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APPENDIXES
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Regional Educational Laboratory West
At WestEd

Progress of Arizona Kindergartners toward English Proficiency in Grade 3 by English Learner Student Classification

See https://go.usa.gov/xfUpX for the full report.

Appendix A. About the study

This appendix describes the general framework, background, and rationale for the study on the progress of non-native English speaker students toward English language proficiency and English language arts (ELA) proficiency in the early grades in Arizona, including a short review of the literature that shows how the current study builds on earlier ones.

General framework, background, and rationale

Through the Arizona Literacy Partnership, the Regional Educational Laboratory (REL) West collaborates with the Arizona Department of Education (ADE) and local school districts to examine early literacy interventions and supports to improve English language proficiency and ELA proficiency by grade 3. The English language proficiency and ELA proficiency of English learner students are of specific interest to the partnership.

This study used existing state data to describe the English language proficiency and ELA proficiency of non-native English speaker students in the early grades (kindergarten through grade 3). A goal of the study was to better understand how students, especially English learner students, progress in both English language proficiency and ELA proficiency in the early grades. This study goes beyond previous analyses by examining how the English language outcomes of English learner students and the ELA outcomes of all students, including non-native English speaker students not classified as English learner students, vary by student and school characteristics and by English language proficiency in kindergarten.

The results of this study can inform efforts to understand and improve K–3 language and literacy policies and programs and can provide important context to support evidence-based decisionmaking for K–3 literacy interventions. Specifically, the study findings can help stakeholders better understand the context for early English language and ELA progress of non-native English speaker students, including English learner students, and patterns of progress.

Related literature

A well-documented, persistent academic achievement gap exists between English learner students and native English speaker students (Fry, 2007; Hemphill & Vanneman, 2011). This gap is generally accepted as being related to English learner students' need to simultaneously learn English and master content knowledge (Genesee et al., 2005). To support non-native English speaker students in achieving English language proficiency, their English language proficiency is evaluated at entry into the school system, and language assistance is offered to students classified as English learner students. The goal is to improve their English language proficiency and ultimately help them master the same academic content and achieve the same standards as other students.

Student characteristics may contribute to the academic achievement gap for English learner students. Influential student characteristics include English language proficiency level on school entry (Cook et al., 2012; Greenberg Motamedi et al., 2016; Haas et al., 2015) and demographic characteristics (Haas et al., 2015; Liasidou, 2013). A previous REL West study conducted in Arizona (Haas et al., 2015) followed three cohorts of students for six years. The study found that the largest differences in cumulative passing rates on the statewide ELA assessment were associated with initial English language proficiency level, eligibility for special education services, eligibility for the national school lunch program (an indicator of socioeconomic status), and gender. Further, another REL West study conducted in Arizona and Nevada examined English learner students' outcomes after grade 3 and found that students who had higher English language proficiency levels in grade 3 had higher passing rates on ELA assessments in the subsequent two years (Haas, Tran, & Huang, 2016). However, neither of these studies looked at school characteristics and how they might have influenced student outcomes, nor did they examine, as a subgroup, non-native English speaker students who demonstrated initial English language proficiency.

Some school characteristics may influence students' academic outcomes. Several studies have investigated the association between the type of English learner program and students' academic outcomes (Greenberg Motamedi et al., 2016; Parker et al., 2014; Slavin et al., 2011; Umansky & Reardon, 2014). A recent REL Northeast & Islands study examined the correlates of academic performance for English learner students in a New England school district and found that, in addition to student characteristics, the type of English learner programs in a school was closely related to average level of English language proficiency (Parker et al., 2014). The study used cross-sectional data, as longitudinal data were not available. A study of elementary school dual language learner students (students who are learning English and another language spoken at home), found that those attending larger schools with fewer dual language learner students had higher levels of English language proficiency in kindergarten and more rapid growth in English language proficiency over time (Kim et al., 2014). This pattern of findings merits further study of the association between school characteristics and English language proficiency and of the association between school characteristics and ELA outcomes. In addition, previous studies that did not focus on English learner students have shown that school composition, such as socioeconomic levels and racial/ethnic makeup, matter for early progress in reading achievement (Benson & Borman, 2010; Borman & Dowling, 2010).

Non-native English speaker students who are not classified as English learner students at kindergarten entry are an understudied group. While some recent studies have examined the academic performance of different subgroups of English learner students (for example, current and former English learner students; Deussen et al., 2017) and compared their performance with that of non-English learner students, few studies have focused on non-native English speaker students who were not classified as English learner students in kindergarten. One study used a nationally representative sample of first-time kindergartners from the Early Childhood Longitudinal Study to compare outcomes for English and math achievement for non-native English speaker students who were not classified as English learner students in kindergarten with outcomes for native English speaker students and students classified as English learner students (Halle et al., 2012). The study found that non-native English speaker students who were not classified as English learner students in kindergarten kept pace with native English speaker students. Among non-native English speakers, entering kindergarten with English language proficiency was

associated with better cognitive and behavioral outcomes through grade 8 compared with non-native English speakers who attained proficiency after kindergarten entry.

