclusive language cohorts.
[a]Differences between English learners and language minorities *not in ESL* are significant ($p < .001$).
[b]Differences between English learners and native English speakers are significant ($p < .001$).
[c]Differences between language minorities *not in ESL* and native English speakers are significant ($p < .01$).

Figure 2. Predicted probabilities of students completing high school graduation and college preparatory coursework net of linguistic, social, and academic characteristics by mutually exclusive language cohort.
[a]Differences between English learners and language minorities *not in ESL* are significant ($p < .001$).
[b]Differences between English learners and native English speakers are significant ($p < .001$).

Source of Figures: Callahan, R.M & Shifrer, D. (2016). Equitable access for secondary English learner students: Course taking as evidence of EL program effectiveness. *Educational Administration Quarterly, 52* (3), 463-496. Left panel, p.479 ; Right panel, p. 485.

conclude by suggesting course-taking as a tool with which secondary leaders could strengthen both curricular equity and overall achievement for EL youth and their schools.

While these previous studies examine the *what*, the effects of the EL label, we know less about the *why*, the mechanisms that motivated the negative estimated effects associated with ESL placement. Although sustained, systematic exposure to weak academic content has long been hypothesized to result in long-term EL status, only recently has work begun to emerge examining how students experience and interact with this particular label. In a recent qualitative case study of three students designated 'long-term ELs', Thompson (2015) demonstrates the

label's stigmatizing, limiting aura, as well as how the students experience its accompanying constraints to their academic identities. Importantly, Thompson documents how these youth internalize the negative social and academic perceptions that have come to characterize EL-focused courses and programs (Dabach, 2015). In their conclusions, both Thompson and Dabach call for future research to determine how to change the perceptions of such EL-focused space.

Constrained access to the academic core as a result of ESL placement may prevent students from fully realizing their academic identities. In a case study analysis of EL education at a large high school, Kanno and Kangas (2014) examine some of the mechanisms that result in ELs' limited curricular exposure and recommend organizational changes to combat this structural inequity. Here, we while curricular exposure is symptomatic of the problem, the authors illustrate how institutional constraints and organizational barriers exacerbate the issue. In a mixed-methods analysis of data from six California districts, Thompson (2017b) found little evidence to suggest that learning improved when students retook math courses, despite the fact that half of all 8th to 10th grade students repeated a math course. Stepping back to examine the organizational factors at work in a school system helps to explain *why* EL students experiences some of the limits to their curricular access that they do. In particular, Thompson (2017b) shows how external, organizational constraints prevent ever-EL students from advancing in math. This inability to advance along the math sequence in particular suggests that exposure alone is an insufficient precursor of academic success. In analyses designed to better understand the immigrant advantage, Callahan and Humphries (2016) show how EL students experience lower returns on advanced math course-taking relative to both other immigrants and native-born, native English speakers. Even when EL students manage to complete honors level advanced mathematics, Calculus or beyond, they fail to receive the same boost in four-year college going

experienced by all other student groups. Figure 2 shows how both children of native-born parents, and other immigrant students, bilingual and native English speaking alike, are significantly more likely to enroll in a four-year college over a two-year college when they complete advanced math. Surprisingly, EL students experience no such returns to the same math course-taking. In fact, the models show how EL students are significantly *more* likely to enroll in a two-year college when completing advanced, college preparatory mathematics.

