



# Predicting Kindergarten Readiness and 3<sup>rd</sup> Grade Test Scores Based on Early Learning Experiences in Washington State

Dan Goldhaber  
University of Washington  
American Institutes for Research

Stephanie Liddle  
University of Washington

Rafia Nisat  
University of Washington

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Dan Goldhaber, Stephanie Liddle, Rafia Nisat

Do Washington state's targeted, public preschool programs help socially vulnerable students succeed in elementary school? In this study, we explore this question by examining the state's Early Childhood Education and Assistance Program (ECEAP) and the Early Support for Infants and Toddlers (ESIT) program. Using statewide censuses of kindergarteners across multiple cohorts, we find that compared to white students, non-Asian students were more likely to participate in ECEAP, while ESIT participants were more likely to be male. On outcomes, we find ECEAP participants demonstrated significantly better kindergarten readiness compared to non-participants, but these effects diminished by 3<sup>rd</sup> grade. By contrast, ESIT participants performed relatively worse in kindergarten, but children who entered ESIT with higher initial skill levels and made greater progress during the program were better prepared for kindergarten. Although somewhat encouraging, these results do not speak to the causal impact of the programs because of how children were selected for participation.

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## 1 INTRODUCTION

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There is ample evidence that children begin school with varying readiness levels (Garcia, 2015; Reardon & Portilla, 2016). To support equal opportunity and increase kindergarten readiness, governments often support pre-kindergarten (“pre-K”) programs for vulnerable populations.<sup>1</sup> Washington state, for example, has long provided early-learning services to students before they begin kindergarten to support the state’s goal of having 90% of children ready for kindergarten (dcfy.wa.gov).<sup>2</sup> In this paper we examine two of the state’s programs that serve vulnerable populations: (1) The Early Childhood Education and Assistance Program (ECEAP), which offers preschool classes for 3- to 5-year-olds from underserved groups (e.g., low-income, tribal, homeless, special needs), and (2) the Early Support for Infants and Toddlers (ESIT) program, which provides services to very young children—birth to 3 years old—who have disabilities or developmental delays. For both programs, we answer three questions:

RQ 1: What is the probability that kindergarten students with different demographic characteristics received ECEAP and/or ESIT services?

RQ 2: To what extent does kindergarten readiness vary for kindergarteners who participated in the ECEAP and/or ESIT programs and those who did not?

RQ 3: To what extent do 3<sup>rd</sup> grade tests scores vary for kindergarteners who participated in the ECEAP and/or ESIT programs and those who did not?

For the ESIT program, we explore two additional questions using assessments of students’ skills before and during program participation:

RQ 4: For ESIT participants, to what extent is kindergarten readiness associated with the measured level and progress students make on age-expected skills during their time in the program?

RQ 5: For ESIT participants, to what extent are 3<sup>rd</sup> grade test scores associated with the measured level and progress students make on age-expected skills during their time in the program?

We find large racial/ethnic differences among kindergarten students based on ECEAP participation. Accounting for student demographic characteristics and relative to white students, Black and Hispanic students were 13.2% and 11.5% more likely to participate in the ECEAP program than white students. Asian students were 2.1% less likely to participate than white students. Consistent with the targeted eligibility of each program, low-income students (identified by their free and-reduced price lunch classification in kindergarten) were roughly 17% more likely to participate in ECEAP. The ESIT program, which serves students with disabilities, had much smaller racial/ethnic differences with non-participants (never more than 1% for any racial/ethnic group). But consistent with its targeting, students identified for special education services in kindergarten were about 19% more likely to participate in ESIT.

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<sup>1</sup> The most well-known example is Head Start, the federal government’s oldest and largest compensatory pre-K program, but many states also have their own universal pre-K policies—a point we return to later.

<sup>2</sup> As of the 2022-23 school year, DCYF reported that less than half of children were ready for kindergarten based on Washington’s kindergarten assessment: the Washington Kindergarten Inventory of Developing Skills (WaKIDS) (see <https://dcyf.wa.gov/node/3254>).

Interestingly, the largest demographic difference in ESIT participation was by gender—females were 2.6% less likely to have participated than males.

Our findings on the relationship between program participation and school readiness were mixed. Controlling for free and-reduced price lunch participation, ECEAP participants were better prepared for kindergarten than nonparticipants on every domain of the WaKIDS assessment. But by the 3<sup>rd</sup> grade, they scored lower on state standardized tests than non-ECEAP students. Students served by the ESIT program showed the opposite pattern. They were *less* prepared for kindergarten based on the WaKIDS assessment than non-ESIT students. But by the 3<sup>rd</sup> grade they had higher test scores than non-ESIT students. While suggestive, we should be cautious about interpreting any of these results as causal. Both programs enroll children based on characteristics that are likely to affect later schooling outcomes.<sup>3</sup> In addition, unmeasured pre-K attendance in our comparisons groups (i.e., students who received neither intervention) likely biases our comparisons (McElrath & Bauman, 2021). On our two additional ESIT questions, we find children who start with higher skills and make more progress during the program are better prepared for kindergarten. By 3<sup>rd</sup> grade, these associations remain marginally predictive of math scores but tend to fade out in ELA.

In the end, both programs appeared to reach their target populations and were associated with some positive elementary outcomes. But the timing and trajectories of these benefits differed. These nuanced results underscore the need for more rigorous causal research that can untangle some of the selection issues, mechanisms, and variation that could be driving how pre-K influences later outcomes.

## 2 BACKGROUND

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Not all children have equal access to early childhood experiences that can support their transition from pre-K to elementary school. Publicly provided pre-K programs aim to reduce such gaps by supporting language, literacy, and social development for vulnerable children, particularly children living in low-income households. Since the 1960s, numerous studies have examined the effects of children’s participation in pre-K programs on later outcomes. Notable research, such as the Perry Preschool and Abecedarian projects, randomly assigned children to preschool programs and found improvements in short-term test scores, behavior, and long-term outcomes like educational attainment, crime reduction, and earnings (see Pages et al., 2020). Larger-scale observational studies of pre-K have yielded more mixed results. A meta-analysis of 84 pre-K studies by Duncan and Magnuson (2013) found an average effect size of 0.35 standard deviations on cognitive and achievement scores by the end of the treatment period, although these effects tend to diminish over time (Pages et al., 2020). Decades of research on Head Start—the nation’s oldest and largest federally-funded compensatory pre-K program—has also yielded mixed results on a range of outcomes, including academic skills, social-emotional wellbeing, executive functioning, and behavior (Bierman et al., 2008; Zhai et al., 2011; Lee et al., 2014; Nix et al., 2016). Evidence of fadeout notwithstanding, preschool participation has also been

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<sup>3</sup> For more on selection bias see Winship & Mare (1992). For more on how disadvantaged backgrounds or statuses negatively affect student outcomes see Wagner et al. (2005 & 2006), Newman et al. (2010), Reardon (2013), Reardon & Portilla (2016).

associated with lasting benefits in high school graduation, college attendance (Gray-Lobe et al., 2023), and earnings (Chetty, 2011).