Building on these earlier studies, the current study used longitudinal data to track a cohort of kindergartners and identify student and school characteristics associated with English language proficiency and ELA proficiency in grade 3. Specifically, the study examined the student characteristics identified in the 2015 REL West study in Arizona as accounting for the largest differences in cumulative passing rates on the statewide ELA assessment (Haas et al., 2015). In addition, the current study examined the relationship between school characteristics, such as a school's socioeconomic and language composition (for example, percentage of socioeconomically disadvantaged students and percentage of English learner students) and students' English language proficiency and ELA proficiency. The study seeks to enable a better understanding of the association between school compositional factors and the development of ELA skills among non-native English speaker students, including those who are not classified as English learner students. Furthermore, the English language proficiency assessment and reassessment in Arizona (the Arizona English Language Learner Assessment) were developed or revised between 2012/13 and 2013/14, and a new state assessment for English language arts in grade 3 (the Arizona Measurement of Education Readiness to Inform Teaching) was first administered in spring 2015. Earlier analyses used the previous assessments, making it even more important to examine the association between English language proficiency and ELA proficiency using current assessments, as in this study.

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Appendix B. Methods

This appendix describes the population of analysis, data sources, definitions of measures and variables, analysis methods, and multilevel regression analyses for the study.

Population of analysis

The study population is based on the cohort of students who entered an Arizona public kindergarten in 2013/14. The population of analysis for research question 1 is the cohort of students who entered an Arizona public kindergarten in 2013/14 (88,857 students; table B1). For examining the association between English language proficiency level in kindergarten and English language proficiency and English language arts (ELA) proficiency levels in grade 3, the population of analysis (which is based on the populations of interest to the study's stakeholders) was English learner students (research question 2) or all students (research question 3) who entered an Arizona public kindergarten in 2013/14, made regular grade progress (were not retained or held back), were still enrolled in the Arizona public school system in 2016/17, and had taken an English language proficiency assessment in kindergarten and grade 3 (research question 2) and an ELA proficiency assessment in grade 3 (research question 3). For research question 2, among the 14,101 students classified as English learner students in kindergarten in 2013/14 who made regular grade progress and were still enrolled in the Arizona public school system in 2016/17, 13,776 students (98 percent) had an Arizona English Language Learner Assessment (AZELLA) score available and were included in the analysis (see table B1). For research question 3, among the 73,476 students who entered an Arizona public kindergarten in 2013/14, made regular grade progress, and were still enrolled in the Arizona public school system in 2016/17, 69,654 students (95 percent) had a score on the Arizona Measurement of Education Readiness to Inform Teaching (AzMERIT) in grade 3 and were included in the analysis.

Further descriptions of the characteristics of the population of analysis are provided in tables C2 and C3 in appendix C.

Table B1. Research question and population of analysis, 2013/14 kindergarten cohort in Arizona

Research question	Population or analytic sample	Number of students
1. What percentage of students entering kindergarten in 2013/14 in Arizona were classified as English learner students, and did the percentage change after reassessment at the end of kindergarten?	All students entering kindergarten in 2013/14 in Arizona	88,857
2. For students classified as English learner students in kindergarten, how did English language proficiency level in grade 3 vary by English language proficiency level in kindergarten and by the characteristics of English learner students and their schools?	Students entering kindergarten in 2013/14 in Arizona who were classified as English learner students and who met three criteria: • Made regular grade progress. • Stayed enrolled in the Arizona public school system through 2016/17 (grade 3). • Had an Arizona English Language Learner Assessment score.	13,776
3. For all students, how did English language arts proficiency level in grade 3 vary by English language proficiency level in kindergarten and by the characteristics of students and their schools?	All students entering kindergarten in 2013/14 in Arizona who met three criteria: • Made regular grade progress. • Stayed enrolled in the Arizona public school system through 2016/17 (grade 3). • Had an Arizona Measurement of Education Readiness to Inform Teaching English language arts assessment score.	69,654

Source: Authors' analysis based on Arizona Department of Education data described in this appendix.

Data sources

The data for this study were obtained from multiple ADE sources. Data on enrollment, English language proficiency assessments, and grade 3 ELA assessments were linked to 2013/14 cohort kindergarten students using a unique student statewide identification number generated by ADE. This was the dataset of analysis for the study and was used to answer the research questions.

Arizona longitudinal enrollment data system. The Arizona longitudinal enrollment data system provides information on students' demographic characteristics and school enrollment records. Data for this study included student records for school years 2013/14–2016/17 for the cohort of students who entered kindergarten in 2013/14.

AZELLA. The AZELLA is a standards-based assessment that measures student English language proficiency for placement into English learner services and for reassessment of the need for such services. The data for this study included students' AZELLA proficiency levels for the 2013/14 (kindergarten) to 2016/17 (grade 3) school years for all students who started kindergarten in the Arizona public school system in 2013/14. At every grade except kindergarten, the proficiency levels are pre-emergent/emergent, basic, intermediate, and proficient. The AZELLA Kindergarten Placement Test (KPT) uses only three proficiency levels: emergent/emergent, basic/intermediate, and proficient.