Figure 2

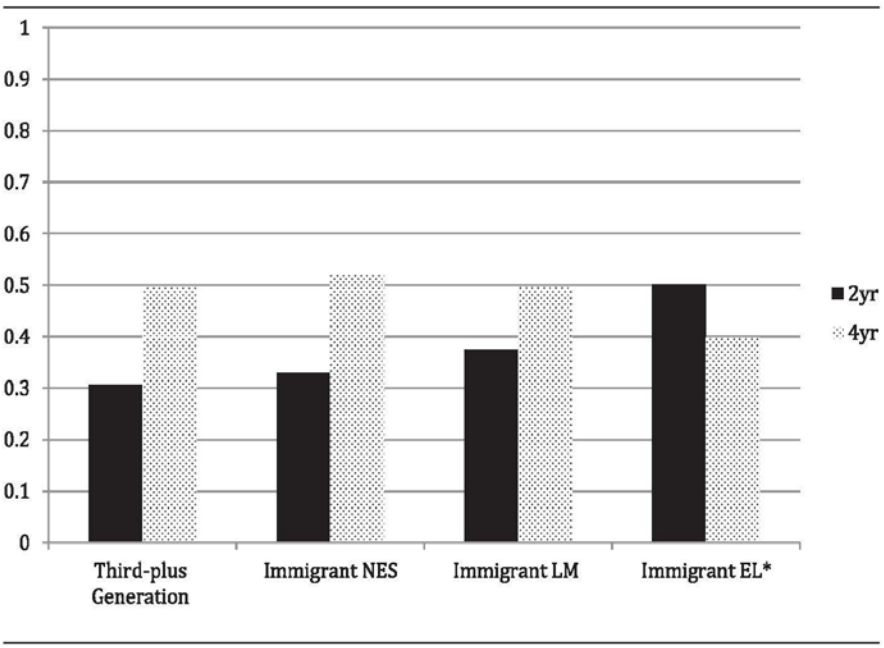

Figure 1. **Predicting the probability of two- and four-year college going by immigrant linguistic status among students who completed college preparatory math.**

Source: Callahan, R. M., & Humphries, M. (2016). Undermatched? School-based linguistic status, college going, and the immigrant advantage. *American Educational Research Journal, 53*(2), 263-295. Figure 1, p. 284.

To date, research has demonstrated not only a persistent, negative relationship between EL status and math and science course taking, but also evidence of disparate course taking effects, and the internalization of negative stereotypes by the students themselves. The fact that

placement in, and access to academic content remains insufficient for levelling the playing field raises cause for concern. These trends surrounding content area access and curricular equity, especially in STEM, suggest a need for further inquiry into the organizational structures that shape EL students' academic experiences, as well as relational factors such as teachers' expectations and engagement. The following section enumerates several empirically-driven implications for policy and practice, as well as recommendations for future research.

Discussion and Implications

The extant literature provides a comprehensive overview of what EL students experience in terms of math and science curricular equity at the secondary level, while relatively less is understood about how to measure content area access, much less equity, in the elementary grades. Elementary EL research tends to expand on the how and the why, exploring the mechanisms of teacher efficacy and learning, and instructional design, while shying away from any concrete tabulations of students' content area exposure. In contrast, secondary EL research clearly delineates students' access; less is understood about how and why EL students experience the curricular constraints they do. Several themes emerged relative to educational policy and practice, all of which suggest a need for further research on schools' organizational structures and the relational aspects of schooling. In the following sections, I first discuss several policy implications of this work regarding Curriculum, Instruction, and Assessment, and then provide recommendations for future research regarding EL students' curricular equity and access.

Policy Implications: Content Area Exposure and Curricular Equity

Curriculum. At the elementary level, bilinguals', and more specifically, EL students' content area access to math and science in particular, is shaped by type of instructional program (Umansky & Reardon, 2014). The quality and fidelity of these program models, however, may vary widely based on numerous local factors (López, et al., 2015). If local and state educational policies are to monitor students' curricular experiences and access across a range of program models, the broad brush of primary language instructional access is inadequate. Despite a rich research base recommending that dual language and other primary language-heavy bilingual instructional models provide the richest curricular coverage, the vast majority of EL students will experience all curricular access through English-medium and English only instructional models. Ensuring curricular equity in the elementary grades through EL educational policy requires first, expanding access to primary language instructional models, and second, prioritizing academic rigor for young EL students, even as they are in the process of learning English. Third, doing so will require novel measures of curricular access to accurately measure math, science, and other content area experiences within the self-contained contexts of elementary grade classrooms