Although Head Start is arguably the nation's most well-known pre-K program, many states fund their own compensatory pre-K programs.<sup>4</sup> Indeed, recent estimates show that in 2022, 32% of 4-year-olds across the U.S. were enrolled in a state-funded pre-K program compared to 6% who were enrolled in Head Start (Friedman-Krauss et al., 2023).<sup>5</sup> Studies suggest these state-run pre-K programs differ not just in their effects (Barnett et al., 2018) but that they may also impact different outcomes than Head Start (Gormley et al., 2010).

In this paper, we contribute to the research on state-run, compensatory pre-K by examining two long-standing programs in Washington state: the ECEAP and the ESIT. The ECEAP started in 1985 and provides education, health, nutrition, and family support to eligible children aged 3 to 5. The program serves families at or below 36% of the state's median income (approximately \$29,680 in 2019) or up to 100% of the state's median income for tribal members. In addition, 10% of ECEAP slots are available for children who either have an individual education plan (IEP) or demonstrate other research-based risk factors affecting school success who do not meet the income eligibility threshold. (See Washington's Department of Children, Youth and Families (DCYF) website for more details: <https://dcyf.wa.gov/services/earlylearning-childcare/eceap-headstart>.) By the 2023-24 school year, it was projected to serve more than 16,000 children at over 480 sites across the state.

Washington launched the ESIT program a year after the ECEAP, in 1986. ESIT offers personalized early intervention services from birth to age 3 for children who have disabilities or developmental delays. Children are eligible for ESIT if they exhibit a 25% developmental delay or perform 1.5 standard deviations below their age group in one or more of five developmental areas.<sup>6</sup> Children with a diagnosed physical or mental condition associated with a high probability of developmental delays are also eligible for ESIT services.<sup>7</sup> ESIT services can include specialized instruction, speech therapy, occupational therapy, and/or physical therapy. Unlike the ECEAP program, ESIT participants can receive services in their home (82% of our sample chose in-home care), although services can also be provided in childcare centers, preschool or school programs, and community centers. ESIT services conclude on a child's 3<sup>rd</sup> birthday or earlier, if satisfactory progress is achieved. (For more details see: <https://dcyf.wa.gov/services/child-development-supports/esit>.)

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<sup>4</sup> Often with financial assistance from the federal government.

<sup>5</sup> Another 18.5% of 3- and 4-year-olds were enrolled in private pre-K programs that same year. See Table 202.20 of NCES Digest of Education Statistics at [nces.ed.gov/programs/digest/d20/tables/dt20\\_202.20.asp](https://nces.ed.gov/programs/digest/d20/tables/dt20_202.20.asp).

<sup>6</sup> These five areas are: *Adaptive* (e.g., holding a bottle, eating with fingers, getting dressed), *Cognitive* (e.g., watching activities, following simple directions, problem-solving), *Communication* (e.g., vocalizing, babbling, using two- to three- word sentences), *Physical* (e.g., reaching or grasping for toys, crawling, walking, jumping), *Social-emotional* (e.g., making needs known, initiating games, starting to take turns). Children are assessed with appropriate diagnostic instruments and procedures administered by qualified personnel. See <https://dcyf.wa.gov/services/child-development-supports/esit/early-intervention-services> and <https://dcyf.wa.gov/services/child-development-supports/esit/eligibility#:~:text=To%20be%20eligible%2C%20a%20child,cause%20a%20delay%20in%20development>.

<sup>7</sup> Such conditions include: chromosomal abnormalities, genetic or congenital disorders, sensory impairments, and fetal alcohol syndrome.

Like the broader literature, studies of ECEAP have produced mixed results. Two studies based on a single cohort, find that former ECEAP participants are better prepared for kindergarten than lower-income kindergarteners who did not participate in ECEAP (Coker, 2017a), especially low-income Hispanic students (Coker, 2017b). A subsequent study using multiple cohorts found that participants' kindergarten readiness varied according to the quality rating of the site they attended (Goodvin et al., 2020). We are unaware of any published research on ESIT participation and later schooling outcomes.<sup>8</sup> Our contributions are two-fold. We extend the research on ECEAP by analyzing a larger sample of children and following them further into elementary school than prior studies. In our analysis of ESIT, we go beyond program participation to examine the extent to which the *levels of* and *growth in* skills gained during the ESIT program is associated with later schooling outcomes.

### 3 DATA, MEASURES, AND ANALYTIC SAMPLE

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The data for this study come from several datasets maintained by the Office of Superintendent of Public Instruction (OSPI) and the Education Research and Data Center (ERDC). The data sources from OSPI are the Comprehensive Education Data and Research System (CEDARS) and the WaKIDS data inventory. Data sources from ERDC include the ECEAP and ESIT databases. Individual student records are longitudinally linkable across years based on a unique student record identifier that the state maintains.

#### 3.1 CEDARS AND WAKIDS DATA

CEDARS data include annual information on student demographics (e.g., race/ethnicity, gender) and student classifications (e.g., free or reduced-price lunch eligibility, disability status and limited English proficiency status). These data also include various educational outcomes, including 3<sup>rd</sup> grade performance on the state's Smarter Balanced Assessment (SBA) tests in math and English language arts (ELA).<sup>9</sup>

WaKIDS data include readiness measures for new kindergarteners across four *developmental* domains (social-emotional, physical, cognitive, and language) and two *content* domains (literacy and mathematics). Within each of these domains, WaKIDS assesses new kindergarteners (within the first few months of starting school) on multiple "objectives" (between four and seven depending on the domain). Kindergarten teachers complete the WaKIDS assessment by rating their students based on a rubric that scores each objective on an ordinal scale from 0 to a maximum that varies between 9 and 15, depending on the objective. Because the raw scores for each domain represent an ordinal level of measurement, score increases do not represent equal amounts of development. To facilitate interpretation, raw scores must be converted to scaled scores that describe a child's relative readiness in terms of equal intervals. This conversion to scale scores is proprietary to the Teaching Strategies GOLD<sup>®</sup> assessment and those scale scores are included in the WaKIDS data.

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<sup>8</sup> Zhao (2020) investigates the pathways of infants and toddlers with disabilities after they receive ESIT services and transition out of the program. Results indicate that upon exiting ESIT, the majority of participants enrolled in special education services at the pre-K level or enrolled in ECEAP.

<sup>9</sup> Similar student-level demographic variables are available from the ECEAP and ESIT data systems. But due to various data quality issues in those datasets, we rely on the CEDARS measures which are generally more consistent and complete.



WaKIDS data also include domain-specific readiness flags that indicate whether students met or exceeded age-appropriate developmental expectations. These flags occur when the sum of all a child’s objective scores within a domain is higher than a given threshold value for that domain. When added together, these domain-specific readiness flags indicate the number of domains in which a student is deemed ready for kindergarten—ranging from 0 to 6 (as shown in **Table 1**). Kindergarteners who meet skill expectations in all 6 domains are deemed “kindergarten ready,” a binary measure that is positively associated with later schooling outcomes, such as 3<sup>rd</sup> grade test scores (Goldhaber et al., 2023). For our analysis, we standardize both the WaKIDS scaled scores and SBA test scores to have a mean of 0 and a standard deviation of 1 within each year.