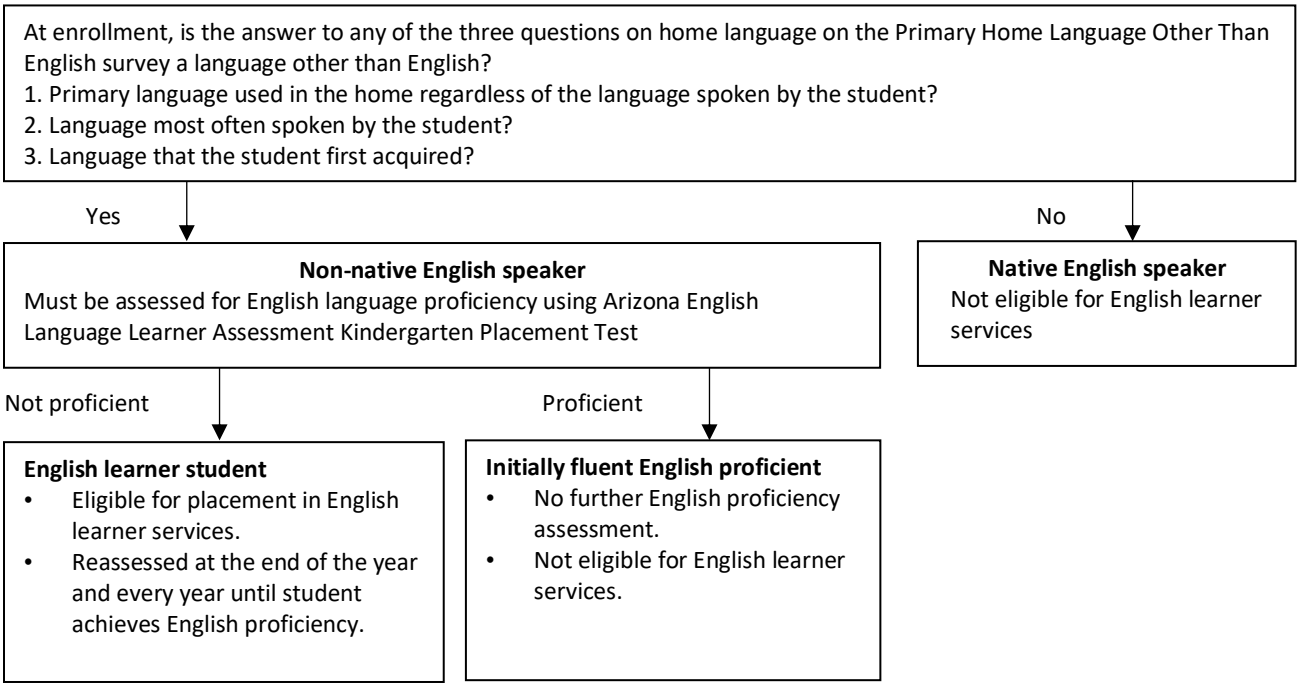
AzMERIT. AzMERIT is the state achievement assessment. Students take AzMERIT content assessments in several subjects, including ELA, annually in grades 3–8 and in either grade 10 or 11 in high school. Each AzMERIT assessment is aligned to Arizona's academic standards. AzMERIT was first administered in spring 2015. Data for this study included students' proficiency levels (minimally proficient, partially proficient, proficient, and highly proficient) on the 2016/17 ELA assessment in grade 3 for all students who started kindergarten in the Arizona public school system in 2013/14. For the multilevel analysis for research question 3, the categories proficient and highly proficient were collapsed into a proficient category and the categories minimally proficient and partially proficient were collapsed into a below proficient category.

Public data sources. Schools' charter school status (whether a school operates under a public charter instead of a school district) for all Arizona public schools was downloaded from the public information available on the ADE website (https://www.azed.gov/accountability-research/reportcards/).

Definitions of measures and variables

Non-native and native English speaker students. Arizona administers the Primary Home Language Other Than English (PHLOTE) survey to all students entering kindergarten in the Arizona public school system to identify non-native English speaker students. Students whose home language is listed as other than English on any of the three questions of the survey (figure B1) are classified as non-native English speaker students. All other students are classified as native English speaker students.

Figure B1. The Arizona Department of Education's standard process for identifying non-native English speaker students and English learner students in kindergarten



Note: This standard process was not followed in 2013/14 because nearly all non-native English speaker students in kindergarten were reassessed at the end of the year as part of a standard-setting review process (Arizona Department of Education, 2014).
Source: Authors' analysis based on Arizona Department of Education data described in this appendix.

English language proficiency measures. As previously described, the AZELLA is Arizona's assessment of English language proficiency. It is aligned to the Arizona English Language Proficiency Standards and is administered to students who are identified by the PHLOTE survey as non-native English speaker students (Arizona Department of Education, 2014). The AZELLA includes the Kindergarten Placement Test (KPT) to determine whether a non-native English speaker needs English learner services and an annual reassessment to monitor the progress of English learner students until they achieve English language proficiency. According to Arizona Revised Statutes 15-752, proficiency is attained when "English learners have acquired a good working knowledge of English and are able to do regular school work in English" (Arizona Department of Education, 2014). Students who score below proficient on the AZELLA are considered not to have sufficient knowledge of English to do regular schoolwork in English. They are classified as English learner students and become eligible for English learner services.

Scores on the AZELLA KPT, administered at the beginning of the kindergarten school year, are reported at three proficiency levels: pre-emergent/emergent, basic/intermediate, and proficient (table B2).

Table B2. The three proficiency levels on the Arizona English Language Learner Assessment Kindergarten Placement Test

Proficiency level	Description
Pre-emergent/emergent	Students at this level lack the English skills to communicate, retell stories heard, or add details to drawings. These students do not demonstrate sufficient skills in English to access mainstream curriculum, and they demonstrate the need for specific support in English language development instruction.
Basic/intermediate	Students at this level generally understand spoken English but do not have the vocabulary to respond consistently. They orally communicate basic needs and ideas with gestures and isolated English words. They use pictures to recall objects from a story heard, repeat words that begin with the same first sound, and add minimal details to drawings. These students do not demonstrate sufficient skills in English to access mainstream curriculum, and they demonstrate the need for specific support in English language development instruction.
Proficient	Students at this level listen and respond appropriately to spoken English. They have an expanded English vocabulary to orally communicate basic needs and ideas with English words, phrases, and sentences with correct pronunciation. They use pictures or words to retell events from a story heard, identify pictures with the same first sound, and add relevant details to drawings. These students demonstrate the skills necessary to access mainstream curriculum.