At the secondary level, a relatively standardized metric of curricular access, the *Classification of Secondary School Courses* (CSSC)[7] provides an easily accessible opportunity to learn indicator. In fact, (Callahan & Hopkins, Forthcoming) suggest that LEAs can use course taking patterns to drive school redesign processes to expand and enrich curricular offerings. School leaders and educators can use prior EL course taking patterns to improve curricular equity, aligning program design, course offerings, implementation, and outcome measures to determine program effectiveness.

[7] https://nces.ed.gov/surveys/hst/courses.asp

Instruction: Teachers' EL efficacy. While content area access and curricular equity is of course critical, the source and perpetuation of the social and academic stigma associated with the EL label (Dabach, 2014; Thompson, 2015) requires attention as well. Improving the quality of EL instruction through teacher training is a first step in improving the process, and a rich field of study has arisen to this end, both in math (Kim, et al., 2011; Moschkovich, 2012; Ross, 2014) and science (Lee & Buxton, 2011, 2013; Lee, et al., 2013) in particular, and EL instruction overall (Kibler, et al., 2015; Walqui, et al., 2010). However, from a policy perspective, it is important to remember that instructional ability is associated with teachers' beliefs about students. Already, we know that teachers perceive US-born bilinguals (i.e., many long-term ELs) more negatively than their foreign-born counterparts, expecting less of them academically. Examining Latinos' educational experiences in new and established Latino destinations, Blanchard and Muller (2015) show how what appears to be a minor difference in teachers' expectations among bilingual Latinos ultimately limits some students' ability to advance up and through the math sequence. Policies governing teachers' professional development must directly address teachers' often unspoken linguistic and racial beliefs and perceptions if we hope to begin to disempower the negative stigma surrounding EL status, the label, and the students.

Assessment. Given evidence of EL students' restricted curricular exposure and access, it is important to consider how EL education has changed in the past two accountability-driven decades. Since the onset of NCLB (2001), when a content area is not tested (i.e., social studies, PE and art (NEA, 2004; Wills, 2007)), or will not be tested until the later grades (i.e., science (See, for example, Marx & Harris, 2006)), it receives significantly less instructional time and attention. This is especially true for students considered at-risk (Cawelti, 2006), a group that all too often includes ELs (Gándara, 2010). The increased societal focus on accountability has

slowly pushed important content areas out of the curriculum altogether, exacerbating educational inequality overall (Darling-Hammond, 2007). This narrowing of the curriculum is particularly problematic for ELs, who already experience curricular constraints.

With the adoption of ESSA (2015), SEAs and LEAs have the opportunity to leverage new accountability and reporting requirements to improve content area access and curricular equity; alternately, this shift in control also has the potential to exacerbate existing disparities. For example, in Georgia's state ESSA plan (Woods, 2017), the state now sets the mandatory minimum cell sizes for participation in state assessments for elementary school students at 15. However, in doing so, the plan also notes that schools need only report achievement scores when cell sizes are 40 or greater. If minimum cell sizes for participation were to change from 15 to 30, the report indicates that the share of elementary schools responsible for reporting EL achievement in ELA and Math grades drop by 12.8%, leaving only 83% of elementary schools to require EL students to participate in math and ELA assessments; likewise the new threshold would produce nearly three times the reduction (33.4%), leaving less than half (48%) of Georgia elementary schools that would require EL students to participate in science and social studies assessments(Woods, 2017, p. 17). Given that the threshold for reporting achievement (n=40) is even higher than the hypothesized thresholds in the report (n=30), one can only speculate as to the considerably larger share of Georgia elementary schools that may not be held accountable for their EL students' achievement. Since Lau (19744), the role of federal EL Educational policy has been to protect ELs' educational equity and access (Mavrogordato, 2012). Decentralization under ESSA (2015), the transfer of responsibility and accountability from the federal to the state level, may ultimately deprive EL students of the limited protections that did exist.