### 3.2 EARLY LEARNING DATA: ECEAP AND ESIT

The DCYF provides ERDC with annual student-level data on all children enrolled in the state-funded ECEAP program. These data include student demographics as well as eligibility and enrollment details.<sup>10</sup> Using enrollment data, we construct a binary variable that flags children with any non-zero enrollment days as ECEAP participants.

The DCYF also provides ERDC with annual updates of the universe of children in the ESIT database for all previous years. These data include student demographics as well as information on referral sources, eligibility, and services provided. From these data we know the number of services each child received and how often they received them. We construct a binary indicator that flags children who received at least one service at least one time as an ESIT participant.<sup>11</sup>

Unlike the ECEAP data, the ESIT data include an in-program assessment of participating children. This assessment is conducted using the Child Outcomes Summary Form (COSF), which addresses three areas: Positive Social-Emotional Skills, Acquiring and Using Knowledge and Skills, and Use of Appropriate Behaviors. The COSF is completed by service providers with input from family members who regularly observe the child’s behavior across different settings. For each area covered on the COSF, children receive ratings between 1 and 7.<sup>12</sup> Ratings of 6 or 7 indicate the child is demonstrating age-appropriate skills in the area across different settings and situations; ratings of 1 to 5 suggest varying degrees of delay. Importantly, children are assessed at two points in time—when they enter the ESIT program and again when they exit—allowing us to calculate children’s growth in skills during the ESIT program.

In our analyses of the COSF data, we apply a graded response model (GRM) to the two data points, transforming the ordered categorical data into a continuous scale (see Goldhaber et al., 2024 for details). This allows us to estimate the probability of observing a score level  $k$  or higher on criterion  $c$  of the COSF score for participant  $i$  (where the score is entry score and exit score) as in equation (1).

$$\Pr(\text{Score}_{ic} \geq k | \theta_i) = \frac{\exp \{a_c(\theta_i - b_{ck})\}}{1 + \exp \{a_c(\theta_i - b_{ck})\}} \quad (1)$$

<sup>10</sup> Though much of these data are incomplete or inconsistent.

<sup>11</sup> The median number of sessions for children in the sample was 49, but with substantial variation and potential data entry errors (mean=124, sd=534, max=43,771).

<sup>12</sup> For more information on this assessment see: <https://dcyf.wa.gov/services/child-dev-support-providers/esit/cos>

where  $a_c$  represents the discrimination of criterion  $c$ ,  $b_{ck}$  is the  $k$ th cut point of criterion  $c$ , and  $\theta_i$  is the latent quality represented by the GRM estimates.

We use GRM-adjusted estimates of  $\theta_i$  as summative measures of an ESIT participants' entry and exit scores on the COSF. We standardize both the GRM-adjusted entry and exit scores, by year, to have means equal to zero and standard deviations equal to one. We then calculate the difference between the standardized GRM-adjusted exit and entry scores to calculate the growth of participant  $i$  as:

$$\text{Growth}_i = \widehat{\theta}_{i_{\text{exit}}} - \widehat{\theta}_{i_{\text{entry}}} \quad (2)$$

We standardize growth, by year, to have a mean of zero and a standard deviation of one.

### 3.3 ANALYTIC SAMPLE AND SAMPLE STATISTICS

Our sample includes 6 cohorts of kindergarteners from school years 2014-15 to 2018-19 and from school year 2021-22 where we can observe WaKIDS readiness outcomes. We do not have outcome data (i.e., WaKIDS scores or 3<sup>rd</sup> grade tests) for the 2019-20 and 2020-21 school years due to data disruptions related to the COVID-19 pandemic. Accordingly, we only observe 3<sup>rd</sup> grade test results for the first two cohorts and the 2019 cohort. Across these cohorts we keep one observation per student in the year most proximate to the year they started kindergarten, yielding a total of 346,782 unique student observations. Since we observe 3<sup>rd</sup> grade test outcomes for only half of the cohorts, we are left with 148,423 unique student observations in analyses focused on 3<sup>rd</sup> grade test scores.<sup>13</sup>

Panel A of **Table 1** shows the percentage of kindergarteners in either pre-K program (ECEAP or ESIT) and those not in either program.<sup>14</sup> Out of the 346,782 kindergarteners in our analytic sample, about 12% participated in ECEAP and 5% participated in ESIT.<sup>15</sup> Selected sample statistics are broken out by ECEAP and ESIT participation. The differences between participants and nonparticipants illustrates the nonrandom nature of program participation. For instance, the percentage of Black and Hispanic ECEAP participants was nearly twice that of nonparticipants while the percentage of Asian participants was less than half that of nonparticipants. Males were overrepresented in the ESIT program, making up 63.6% of participants compared to 50.6% of nonparticipants. Students eligible for free or reduced-price lunch (in kindergarten) made up 94.6% of ECEAP participants compared to 55% of nonparticipants. And students who were later identified for special education services in kindergarten made up 87.5% of ESIT participants compared to 19.4% of nonparticipants.

Panel B of **Table 1** shows the average number of WaKIDS domains in which students were deemed “ready” for kindergarten, by program participation status. Across all student demographics and classifications, ECEAP and ESIT participants met fewer readiness thresholds than nonparticipants, with especially bigger differences for ESIT participants.

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<sup>13</sup> The 2022 cohort is smaller than the other cohorts and may be related to the COVID-19 pandemic or it may be due to limitations in the availability of data across different data systems.

<sup>14</sup> Students not enrolled in either the ECEAP or ESIT program could have opted for a private pre-K program, a day care center, a Head Start program, or no early learning program.

<sup>15</sup> 2,359 students were enrolled in both ECEAP and ESIT. They are included in samples for both programs.

We begin our analysis by estimating logistic regression models that predict the likelihood that kindergarteners with varying characteristics participated in the ECEAP and ESIT programs before enrolling in K12 (RQ 1):

$$\log\left(\frac{PreK\ Participation_{ij}}{1-PreK\ Participation_{ij}}\right) = \alpha_0 + \varphi Demographics_i + \tau Classifications_i + \gamma_j + \varepsilon_{ij} \quad (3)$$

where  $PreK\ Participation_{ij}$  represents the probability that student  $i$  in district  $j$  was enrolled in the ECEAP (or ESIT),  $Demographics_i$  is a vector of student demographics (i.e., race/ethnicity and gender),  $Classifications_i$  is a vector of student classifications (i.e., whether a student is eligible for free or reduced-price lunch, has a disability, is receiving services for limited English proficiency or is identified for special education services) and  $\gamma_j$  is a vector of district fixed effects. In these models the referent category is students who did not participate in the ECEAP or ESIT programs.

We begin with a sparse version of (3) that only includes demographics. This model is identified by both within- and between-district participation in the two pre-K programs. In specifications that include district fixed effects, identification is based on differences in participation within school districts.<sup>16</sup>

In some specifications we add a vector of student classifications. Since these classifications are observed in kindergarten, they are potentially endogenous. An ESIT participant, for example, could be more likely to be identified for special education services in kindergarten if their ESIT experience increased their parents' awareness of the benefits of special education services. Alternatively, ESIT students could be less likely to be identified for special education services in kindergarten if, thanks to ESIT, they no longer need those services.