Source: Arizona Department of Education (https://cms.azed.gov/home/GetDocumentFile?id=5852d396aadebe0658611fd0).

Scores on the AZELLA Reassessments are reported at four levels of English language proficiency: pre-emergent/emergent, basic, intermediate, and proficient. Students who are classified as English learner students take the AZELLA Reassessment annually until they demonstrate English language proficiency.

These AZELLA proficiency levels are the measures of English language proficiency used in this study. Students who demonstrate English language proficiency on the AZELLA are reclassified as proficient and are no longer eligible for English learner services.

The 2013/14 AZELLA standard setting review. As part of a voluntary resolution agreement with the federal government related to a complaint filed against ADE on how English learner students were reclassified as English language proficient and no longer eligible for English learner services (U.S. Department of Education, 2012; U.S. Department of Justice, 2012), ADE developed the AZELLA KPT in 2012/13. In spring 2014 ADE convened a Technical Advisory Committee to define cutscores for the AZELLA KPT categories of basic/intermediate and proficient.[1] The committee recommended higher cutscores for the two categories for school year 2014/15. During this standard-setting review, non-native English speaker students, including students initially classified as proficient in English, were reassessed. Typically, as outlined in figure B1, students who score proficient on the AZELLA KPT receive no other assessment of their English language proficiency during the same school year (unless referred by a teacher). However, as part of the standard-setting review, 95 percent of non-native English speaker students in the 2013/14 kindergarten cohort were systematically reassessed during kindergarten using the AZELLA Stage I Reassessment.

English learner students as of kindergarten. Students who demonstrate an English language need on the AZELLA KPT immediately qualify for English learner services. Therefore, according to ADE policy, English learner students include all students evaluated as having an English language need during their kindergarten school year. Kindergarten students who demonstrate an English language need include:

- Students classified as English learner students on the AZELLA KPT.

[1] Further information about the 2013/14 standard-setting review can be found in Arizona Department of Education (2014).

- Students who were either assessed as proficient on the AZELLA KPT or who were not assessed based on the PHLOTE survey but who subsequently qualified for English language services during kindergarten based on the AZELLA Stage I Reassessment.

Confirmed as proficient in kindergarten. For the purposes of this study non-native English speaker students initially classified as English language proficient on the AZELLA KPT and confirmed as proficient at the AZELLA Stage I Reassessment at the end of kindergarten are referred to as *students confirmed as proficient in kindergarten*.

Reclassified as English learner students in kindergarten. For the purposes of this study non-native English speaker students initially classified as English language proficient based on the AZELLA KPT but who scored below proficient on the AZELLA Stage I Reassessment at the end of kindergarten and were therefore reclassified as English learner students are referred to as *reclassified as English learner students in kindergarten*.

English language proficiency subgroups. English language proficiency subgroups were constructed to follow student progress in English skills through grade 3 and to measure the association between English language proficiency level in kindergarten and ELA proficiency in grade 3. A student's initial English language proficiency level was defined as of the first AZELLA assessment in kindergarten that qualified the student for English learner services. The following subgroups were defined based on the definitions of English language proficiency:

- Native English speaker students.
- Students confirmed as proficient in kindergarten (initially classified as English language proficient and confirmed as proficient at the end of kindergarten).
- Reclassified as English learner students in kindergarten (initially classified as English language proficient and reclassified as English learner students at the end of kindergarten).
- Other English learner students who scored at the basic/intermediate level on their first AZELLA assessment.
- Other English learner students who scored at the pre-emergent/emergent level on their first AZELLA assessment.

The distribution of students across these English language proficiency subgroups is shown in table C1 in appendix C.

ELA proficiency. ELA proficiency was measured by the AzMERIT ELA assessment in grade 3, administered to all students, and was examined across the English language proficiency subgroups defined above. A student's ELA performance is reported as being at one of four proficiency levels: minimally proficient, partially proficient, proficient, or highly proficient. Students who score minimally proficient or partially proficient are considered likely to need support to be ready for the next grade or course, and those who score proficient or highly proficient are considered likely to be ready for the next grade or course.

Student characteristics. Based on previous related literature that identified certain student characteristics as potentially associated with the academic outcomes of non-native English speaker students (see appendix A), the study team included in the analysis the following student characteristics for which data were available in the ADE datasets:

- Socioeconomic status (as indicated by eligibility for the national school lunch program).
- Gender.
- Race/ethnicity.
- Eligibility for special education services.

These variables were defined as of entry into kindergarten.

School characteristics. Based on previous related literature that identified certain school characteristics as potentially associated with the academic outcomes of non-native English speaker students (see appendix A), the study team included in the analysis the following school characteristics for which data were available in the ADE datasets:

- Percentage of students from low socioeconomic status families (as indicated by eligibility for the national school lunch program).
- Percentage of English learner students.
- School size.

Those variables were derived from student-level records from the Arizona longitudinal enrollment database for the cohort of analysis at entry into kindergarten in 2013/14. For example, school size is approximated by the size of the 2013/14 kindergarten cohort in the school, and the percentage of English learner students is computed specifically for the cohort of analysis rather than schoolwide. In addition, because Arizona has a high percentage of students enrolled in charter schools (18 percent in 2013/14, according to U.S. Department of Education, 2015), schools' charter status was included.

Analysis methods

This study used different quantitative methods of analysis for each research question.