However, it is important to remember that the third prong of Castañeda (1981) details how EL instructional programs are to be evaluated regularly for their effectiveness. As SEAs and LEAs move to evaluate EL program effectiveness under ESSA (2015), EL curriculum must provide not only linguistic supports, but also rich math and science experiences. In the past decade, reclassification has received considerable empirical attention as an indicator of EL program effectiveness (Robinson-Cimpian, et al., 2017; Robinson-Cimpian, et al., 2016; Thompson, 2017a) with less time spent disentangling its conflation of English proficiency and curricular equity. That reclassification increasingly reflects EL students' access to content area curriculum, especially in math, warrants a more comprehensive understanding of EL program effectiveness. Improving reclassification rates requires first improving curricular equity and access; until then a focus on reclassification distracts much needed policy attention from the improvement of content area access.

One final note on assessment-related policy implications: expansion of the EL category to include former, as well as current EL students has the potential to reorient the EL education conversation back to academic equity, and away from reclassification (Hopkins, Thompson, Linquanti, Hakuta, & August, 2013; Umansky, et al., 2015). Reconstitution of the EL category may also ease bureaucratic impediments to reclassification (Estrada & Wang, 2013), especially those stemming from local-level policy interpretation (Mavrogordato & White, 2017). Just as EL course-taking offers a more comprehensive measure of secondary EL program effectiveness than reclassification (Callahan & Hopkins, Forthcoming), expanding our analyses to include ever-ELs will provide a more equitable marker of program effectiveness (Hopkins et al., 2013). This broader interpretation of the EL category has the potential to expand educational opportunities through improved curricular access.

Recommendations for Future Research

Elementary STEM access. Before all else, in writing this report it became exceedingly clear that no clear metric exists to accurately compare elementary EL students' math and science content area access to that of their non-EL peers. At the elementary level, language of instruction (primary language vs. English) serves as the de facto indicator of curricular equity for EL students. Even if bilingual education were a viable marker of curricular equity and access—and it arguably is not—Goldenberg and Wagner (2015) note its relative rarity as an instructional program *for* ELs. The authors estimate that at most three percent of today's EL experience bilingual instruction. The sheer lack of bilingual education programs for EL students limits the viability of primary language instruction as a policy recommendation. Further research is necessary to determine how to best measure EL students' curricular equity and access. At the elementary level, ample empirical attention has been paid to bilingual education program models, teachers' instructional efficacy, especially through professional development, and reclassification. However, to move the field forward, the question of content area access and curricular equity will require more attention; no true equivalent exists to date at the elementary level to match the CSSC course-taking codes used in the secondary sector to gauge students' access. If, as a field, we are to examine and improve EL students' math and science access in the elementary grades, we will first need to identify a clear and comparable metric with which to begin the discussion.

School organization. Only recently has research recently begun to examine the relationship between instructional organization and EL student achievement (Hopkins, Lowenhaupt, & Sweet, 2015), and given rapidly changing national demographics, the need to improve understanding in this area has never been greater. As inter-sector (middle-to-high

school) communication appears to matter more for EL students than for their non-EL peers (Crosnoe, 2009), organizational patterns of communication merit closer examination. In particular, researchers might investigate the actors at play in cross-school, cross-sector communication (counselors, teachers, administrators), as well as the policies that shape the actual communication. In addition, the role of school leaders in shaping equitable EL programs and practices is less well understood compared to teachers' professional development. Beyond general training, most leadership programs do not clearly focus on the research and theory that motivate bilingual and EL educational programs and practices. Further research is necessary to better understand the role of site and district-level leadership in improving bilingual and EL students' curricular equity, specifically via math and science access.