To assess the relationship between participation in pre-K programs and kindergarten readiness (RQ 2) or 3rd grade tests scores (RQ 3), we estimate linear regression models as shown in equation (4):

$$WaKIDS_{ij}/Test3GR_{ij} = \alpha_0 + \beta PreK_i + \varphi Demographics_i + \tau Classifications_i + \gamma_j + \varepsilon_{ij} \quad (4)$$

where  $WaKIDS_{ij}$  represents the domain-specific standardized scaled scores for student  $i$  in district  $j$  for each of the six domains assessed by WaKIDS and  $Test3GR_{ij}$  represents the subject-specific standardized 3<sup>rd</sup> grade test scores for student  $i$  in district  $j$  for math and ELA.  $\beta$  contains the coefficients of interest capturing program-specific effects of  $PreK_i$  which is a vector of indicators for a student's participation in ECEAP only, ESIT only, or both programs. Other vectors are as described in equation (3). Note that in models predicting 3<sup>rd</sup> grade scores we also include  $WaKIDS_i$  as covariates on the right-hand side of equation (4).

<sup>16</sup> Location-specific information about pre-K services is only available for the students we observe in the ECEAP or ESIT programs so we cannot estimate models with site-specific effects. To the extent that children move out of their kindergarten district between the time they participate in a pre-K program and enroll in kindergarten, the precision of these fixed effects will be attenuated.

For our two research questions related to skills before and during ESIT (RQ4 and RQ5), we estimate linear regressions as shown in equation (5) for ESIT participants only:

$$WaKIDS_{ij}/Test3GR_{ij} = \alpha_0 + \beta COSF_i + \varphi Demographics_i + \tau Classifications_i + \gamma_j + \varepsilon_{ij} \quad (5)$$

where  $WaKIDS_{ij}$  represents the domain-specific standardized scaled scores for student  $i$  in district  $j$  for each of the six domains assessed by WaKIDS and  $Test3GR_{ij}$  represents the subject-specific standardized 3<sup>rd</sup> grade test scores for student  $i$  in district  $j$  for math and ELA.  $\beta$  contains the coefficients of interest capturing the effects of  $COSF_i$  which, in various models, represents *both* a child’s entry-level measurement on age-expected skills (as assessed by COSF) and the difference between their exit and entry scores from equation (2). Other vectors are as described in equation (3). In models predicting 3<sup>rd</sup> grade test scores, we also include students’  $WaKIDS_i$  as covariates on the right-hand side of equation (5).

## 5 FINDINGS<sup>17</sup>

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### 5.1 PROGRAM PARTICIPATION

**Table 2** shows the log odds of participating in ECEAP (Panel A) or ESIT (Panel B) for various model specifications (RQ 1). For ease of interpretation, we present marginal probabilities based on these models in **Figure 1**. We see significant differences in ECEAP participation by race/ethnicity for a model including only student demographics (the black dots). All non-Asian student groups were between 3.2% (Other) and 13.1% (Black) more likely than white students to participate in ECEAP. The magnitudes of these effects decrease (but remain statistically significant) when student’s kindergarten classifications are included in the model (dark gray dots). Again, these findings may be biased if kindergarten classifications (like free or reduced-lunch eligibility) are influenced by earlier participation in ECEAP. Notably, the predicted likelihood of participation is estimated to be higher for all non-Asian racial categories in the model that includes district fixed effects (light gray dots in **Figure 1**).

The different results from models with and without fixed effects could be due to unequal access to ECEAP services in different districts for students of different races/ethnicities. Models that do not include district fixed effects compare the participation of students both within and across districts. By comparing all students to each other, these models may inflate white participation if white preschoolers tend to be concentrated in districts that are more likely to offer ECEAP. Investigating this possibility is difficult because the ECEAP data do not include location specifics.<sup>18</sup> As a workaround, we assigned each ECEAP site to the school district where most of its students attended kindergarten. The results do not suggest that white students were overrepresented in districts with at least one ECEAP site.<sup>19</sup> Because ECEAP is targeted to low-income families, it is unsurprising that **Table 2** shows kindergarteners eligible for free or

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<sup>17</sup> Though not shown here, we also estimated models with cohort fixed effects. Results were broadly similar to the fully-saturated models as specified in equations 3 through 5.

<sup>18</sup> Recall that we do know a child’s K-12 school district at the point that children enroll in kindergarten, but we observe in the data that ECEAP sites often serve children who end up attending kindergarten across different districts complicating any 1-to-1 connection between sites and districts during ECEAP participation.

<sup>19</sup> On average, in districts with at least one ECEAP site 61% of students were white compared to 64.5% of students in districts with no ECEAP site.

reduced-price lunch were more likely (by about 16.7%) than their higher-income peers to have participated.

Turning to ESIT, we generally see smaller differentials in the likelihood of participation in ESIT by student demographics and classifications, with one notable exception. Students who were later identified for special education services in kindergarten were 19.3% more likely to have participated in ESIT than their peers who were not identified. Again, is this unsurprising given that ESIT services are specifically targeted to young children with disabilities. In terms of gender, fully-saturated models (Columns 3 and 6 in **Table 2**) show that females were slightly (0.3%) more likely to have participated in ECEAP and slightly (0.4%) less likely to have participated in ESIT.

## 5.2 PRE-K PROGRAM PARTICIPATION AND KINDERGARTEN READINESS

**Tables 3A-3F** show results from various models using participation in the pre-K programs to predict WaKIDS scores for each of six domains. Looking at the first row in the tables (i.e., ECEAP only participation) shows the importance of covariate adjustments. If solely focused on the effect of participating in ECEAP from models with only pre-K participation flags or demographic covariates, the program appears detrimental (all effects are negative and statistically significant). After controlling for students' kindergarten classifications, however, program participation tends to *increase* readiness across all domains. This shift in results is mainly due to controlling for free and reduced-price lunch eligibility. In other words, among kindergarteners who were eligible for free or reduced-price lunch, those with ECEAP did better on the WaKIDS assessment by between 5.4% (in social-emotional domain, see Column 3 in **Table 3F**) and 9.0% of a standard deviation (in physical domain, see Column 3 in **Table 3E**) than non-participants, holding demographics and classifications constant. The magnitudes of the ECEAP participation coefficients are attenuated slightly with district fixed effects. Although we do not interpret these findings as causal, the positive coefficients in the last two columns of each panel (with kindergarten classifications and/or district fixed effects) suggest that if a causal relationship does exist, our estimates likely represent its lower bound.

Unlike ECEAP, having participated only in the ESIT program is negatively associated with kindergarten readiness across the board. But the negative effect of participation decreases in magnitude in more controlled models. For example, Column 1 in **Table 3A** (a model with no covariates) suggests that students who participated only in ESIT scored 61.5% of a standard deviation lower on cognitive readiness in kindergarten than those not did not. But once we consider student demographics and classifications (see Column 3), the size of that coefficient drops to 21.3% of a standard deviation. A similar pattern holds across WaKIDS domains and in models with district fixed effects. That said, regardless of model specification—and even after controlling for special education status—ESIT participants performed worse on each domain of the WaKIDS assessment. In fully-saturated models, participants in ESIT only were estimated to have scored between 12.4% (in literacy, see Column 4 in **Table 3C**) and 24.2% of a standard deviation (in physical, Column 4 in **Table 3E**) lower than their kindergarten peers who did not participate in ESIT. Given our assumptions about selection into the ESIT program, we again want to caution against concluding that these negative associations represent the program's causal effect.