Research question 1. What percentage of students entering kindergarten in 2013/14 in Arizona were classified as English learner students, and did the percentage change after reassessment at the end of kindergarten? The study team calculated descriptive statistics on the number and percentage of students at each English language proficiency level at kindergarten entry as measured by the AZELLA KPT (pre-emergent/emergent, basic/intermediate, and proficient) and after reassessment at the end of kindergarten.

Research question 2. For students classified as English learner students in kindergarten, how did English language proficiency level in grade 3 vary by English language proficiency level in kindergarten and by the characteristics of English learner students and their schools? The study team first calculated descriptive statistics on the distribution of English language proficiency levels in kindergarten by English language proficiency level in grade 3 for students classified at the pre-emergent/emergent level, students classified at the basic/intermediate level, and students reclassified as English learner students in kindergarten. Starting with the kindergarten AZELLA Stage I Reassessment (administered at the end of kindergarten), proficiency levels were reported using four categories: pre-emergent/emergent, basic, intermediate, and proficient. Students scoring at the proficient level on the AZELLA Reassessment were reclassified as proficient for the following school year. A chi-squared test of the independence of English language proficiency levels in kindergarten and grade 3 was used to estimate whether the distribution of English language proficiency levels at the end of grade 3 varied by students' English language proficiency level in kindergarten. Independence was rejected (X^2 [6, N = 13,776] = 392, p < .0001).

Next, the study team conducted a regression analysis that included student characteristics (English language proficiency level in kindergarten, gender, eligibility for special education services, socioeconomic status, and race/ethnicity) and school-level characteristics (percentage of economically disadvantaged students, percentage of English learner students, charter school status, and school size). These characteristics were selected because data were available from ADE and because previous research had found them to be correlated with English language proficiency. Further details on the analysis method are provided in the section below on multilevel regression analyses.

Research question 3. For all students how did ELA proficiency level in grade 3 vary by English language proficiency level in kindergarten and by the characteristics of students and their schools? The study team first calculated

descriptive statistics on the distribution of ELA proficiency levels on the AzMERIT ELA assessment in grade 3 by English language proficiency level in kindergarten. Specifically, the percentages of students who scored minimally proficient, partially proficient, proficient, and highly proficient on the ELA assessment in grade 3 were calculated for non-native English speaker students by their English language proficiency level in kindergarten (pre-emergent/emergent, basic/intermediate, reclassified as English learner student in kindergarten, and confirmed as proficient in kindergarten). The percentage of native English speaker students at each ELA proficiency level in grade 3 was also calculated as a comparison distribution. A chi-squared test of the independence of ELA proficiency level in grade 3 and English language proficiency level in kindergarten among non-native English speaker students was used to estimate whether the distribution of ELA proficiency levels in grade 3 varied by students' English language proficiency level in kindergarten. Independence was rejected (X^2 [6, N = 19,028] = 3312, p < .0001).

Next, the study team conducted a multilevel regression analysis using ELA proficiency level in grade 3 as the dependent variable and the same student and school characteristics used in research question 2 to identify characteristics correlated with non-native English speaker students' ELA proficiency level in grade 3. Further details on the analysis method are provided in the next section on multilevel regression analyses.

Multilevel regression analyses

Because students are nested within schools, the study team used a random intercept multilevel regression model (O'Dwyer & Parker, 2014; Raudenbush & Bryk, 2002; Snijders & Bosker, 1999) to examine which student and school characteristics were most closely associated with achieving English language proficiency and ELA proficiency by the end of grade 3.

Models. Because the dependent variable was dichotomous for research questions 2 and 3, hierarchical generalized linear models, allowing for binary, non-normally distributed responses, were estimated, and the dependent variable was transformed using the logit link function (Ene et al., 2015; Luke, 2004). The random intercept model accounting for individual students (level 1) nested within schools (level 2) can be represented as:

(B1) $Z_{ij} = \log [P_{ij} / (1 - P_{ij})]$

$Z_{ij} = \beta_{0j} + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \ldots + \beta_n X_{nij}$ (level 1)

where $Z_{ij,}$ the dependent variable, is the log odds of achieving English language proficiency by the end of grade 3 or the log odds of achieving ELA proficiency by the end of grade 3 for student i in school j; P_{ij} is the probability of achieving English language proficiency or the probability of achieving ELA proficiency for student i in school j; X_{nij} is a set of student characteristics (English language proficiency level in kindergarten and demographic characteristics); β_{0j} represents a school j constant; and β_n is a regression coefficient indicating the predicted change in Z_{ij} for every one-unit increase in the value of the associated X_n variable, holding constant the other variables in the model.

At the school level the random intercept model can be represented as:

(B2) $\beta_{0j} = \gamma_{00} + \gamma_{01} W_{1j} + \gamma_{02} W_{2j} + \ldots + \gamma_{0n} W_{nj} + u_{0j}$ (level 2)

where $\gamma_{0n} W_{nj}$ represents a set of school characteristics, such as school demographic composition and charter school designation, and u_{0j} is a school error term that is assumed to be normally distributed with a mean of zero $u_{0j} \sim N(0, \tau_{00})$. Each predictor was centered to its grand mean (the average proportion of each demographic in the analytic sample). Therefore, the estimated intercept γ_{00} represents the log odds of achieving English language proficiency and ELA proficiency for a typical student at a typical school by the end of grade 3. The models were estimated using the SAS GLIMMIX procedure with the Laplace estimation method.