In addition, the bulk of research in this report frames secondary STEM course taking as an outcome. Future research might examine the roles, motivations, and perceptions of those actors who make and execute decisions regarding student placement. The Master Schedule is at once a central construct in secondary education, and a relatively rare afterthought in contemporary research. Only 8 of the 30 articles that surfaced in a quick EBSCO search of "Master Schedule" and "High School" were published after 2000, with the majority appearing between 1940 and 1975. Research investigating the human element shaping the algorithms that currently produce secondary schools' master schedules will likely offer insights into the organizational factors that shape the patterns of content area access and curricular equity that we observe at present.

Teacher beliefs and efficacy. Improving ELs' curricular access means, indirectly, improving teachers' abilities to facilitate students' simultaneous linguistic and academic development (Calderón, et al., 2011). Improving teachers' EL efficacy not only has implications

for students' achievement in math (Ross, 2014) and science (Buxton, Lee, & Santau, 2008), but has also been found to shape teachers attitudes towards and expectations of EL students (Song, 2016). However, further research is necessary to determine whether and how teacher professional development may shape ELs' academic achievement. Such work is likely to yield insights into the racial and linguistic perceptions educators hold that shape student access (López, 2018). Further research is required to understand how educators wield these beliefs when interacting with students, and later, how these beliefs are related to EL student outcomes.

This relationship is especially salient given findings to suggest that when teachers lack confidence in their abilities to teach EL students, they express negative beliefs about the students (Carley Rizzuto, 2017; Ross, 2014). In particular, teacher preparation in STEM, another area where teachers often express low levels of self-efficacy, requires empirical attention, especially given recent, improved curricular standards (Tolbert, Lyon, & Solís, 2014; Walqui, et al., 2010). There exists a need for greater understanding of the relationship between teachers' culturally responsive and linguistically focused professional development (Lee & Buxton, 2011; Lee & Buxton, 2013) and EL students' content area achievement. Given findings that suggest teachers' expectations may matter more for ELs and other racial and ethnic minority youth, future research will want to pay attention to the relationship between teacher EL efficacy and teachers' beliefs. Efforts linking school-wide transformation to shared professional development hold promise for a sea-change in educators' attitudes in schools that demonstrate systemically low EL achievement.

Parental outreach and engagement. Finally, the bulk of the research covered here has framed course placement as a school- and educator-driven process. Parental involvement is notably absent from the course taking research, despite empirical awareness of adolescents' use

of social capital to navigate the U.S. educational system in general (Carbonaro, 1998; Frank, Muller, & Mueller, 2013). In a study examining the role of family-school communications in the transition from middle school to high school, Crosnoe (2009) found that triangulated (family-middle school-high school) communication was associated with higher level math course taking. Interestingly, however, he also found the effect to not only be stronger, and thus substantively more meaningful for EL students, but to also extend to science course taking among ELs (Crosnoe, 2009). This work suggests that how middle and high schools connect with the parents of EL students will, in turn, shape their curricular access. Future research will want to consider not only EL parental engagement, but also how schools do and do not invite parents into the system. Informing and educating EL students' parents about the mechanisms of schooling in general, and STEM curriculum and instruction in particular, has the potential to greatly improve parents' abilities to advocate for their children.

In Closing

Elementary EL educational research, practice, and policy have focused on language of instruction to date, drawing attention to the need to identify and employ metrics that accurately determine students' access to academic content, STEM and otherwise. While there has been relatively less attention to language of instruction in the secondary grades, and greater focus on course taking as an indicator of curricular equity, the research to date highlights marked disparities in access related to ELs' linguistic status, and exacerbated by the racial and social stratification already at work in U.S. schools. Moving forward as a field, there is considerable need to better understand the organizational factors at play that shape EL students' access to

math and science content, especially in the critical early elementary years. In addition, while we know much about the 'what' of secondary EL math and science course taking, we know relatively little about the '*how*' and '*why*'. With this information, we can begin to construct productive, effective EL educational policies to move us through the next century.

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