Finally, we see increased kindergarten readiness for students who participating in *both* the ECEAP and ESIT programs. Fully-saturated models with significant coefficients show that these children did better by between 7.2% (in language, see **Table 3B**) and 11.5% of a standard deviation (in literacy, see **Table 3C**) compared to students who were not enrolled in both programs.

### **5.3 PRE-K PROGRAM PARTICIPATION AND 3<sup>RD</sup> GRADE TEST SCORES**

Following students beyond kindergarten, we find persistent negative associations between ECEAP participation and 3<sup>rd</sup> grade test scores for both ELA (**Table 4A**) and math (**Table 4B**) across model specifications. As was the case with ESIT participation and kindergarten readiness, we find a marked decrease in the magnitudes of these negative effects within each subject as we build toward fully-saturated models using the covariates described in equation (5)—a drop in magnitude of 82 percent in both ELA (from -0.400 in Column 1 to -0.074 in Column 5 of **Table 4A**) and math (from -0.396 in Column 1 to -0.073 in Column 5 of **Table 4B**).

We find a different trajectory with ESIT participation. The program is negatively associated with 3<sup>rd</sup> grade test scores in naïve models with no covariates (Columns 1 in **Tables 4A** and **4B**) and in models that only include student demographics (Columns 2). But once we account for student classifications—and special education identification in particular—the coefficient for ESIT participation on 3<sup>rd</sup> grade tests turns positive (Columns 3). For ELA, this result is fairly robust to subsequent models that include domain-specific WaKIDS scores (Columns 4) and district fixed effects (Columns 5).

Participation in both programs is associated with higher 3<sup>rd</sup> grade test scores. Fully-saturated models show gains between 2.8% of a standard deviation in ELA (see Column 5 in **Table 4A**) and 4.3% of a standard deviation in math (Column 5 in **Table 4B**) with marginal significance in math only.

The ECEAP’s fadeout is somewhat puzzling, given that previous research suggests kindergarten readiness—measured either as binary indicator or as domain-specific scaled scores of the WaKIDS assessment—is associated with higher 3<sup>rd</sup> grade test scores (Goldhaber et al., 2023). At the same time, this result is broadly consistent with several studies that find the positive effects of Head Start participation tend to weaken over time (Currie & Thomas, 1995; Ludwig & Philips, 2008; U.S. Department of Health and Human Services, 2010; Bitler et al., 2014). Indeed, in some studies, Head Start participation was found to be negatively related to various schooling outcomes (Pages et al., 2020; Vogel et al., 2010).

### **5.4 SKILLS AND PROGRESS DURING THE ESIT PROGRAM**

**Tables 5A-5F** show the estimated associations between children’s initial level of age-expected skill, the progress or “growth” they made during their time in the ESIT program, and their kindergarten readiness (RQ 4). Among roughly 16,000 ESIT participants, children who entered the ESIT program with higher measured levels of age-expected skills did better on the WaKIDS assessment than students with lower skill levels (Columns 1 across tables). This is also

the case for students who made more progress on age-expected skills during course of the program (Columns 2 across tables). Specifically, a one standard deviation increase in growth on COSF scores is associated with gains ranging from 10.1% to 11.6% of a standard deviation on the WaKIDS assessment, depending on the domain. In specifications that include controls for COSF entry scores (Columns 3 across tables), the findings are even stronger, with gains ranging from 24.7% (in literacy, see Column 3 in **Table 5C**) to 26.8% of a standard deviation (in social-emotional, see Column 3 in **Table 5F**). The magnitudes of the coefficients for growth are only slightly attenuated in models that include student demographics (Columns 4), student classifications (Columns 5), and district fixed effects (Columns 6), suggesting a robust positive association between measures of students' progress made on COSF while in ESIT and measures of their kindergarten readiness.

Turning to the relationship between ESIT skills and progress and later (3<sup>rd</sup> grade) test outcomes (**Tables 6A** and **6B**), we see smaller yet still positive associations between starting skill levels and skill development during ESIT and students' 3<sup>rd</sup> grade test scores, even after controlling for various student-level covariates and WaKIDS readiness scores. For example, a one standard deviation increase in growth is associated with 2% of a standard deviation increase in students' ELA test scores (Column 6 in **Table 6A**) and 2.9% of a standard deviation in students' math test scores (Column 6 in **Table 6B**). Even when statistically insignificant—as in the fully-saturated models—the positive effects of COSF growth during ESIT are educationally meaningful. As with all our analyses, we caution against interpreting COSF growth as program effects—they may reflect skill development that would have happened independently of the program's contributions. Regardless, our results suggest that the COSF assessment can help identify age-expected skill levels and progress in young children that predicts kindergarten readiness.

## 6 DISCUSSION AND CONCLUSIONS

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This study contributes to the limited body of evidence on the relationship between participating in two early-learning interventions in Washington state and later academic outcomes. We explore who participated in the programs, their readiness for kindergarten, and their 3<sup>rd</sup> grade test scores. For one program, we considered whether children's skills and skill growth before and during the program predicted later outcomes.

The demographic differences we found in program participation were largely what we anticipated. As we noted earlier, the difference in participation rates across demographic subgroups (for models with and without kindergarten-district fixed effects) is puzzling. We imagined these differences were likely be driven by racial/ethnic inequities in access to ECEAP sites. But when we explored this possibility, we found that districts without ECEAP sites had higher percentages of white students than districts with at least one ECEAP site. A more rigorous investigation using location data could provide additional insight into how geographical and demographic factors influence participation rates across racial and ethnic groups.

On outcomes, our findings show that ECEAP participation is associated with improved kindergarten readiness but not 3<sup>rd</sup> grade test scores. The estimated effects on later schooling outcomes are likely biased downward, given the program's emphasis on serving disadvantaged students. Moreover, the result for 3<sup>rd</sup> grade test scores is broadly consistent with previous studies

showing the positive effects of Head Start participation tend to fade out over time, and were even negatively related to school outcomes in some studies.

We find a different pattern of results for ESIT participants. They have lower kindergarten readiness but exhibit higher 3rd grade test scores, perhaps suggesting the program provides long-term benefits that emerge as children progress through school.

Our previous cautions against causal interpretations remain. For example, the negative association between ECEAP participation and 3rd grade test scores (in math) may reflect the challenges faced by students from lower-income families rather than program participation. On the other hand, positive correlations observed for ESIT participants' later performance are encouraging, but they could reflect secular improvement or some other factor, rather than program effects. In either case, we hold that our correlational estimates of program participation—in either ECEAP or ESIT—are biased downward and are likely lower-bound estimates of their true causal effect.