Intraclass correlation coefficient and variance partition. For each dependent variable the study team first estimated an unconditional multilevel model (a model without any predictors and including only a random school effect). These unconditional models were used to partition the variance of the dependent variable into within-school and between-school variance. The intraclass correlation coefficient (*ICC*) for each unconditional regression calculated the portion of variance that was due to between-school differences:[2]

(B3) $ICC = \tau^2_{00} / (\tau^2_{00} + 3.29)$.

If there is no statistical dependency due to the nesting of students within schools, all of the variance would be expected to be among students, and the ICC would be close to zero. In contrast, with highly dependent data the largest proportion of variance would be between schools, and the ICC would be closer to 1 (O'Dwyer & Parker, 2014). In both regression analyses the school random effect was significant, but the percentage of variance due to between-school differences was relatively low: the ICC was 6.5 percent for achieving English language proficiency and 16.4 percent for achieving ELA proficiency, indicating that most of the variation was due to within-school differences or to unknown factors (see tables C6 and C10 in appendix C). Because the effect was significant, a school random intercept was retained in the analyses, but no further attempt was made to include school random effects.

The study team then added to the model student- and school-level fixed effects of interest (predicted probabilities are presented in tables 1 and 2 in the main report). To facilitate the interpretation of the findings, the study team provided odds ratios and predicted probabilities in addition to the estimated coefficients (see tables C7 and C11 in appendix C).

Odds ratio. An odds ratio (*OR*) is a relative measure of effect, which enables comparing the effect for one group of a study relative to the effect for a comparison or reference group. The odds ratio of group 1 relative to group 2 is defined as:

(B4) $OR_{12} = Odds_{group1} / Odds_{group2} = [P_1 / (1 - P_1)] / [P_2 / (1 - P_2)]$

where P_1 is the probability of achieving English language proficiency or ELA proficiency for group 1 and P_2 is the probability of achieving English language proficiency or ELA proficiency for group 2.

For each variable, a category with an odds ratio greater than 1 means that students in that category were more likely to achieve English language proficiency or to achieve ELA proficiency than students in the reference category. A category with an odds ratio less than 1 means that students in that category had lower odds of the dependent variable than students in the reference category.

For the model described above, with group 2 as the reference category, the group 1 coefficient (β_1) is an estimate of the log odds ratio of group 1 versus group 2. Therefore, a significant coefficient β_1 indicates a significant difference between the two groups, and OR_{12} can be estimated as exp (β_1).

Predicted probabilities. Predicted probabilities were computed by applying the inverse link function to the least squares means of each group effect on the logit scale, with all other student and school variables at the average value for the population.[3] For example, the predicted probability for native English speaker students was computed for an average student (other than being classified as a native English speaker) attending an average school. This predicted probability can be compared with the predicted probability for students confirmed as proficient in kindergarten, which was computed for an average student (other than being confirmed as proficient in kindergarten) attending an average school.

[2] $\pi^2/3 = 3.29$ is the variance of the standard logistic distribution (Snijders & Bosker, 1999).

[3] Using GLIMMIX LSMEANS statement.

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Appendix C. Supporting analyses for research questions 2 and 3

Appendix C provides additional detailed results, including summary information about the population of analysis and estimated coefficients, odds ratios, and predicted probabilities for the multilevel regression analyses estimated for research questions 2 and 3.

Table C1. Distribution of native and non-native English speaker students at kindergarten entry, 2013/14 kindergarten cohort in Arizona

Student group and English language proficiency level at kindergarten entry	Number	Percent
Native English speaker students	66,756	75.1
Non-native English speaker students	22,101	24.9
Proficient	11,940	13.4
Nonproficient	10,161	11.4
Basic/intermediate	4,987	5.6
Pre-emergent/emergent	5,174	5.8
Total	88,857	100.0

Note: Percentages may not sum to totals because of rounding.
Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

Table C2. The number and percentage of students for the categorical variables of analysis, 2013/14 kindergarten cohort in Arizona

Student characteristic	Number	Percent
Total 2013/14 kindergarten cohort	88,857	100.0
Total English learner students	16,257	18.4
English language proficiency level in kindergarten		
Non-native English speaker students	22,837	25.7
Pre-emergent/emergent	5,392	6.1
Basic/intermediate	5,219	5.9
Reclassified as English learner student in kindergarten	5,646	6.4
Confirmed as proficient in kindergarten	6,590	7.4
Native English speaker students	66,010	74.3
Gender		
Female	43,514	49.0
Male	45,343	51.0
Eligible for special education services		
No	80,750	90.9
Yes	8,107	9.1
Economically disadvantaged status		
No	46,331	52.1
Yes	42,526	47.9
Race/ethnicity		
American Indian or Alaska Native	4,132	4.7
Asian	2,295	2.6
Black/African American	4,328	4.9
Hispanic/Latino	41,380	46.6
White	33,402	37.6
Other	3,320	3.7
Charter school status[a]		
Yes	14,723	16.6
No	74,072	83.4

a. Charter status of school of enrollment in kindergarten was missing for 62 students.
Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

Table C3. Distribution of students by school characteristics for the continuous variables of analysis, 2013/14 kindergarten cohort in Arizona

School characteristic variable	Total number of 2013/14 kindergartners	Mean	Standard deviation	Minimum	Maximum
Percentage of English learner students	88,857	18.3	18.946	0	100
Number of students	88,857	100.1	45.943	1	297
Percentage of economically disadvantaged students	88,857	47.9	32.306	0	100

Note: Variables are computed for the cohort of analysis. Number of students in school is approximated by the number of students in the cohort. Some very small schools in Arizona have fewer than 10 students in the elementary grades.
Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

Table C4. Number of English learner students by English language proficiency levels in kindergarten and in grade 3, 2013/14 kindergarten cohort in Arizona