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**TABLES AND FIGURES**

Table 1. Summary Statistics for Analytic Sample

Program Participation	Panel A: Percent of Kindergarteners			Panel B: Average Number of WaKIDS Domains Met		
	ECEAP	ESIT	Neither	ECEAP	ESIT	Neither
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Student Demographics</i>						
Asian	3.3***	5.2***	7.2	4.4***	3.7***	4.8
Black	7.9***	3.7***	4.0	4.2	2.8***	4.3
Hispanic	41.7***	28.3***	23.3	3.8	2.9***	3.8
Other Race/Ethnicity	10.8***	10.1***	11.6	4.2***	3.4***	4.5
White	33.7***	47.9***	52.7	4.2***	3.5***	4.8
Female	46.9***	31.5***	48.3	4.3***	3.5***	4.7
Male	50.5	63.6***	50.6	3.8***	3.2***	4.3
<i>Student Classifications in Kindergarten</i>						
Free/Reduced-Price Lunch	94.6***	65.7***	55.0	4.0	3.0***	4.0
Learning Disability	7.5***	10.6***	5.0	2.8***	2.5***	3.0
English Proficiency Services	36.7***	22.7***	21.2	3.8**	2.9***	3.7
Special Education Services	28.4***	87.5***	19.4	3.2***	3.2***	3.4
N	41,710	16,340	291,091	41,710	16,340	291,091

Note. Across all cohorts 2,359 students (0.68%) were enrolled in both the ESIT and ECEAP programs. Those students are double counted in this table because they are included in both the ECEAP and ESIT samples.

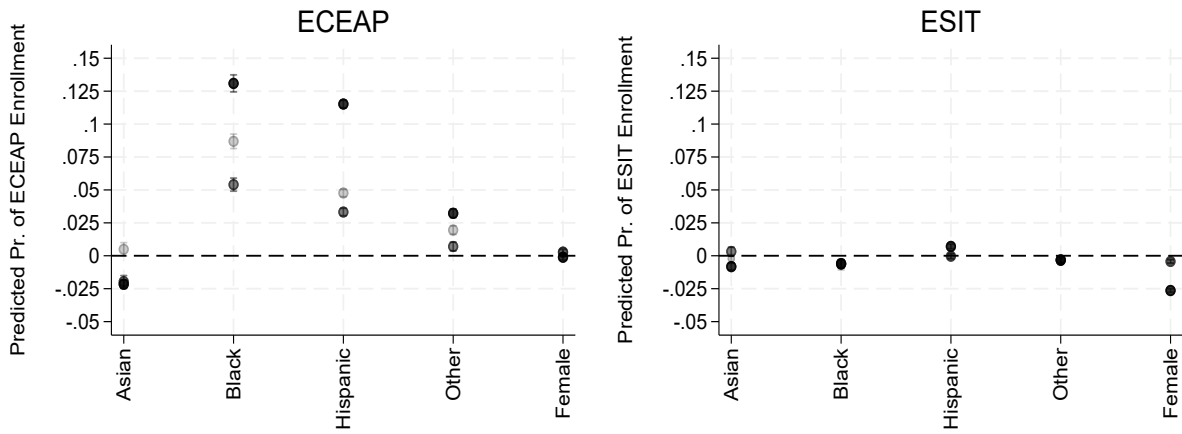
p values in columns 1 and 2 from two-sided t test against column 3; p values in columns 4 and 5 from two-sided t test against column 6. \*\*\*p<.001 \*\*p<.01 \*p<.05

Table 2. Log Odds from Logistic Regressions Predicting Pre-K Program Participation

Pre-K Program	Panel A: ECEAP Participation			Panel B: ESIT Participation		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Student Demographics</i>						
Asian	-0.317*** (0.029)	-0.252*** (0.031)	0.050 (0.033)	-0.216*** (0.037)	0.187*** (0.043)	0.035 (0.045)
Black	1.124*** (0.021)	0.514*** (0.022)	0.874*** (0.025)	-0.153*** (0.043)	-0.124** (0.047)	-0.173*** (0.049)
Hispanic	1.024*** (0.012)	0.323*** (0.015)	0.514*** (0.016)	0.160*** (0.019)	0.097*** (0.025)	0.099*** (0.026)
Other Race/Ethnicity	0.378*** (0.018)	0.078*** (0.019)	0.238*** (0.020)	-0.087** (0.028)	-0.073* (0.030)	-0.120*** (0.031)
Female	-0.006 (0.011)	0.028* (0.011)	0.030* (0.012)	-0.657*** (0.017)	-0.113*** (0.019)	-0.112*** (0.019)
<i>Student Classifications in Kindergarten</i>						
Free/Reduced-Price Lunch		3.047*** (0.030)	2.961*** (0.030)		0.048* (0.020)	0.171*** (0.022)
Learning Disability		-0.091*** (0.024)	-0.114*** (0.025)		-0.970*** (0.027)	-0.971*** (0.028)
English Proficiency Services		0.237*** (0.014)	0.351*** (0.015)		0.277*** (0.026)	0.240*** (0.027)
Special Education Services		0.217*** (0.014)	0.243*** (0.015)		3.986*** (0.030)	4.007*** (0.031)
District FE	No	No	Yes	No	No	Yes
Constant	-2.433*** (0.010)	-4.813*** (0.030)	-4.719*** (0.127)	-2.790*** (0.013)	-5.418*** (0.033)	-5.847*** (0.326)
Observations	341,836	341,836	341,000	341,836	341,836	340,655

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05

Figure 1. Predicted Probabilities of Pre-K Program Participation



### Model Covariates

- Demographics Only
- Demographics and Classifications
- Demographics, Classifications and District FE

Table 3A. Linear Regressions Predicting WaKIDS Cognitive Scores with Pre-K Participation

WaKIDS Domain: Cognitive	Model Specifications			
	(1)	(2)	(3)	(4)
<i>Pre-K Participation</i>				
ECEAP Only	-0.164*** (0.005)	-0.088*** (0.005)	0.071*** (0.005)	0.059*** (0.005)
ESIT Only	-0.615*** (0.009)	-0.573*** (0.009)	-0.213*** (0.009)	-0.211*** (0.009)
ECEAP and ESIT	-0.510*** (0.021)	-0.420*** (0.021)	0.033 (0.020)	0.024 (0.020)
<i>Student Demographics</i>				
Asian		-0.022*** (0.007)	0.036*** (0.007)	-0.002 (0.007)
Black		-0.271*** (0.008)	-0.113*** (0.008)	-0.180*** (0.008)
Hispanic		-0.349*** (0.004)	-0.111*** (0.005)	-0.094*** (0.005)
Other Race/Ethnicity		-0.118*** (0.005)	-0.058*** (0.005)	-0.071*** (0.005)
Female		0.190*** (0.003)	0.137*** (0.003)	0.138*** (0.003)
<i>Student Classifications in Kindergarten</i>				
Free/Reduced-Price Lunch			-0.324*** (0.004)	-0.297*** (0.004)
Learning Disability			-0.160*** (0.008)	-0.168*** (0.008)
English Proficiency Services			-0.267*** (0.005)	-0.273*** (0.005)
Special Education Services			-0.462*** (0.005)	-0.461*** (0.004)
District FE	No	No	No	Yes
Constant	0.047*** (0.002)	0.064*** (0.003)	0.352*** (0.003)	0.956*** (0.323)
Observations	344,501	339,604	339,604	339,603
R-squared	0.018	0.048	0.126	0.162

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 3B. Linear Regressions Predicting WaKIDS Language Scores with Pre-K Participation

WaKIDS Domain: Language	Model Specifications			
	(1)	(2)	(3)	(4)
<i>Pre-K Participation</i>				
ECEAP Only	-0.162*** (0.005)	-0.080*** (0.005)	0.087*** (0.005)	0.073*** (0.005)
ESIT Only	-0.616*** (0.009)	-0.575*** (0.009)	-0.180*** (0.009)	-0.178*** (0.009)
ECEAP and ESIT	-0.502*** (0.021)	-0.411*** (0.021)	0.078*** (0.020)	0.072*** (0.020)
<i>Student Demographics</i>				
Asian		-0.209*** (0.007)	-0.027*** (0.007)	-0.062*** (0.007)
Black		-0.221*** (0.008)	-0.026*** (0.008)	-0.097*** (0.008)
Hispanic		-0.435*** (0.004)	-0.102*** (0.005)	-0.092*** (0.005)
Other Race/Ethnicity		-0.103*** (0.005)	-0.042*** (0.005)	-0.060*** (0.005)
Female		0.190*** (0.003)	0.132*** (0.003)	0.132*** (0.003)
<i>Student Classifications in Kindergarten</i>				
Free/Reduced-Price Lunch			-0.276*** (0.004)	-0.258*** (0.004)
Learning Disability			-0.090*** (0.008)	-0.098*** (0.008)
English Proficiency Services			-0.513*** (0.005)	-0.523*** (0.005)
Special Education Services			-0.522*** (0.005)	-0.521*** (0.004)
District FE	No	No	No	Yes
Constant	0.047*** (0.002)	0.091*** (0.003)	0.381*** (0.003)	0.608+ (0.318)
Observations	342,086	337,193	337,193	337,192
R-squared	0.018	0.059	0.160	0.191

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 3C. Linear Regressions Predicting WaKIDS Literacy Scores with Pre-K Participation

WaKIDS Domain: Literacy	Model Specifications			
	(1)	(2)	(3)	(4)
<i>Pre-K Participation</i>				
ECEAP Only	-0.244*** (0.005)	-0.127*** (0.005)	0.087*** (0.005)	0.083*** (0.005)
ESIT Only	-0.469*** (0.009)	-0.426*** (0.009)	-0.114*** (0.009)	-0.124*** (0.008)
ECEAP and ESIT	-0.470*** (0.021)	-0.340*** (0.021)	0.113*** (0.020)	0.115*** (0.019)
<i>Student Demographics</i>				
Asian		0.098*** (0.007)	0.236*** (0.007)	0.152*** (0.007)
Black		-0.198*** (0.008)	0.041*** (0.008)	-0.040*** (0.008)
Hispanic		-0.562*** (0.004)	-0.203*** (0.004)	-0.179*** (0.005)
Other Race/Ethnicity		-0.141*** (0.005)	-0.054*** (0.005)	-0.076*** (0.005)
Female		0.122*** (0.003)	0.078*** (0.003)	0.077*** (0.003)
<i>Student Classifications in Kindergarten</i>				
Free/Reduced-Price Lunch			-0.449*** (0.004)	-0.387*** (0.004)
Learning Disability			-0.303*** (0.008)	-0.312*** (0.007)
English Proficiency Services			-0.434*** (0.004)	-0.451*** (0.004)
Special Education Services			-0.368*** (0.004)	-0.372*** (0.004)
District FE	No	No	No	Yes
Constant	0.050*** (0.002)	0.137*** (0.003)	0.472*** (0.003)	0.833*** (0.311)
Observations	340,290	335,430	335,430	335,429
R-squared	0.015	0.075	0.187	0.223

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10



Table 3D. Linear Regressions Predicting WaKIDS Math Scores with Pre-K Participation

WaKIDS Domain: Math	Model Specifications			
	(1)	(2)	(3)	(4)
<i>Pre-K Participation</i>				
ECEAP Only	-0.245*** (0.005)	-0.128*** (0.005)	0.081*** (0.005)	0.082*** (0.005)
ESIT Only	-0.470*** (0.009)	-0.448*** (0.009)	-0.121*** (0.009)	-0.130*** (0.008)
ECEAP and ESIT	-0.481*** (0.021)	-0.371*** (0.021)	0.092*** (0.020)	0.103*** (0.019)
<i>Student Demographics</i>				
Asian		0.144*** (0.007)	0.266*** (0.007)	0.157*** (0.007)
Black		-0.196*** (0.008)	0.034*** (0.008)	-0.067*** (0.008)
Hispanic		-0.548*** (0.004)	-0.197*** (0.004)	-0.169*** (0.005)
Other Race/Ethnicity		-0.138*** (0.005)	-0.053*** (0.005)	-0.076*** (0.005)
Female		-0.010*** (0.003)	-0.057*** (0.003)	-0.057*** (0.003)
<i>Student Classifications in Kindergarten</i>				
Free/Reduced-Price Lunch			-0.438*** (0.004)	-0.364*** (0.004)
Learning Disability			-0.359*** (0.008)	-0.368*** (0.007)
English Proficiency Services			-0.408*** (0.004)	-0.422*** (0.004)
Special Education Services			-0.388*** (0.004)	-0.393*** (0.004)
District FE	No	No	No	Yes
Constant	0.050*** (0.002)	0.199*** (0.003)	0.536*** (0.003)	0.961** (0.312)
Observations	344,256	339,359	339,359	339,358
R-squared	0.015	0.072	0.185	0.218

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 3E. Linear Regressions Predicting WaKIDS Physical Scores with Pre-K Participation

WaKIDS Domain: Physical	Model Specifications			
	(1)	(2)	(3)	(4)
<i>Pre-K Participation</i>				
ECEAP Only	-0.047*** (0.005)	-0.010+ (0.005)	0.090*** (0.005)	0.065*** (0.005)
ESIT Only	-0.597*** (0.009)	-0.553*** (0.009)	-0.251*** (0.009)	-0.242*** (0.009)
ECEAP and ESIT	-0.400*** (0.021)	-0.340*** (0.021)	0.011 (0.021)	0.002 (0.021)
<i>Student Demographics</i>				
Asian		0.058*** (0.007)	0.032*** (0.007)	0.034*** (0.007)
Black		-0.141*** (0.008)	-0.065*** (0.008)	-0.085*** (0.008)
Hispanic		-0.149*** (0.004)	-0.050*** (0.005)	-0.028*** (0.005)
Other Race/Ethnicity		-0.032*** (0.005)	0.002 (0.005)	0.004 (0.005)
Female		0.243*** (0.003)	0.198*** (0.003)	0.199*** (0.003)
<i>Student Classifications in Kindergarten</i>				
Free/Reduced-Price Lunch			-0.208*** (0.004)	-0.192*** (0.004)
Learning Disability			-0.059*** (0.008)	-0.063*** (0.008)
English Proficiency Services			-0.065*** (0.005)	-0.052*** (0.005)
Special Education Services			-0.400*** (0.005)	-0.400*** (0.005)
District FE	No	No	No	Yes
Constant	0.032*** (0.002)	-0.045*** (0.003)	0.159*** (0.003)	0.407 (0.332)
Observations	345,092	340,184	340,184	340,183
R-squared	0.015	0.034	0.072	0.116

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 3F. Linear Regressions Predicting WaKIDS Social-Emotional Scores with Pre-K Participation