	English language proficiency level in kindergarten			
English language proficiency level in grade 3	Pre-emergent/ emergent	Basic/ intermediate	Reclassified as English learner student in kindergarten	Total
Pre-emergent/emergent	236	95	65	396
Basic	931	633	662	2,226
Intermediate	865	823	1,126	2,814
Reclassified as English learner student in kindergarten	2,178	2,899	3,263	8,340
Total	4,210	4,450	5,116	13,776

Note: The total of 13,776 English learner students includes students who made regular grade progress and were still enrolled in the Arizona public school system in 2016/17.
Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

Table C5. Percentage of English learner students by English language proficiency levels in kindergarten and in grade 3, 2013/14 kindergarten cohort in Arizona

	English language proficiency level in kindergarten		
English language proficiency level in grade 3	Pre-emergent/ emergent	Basic/ intermediate	Reclassified as English learner student in kindergarten
Pre-emergent/emergent	5.6	2.1	1.3
Basic	22.1	14.2	12.9
Intermediate	20.5	18.5	22.0
Reclassified as English learner in kindergarten	51.7	65.1	63.8
Total	100	100	100

Note: A total of 13,776 English learner students made regular grade progress and were still enrolled in the Arizona public school system in 2016/17. Percentages may not sum to 100 because of rounding.
Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

Table C6. Intraclass correlation coefficient and variance partition for an unconditional multilevel model of achieving English language proficiency by the end of grade 3, 2013/14 kindergarten cohort in Arizona

Covariance parameter	Subject	Estimate	Standard error	*Z*-value	$P_r > Z$	Intraclass correlation coefficient (percent)
τ_{00}	School	0.2275	0.03035	7.5	< .0001	6.5

Note: The unconditional model with random intercept can be written as $Z_{ij} = \beta_{0j} + u_{0j}$ with $u_{0j} \sim N(0, \tau_{00})$. ICC (intraclass correlation coefficient) = $\tau^2_{00} / (\tau^2_{00} + 3.29)$. Estimates obtained with SAS GLIMMIX with a population of 13,776 students who were classified as English learner students in kindergarten, made regular grade progress, and were still enrolled in the Arizona public school system in 2016/17.
Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

Table C7. Predicted probability of achieving English language proficiency by the end of grade 3, by student and school characteristics, 2013/14 kindergarten cohort in Arizona

Characteristic	Estimated coefficient (standard error)	Odds ratio estimate	Predicted probability (percent)
Intercept (average student)	0.479** (0.0322)		61.8
Student characteristic			
English language proficiency in kindergarten			
Pre-emergent/emergent	–0.641** (0.0474)	0.53	50.9
Reclassified as English learner student in kindergarten	–0.001 (0.0466)	1.00	66.3
Basic/intermediate[a]			66.3
Gender			
Female	0.238** (0.0373)	1.27	64.6
Male[a]			59.0
Eligible for special education services			
Yes	–0.945** (0.0678)	0.39	40.5
No[a]			63.6
Economically disadvantaged status			
Yes	–0.005 (0.0634)	1.00	61.7
No[a]			61.8
Race/ethnicity			
American Indian or Alaska Native	–0.911** (0.1686)	0.40	38.7
Asian	0.742** (0.1236)	2.10	76.7
Black/African American	0.230 (0.1689)	1.26	66.4
Hispanic/Latino[a]			61.1
White	0.549** (0.1255)	1.73	73.1
Other	0.297 (0.2977)	1.35	67.8

Characteristic	Estimated coefficient (standard error)	Odds ratio estimate	Predicted probability (percent)
School characteristic			
Percentage of English learner students			
Higher than average by 10 percentage points	–0.005 (0.0152)	1.00	61.6
Number of students			
Higher than average by 20 students	0.044** (0.0068)	1.04	62.8
Percentage of economically disadvantaged students			
Higher than average by 10 points	–0.008 (0.0111)	0.99	61.6
Charter school status			
Yes	–0.004 (0.0894)	1.00	61.7
No[a]			61.8

** Significant at $p = .01$.

a. Reference category for the categorical predictors.

Note: No additional probabilities were significant at $p = .05$, and no probabilities were significant at $p = .001$.

Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

Table C8. Number of students by English language proficiency level in kindergarten and English language arts proficiency level in grade 3, 2013/14 kindergarten cohort in Arizona

	English language arts proficiency level in grade 3[a]				
English language proficiency level in kindergarten	Minimally proficient	Partially proficient	Proficient	Highly proficient	Total
Total	29,350	8,720	22,001	9,583	69,654
English learner students					
Pre-emergent/emergent	2,950	422	590	91	4,053
Basic/intermediate	2,854	542	831	115	4,342
Reclassified as English learner in kindergarten	3,121	721	1,032	101	4,975
Students proficient in English language in kindergarten					
Native English speaker	18,873	6,203	17,222	8,328	50,626
Confirmed as proficient in kindergarten	1,552	832	2,326	948	5,658

a. As assessed by the Arizona Measurement of Education Readiness to Inform Teaching.

Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

Table C9. Percentage of students by initial English language proficiency level in kindergarten and English language arts proficiency level in grade 3, 2013/14 kindergarten cohort in Arizona

	English language arts proficiency level in grade 3[a]				
English language proficiency level in kindergarten	Minimally proficient	Partially proficient	Proficient	Highly proficient	Total
English learner students					
Pre-emergent/emergent	72.8	10.4	14.6	2.3	100.0
Basic/intermediate	65.7	12.5	19.1	2.7	100.0
Reclassified as English learner student in kindergarten	62.7	14.5	20.7	2.0	100.0
Students proficient in English language in kindergarten					
Native English speaker	37.3	12.3	34.0	16.5	100.0
Confirmed as proficient in kindergarten	27.4	14.7	41.1	16.8	100.0

a. As assessed by the Arizona Measurement of Education Readiness to Inform Teaching.
Note: Percentages may not sum to 100 because of rounding.
Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

Table C10. Intraclass correlation coefficient and variance partition for an unconditional multilevel model of achieving English language arts proficiency by the end of grade 3

Covariance parameter	Subject	Estimate	Standard error	*Z*-value	$P_r > Z$	ICC (percent)
τ_{00}	School	0.6465	0.03255	19.86	< .0001	16.4

Note: The unconditional model with random intercept can be written as $Z_{ij} = \beta_{0j} + u_{0j}$ with $u_{0j} \sim N(0,\tau_{00})$. ICC (intraclass correlation coefficient) = τ^2_{00} / (τ^2_{00} + 3.29). Estimates obtained with SAS GLIMMIX with a population of 69,654 students who made regular grade progress, were still enrolled in the Arizona public school system in 2016/17, and had an Arizona Measurement of Education Readiness to Inform Teaching English language arts assessment proficiency level.
Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

Table C11. Predicted probability of achieving English language arts proficiency in grade 3, by student and school characteristics, 2013/14 kindergarten cohort in Arizona

Characteristic	Estimated coefficient (standard error)	Odds ratio estimate	Predicted probability (percent)
Intercept (average student)	–0.24** (0.018)		44.0
Student characteristic			
English language proficiency level in kindergarten			
Pre-emergent/emergent	–0.98** (0.049)	0.38	24.3
Basic/intermediate	–0.66** (0.043)	0.52	30.6
Reclassified as English learner in kindergarten	–0.68** (0.039)	0.51	30.3
Confirmed as proficient in kindergarten	0.73** (0.033)	2.08	64.0
Native English speaker student[a]			46.1

Characteristic	Estimated coefficient (standard error)	Odds ratio estimate	Predicted probability (percent)
Gender			
Female	0.23** (0.017)	1.26	46.8
Male [a]			41.1
Eligible for special education services			
Yes	–0.90** (0.035)	0.41	25.6
No [a]			45.7
Economically disadvantaged status			
Yes	–0.52** (0.022)	0.59	37.4
No [a]			50.2
Race/ethnicity			
American Indian or Alaska Native	–0.81** (0.058)	0.45	22.8
Asian	0.92** (0.063)	2.50	62.4
Black/African American	–0.18** (0.043)	0.84	35.7
Other	0.28** (0.046)	1.33	46.8
White	0.48** (0.023)	1.62	51.7
Hispanic or Latino [a]			39.9
School characteristic			
Percentage of English learner students			
Higher than average by 10 percentage points	–0.11** (0.010)	0.90	41.3
Number of students			
Higher than average by 20 students	0.01 (0.008)	1.01	44.1
Percentage of economically disadvantaged students			
Higher than average by 10 points	–0.04** (0.006)	0.97	43.1
Charter school status			
Yes	0.0009 (0.043)	1.00	44.0
No [a]			44.0

** Significant at $p = .01$.

a. Reference category for the categorical predictors.

Note: No additional probabilities were significant at $p = .05$, and no probabilities were significant at $p = .001$.

Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

Appendix D. Analysis of the number of years classified as English learner students

This appendix describes how the study team estimated the number of years that students in each group of English learner students in the 2013/24 kindergarten cohort in Arizona were classified as English learner students, on average (table D1). This analysis provides additional information showing that the supports that English learner students received over the years were not enough to enable them to achieve English language arts (ELA) proficiency in grade 3.

Table D1. Average number of years students were classified as English learner students by the end of grade 3, by English language proficiency level in kindergarten, 2013/14 kindergarten cohort in Arizona

Statistic	Pre-emergent/ emergent	Basic/ intermediate	Reclassified as English learner student in kindergarten[a]
Number of years classified as English learner student, on average, by the end of grade 3	2.95	2.61	2.15
Number of students	4,420	4,565	5,116

a. The kindergarten year was not counted as a year of classification because most of these students were reclassified at the end of the school year and were not eligible for services at the beginning of the year.

Source: Authors' analysis based on Arizona Department of Education data described in appendix B.

The number of years students in the 2013/14 kindergarten cohort were classified as English learner students was estimated based on their English learner status at the end of each school year. For kindergarten students initially classified as English language proficient and reclassified as English learner students at the end of kindergarten, the kindergarten year was not counted as a year of classification because most of these students were reclassified at the end of the school year and were not eligible for English learner services at the beginning of the year. The number of years classified as an English learner student only approximates the number of years of English learner services received because families can refuse services and because students who are reclassified in the middle of the year typically receive only half a year of services.

Because students reclassified as English learner students in kindergarten were not eligible for English learner services at the beginning of kindergarten, these students tended to be classified as English learner students for the fewest number of years from kindergarten through grade 3. These students were classified as English learner students for, on average, 2.15 years, suggesting that they achieved English language proficiency and ended eligibility for English learner services around grade 2. Students classified at the basic/intermediate level of English language proficiency in kindergarten ended eligibility for English learner services after 2.61 years (during grade 2), and students classified at the pre-emergent/emergent level in kindergarten ended eligibility for English learner services after nearly 3 years (during grade 3).

A follow-up analysis could look more closely into students' performance growth in English language and ELA by the type of services received and by the length of exposure to those services.