WaKIDS Domain: Social-Emotional	Model Specifications			
	(1)	(2)	(3)	(4)
<i>Pre-K Participation</i>				
ECEAP Only	-0.106*** (0.005)	-0.068*** (0.005)	0.054*** (0.005)	0.039*** (0.005)
ESIT Only	-0.636*** (0.009)	-0.584*** (0.009)	-0.191*** (0.009)	-0.183*** (0.009)
ECEAP and ESIT	-0.478*** (0.021)	-0.417*** (0.021)	0.035* (0.021)	0.029 (0.020)
<i>Student Demographics</i>				
Asian		-0.012+ (0.007)	-0.019*** (0.007)	-0.022*** (0.007)
Black		-0.218*** (0.008)	-0.120*** (0.008)	-0.165*** (0.008)
Hispanic		-0.154*** (0.004)	-0.014*** (0.005)	-0.011** (0.005)
Other Race/Ethnicity		-0.073*** (0.005)	-0.032*** (0.005)	-0.040*** (0.005)
Female		0.305*** (0.003)	0.247*** (0.003)	0.249*** (0.003)
<i>Student Classifications in Kindergarten</i>				
Free/Reduced-Price Lunch			-0.241*** (0.004)	-0.250*** (0.004)
Learning Disability			-0.010 (0.008)	-0.018** (0.008)
English Proficiency Services			-0.129*** (0.005)	-0.126*** (0.005)
Special Education Services			-0.529*** (0.005)	-0.526*** (0.005)
District FE	No	No	No	Yes
Constant	0.041*** (0.002)	-0.052*** (0.003)	0.201*** (0.003)	0.652* (0.329)
Observations	345,465	340,542	340,542	340,541
R-squared	0.017	0.045	0.107	0.134

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 4A. Linear Regressions Predicting 3<sup>rd</sup> Grade ELA Scores with Pre-K Participation

Third Grade Subject: ELA	Model Specifications				
	(1)	(2)	(3)	(4)	(5)
<i>Pre-K Participation</i>					
ECEAP Only	-0.400*** (0.008)	-0.272*** (0.008)	-0.058*** (0.007)	-0.087*** (0.007)	-0.074*** (0.007)
ESIT Only	-0.364*** (0.014)	-0.320*** (0.014)	0.060*** (0.013)	0.038** (0.013)	0.022+ (0.012)
ECEAP and ESIT	-0.600*** (0.031)	-0.457*** (0.032)	0.053+ (0.029)	0.014 (0.027)	0.028 (0.027)
<i>Student Demographics</i>					
Asian		0.214*** (0.010)	0.259*** (0.010)	0.161*** (0.009)	0.109*** (0.010)
Black		-0.477*** (0.012)	-0.232*** (0.011)	-0.253*** (0.010)	-0.271*** (0.011)
Hispanic		-0.534*** (0.006)	-0.208*** (0.006)	-0.116*** (0.006)	-0.109*** (0.006)
Other Race/Ethnicity		-0.243*** (0.008)	-0.135*** (0.007)	-0.109*** (0.007)	-0.096*** (0.007)
Female		0.173*** (0.005)	0.118*** (0.004)	0.106*** (0.004)	0.102*** (0.004)
<i>Student Classifications in Kindergarten</i>					
Free/Reduced-Price Lunch			-0.546*** (0.005)	-0.357*** (0.005)	-0.295*** (0.005)
Learning Disability			-0.612*** (0.011)	-0.440*** (0.010)	-0.431*** (0.010)
English Proficiency Services			-0.247*** (0.006)	-0.042*** (0.006)	-0.040*** (0.006)
Special Education Services			-0.431*** (0.007)	-0.288*** (0.006)	-0.285*** (0.006)
<i>WaKIDS Domain Scores</i>					
Cognitive				0.041*** (0.004)	0.048*** (0.004)
Language				0.017*** (0.004)	0.017*** (0.004)
Literacy				0.211*** (0.004)	0.214*** (0.004)
Math				0.166*** (0.004)	0.161*** (0.004)
Physical				-0.063*** (0.003)	-0.061*** (0.003)
Social-Emotional				0.038***	0.043***
District FE	No	No	No	No	Yes
Constant	-0.029*** (0.003)	0.061*** (0.004)	0.483*** (0.005)	0.247*** (0.005)	-1.077 (0.765)
Observations	148,137	146,041	146,041	140,722	140,722
R-squared	0.022	0.096	0.258	0.366	0.388

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 4B. Linear Regressions Predicting 3<sup>rd</sup> Grade Math Scores with Pre-K Participation

Third Grade Subject: Math	Model Specifications				
	(1)	(2)	(3)	(4)	(5)
<i>Pre-K Participation</i>					
ECEAP Only	-0.396*** (0.008)	-0.267*** (0.008)	-0.060*** (0.007)	-0.087*** (0.007)	-0.073*** (0.007)
ESIT Only	-0.357*** (0.014)	-0.352*** (0.014)	0.039*** (0.013)	0.019 (0.012)	0.008 (0.012)
ECEAP and ESIT	-0.545*** (0.031)	-0.448*** (0.031)	0.067** (0.029)	0.027 (0.027)	0.043+ (0.026)
<i>Student Demographics</i>					
Asian		0.321*** (0.010)	0.318*** (0.010)	0.212*** (0.009)	0.180*** (0.009)
Black		-0.527*** (0.012)	-0.302*** (0.011)	-0.320*** (0.010)	-0.317*** (0.010)
Hispanic		-0.505*** (0.006)	-0.224*** (0.006)	-0.131*** (0.006)	-0.148*** (0.006)
Other Race/Ethnicity		-0.262*** (0.008)	-0.158*** (0.007)	-0.132*** (0.007)	-0.111*** (0.007)
Female		-0.067*** (0.005)	-0.124*** (0.004)	-0.133*** (0.004)	-0.137*** (0.004)
<i>Student Classifications in Kindergarten</i>					
Free/Reduced-Price Lunch			-0.545*** (0.005)	-0.349*** (0.005)	-0.297*** (0.005)
Learning Disability			-0.688*** (0.010)	-0.504*** (0.010)	-0.495*** (0.010)
English Proficiency Services			-0.160*** (0.006)	0.032*** (0.006)	0.037*** (0.006)
Special Education Services			-0.438*** (0.007)	-0.289*** (0.006)	-0.282*** (0.006)
<i>WaKIDS Domain Scores</i>					
Cognitive				0.045*** (0.004)	0.054*** (0.004)
Language				-0.021*** (0.004)	-0.022*** (0.004)
Literacy				0.171*** (0.004)	0.175*** (0.004)
Math				0.228*** (0.004)	0.227*** (0.004)
Physical				-0.032*** (0.003)	-0.029*** (0.003)
Social-Emotional				0.047***	0.052***
District FE	No	No	No	No	Yes
Constant	-0.017*** (0.003)	0.182*** (0.004)	0.605*** (0.005)	0.361*** (0.005)	-1.249+ (0.746)
Observations	147,940	145,842	145,842	140,531	140,531
R-squared	0.022	0.093	0.263	0.384	0.410

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 5A. Linear Regressions Predicting WaKIDS Cognitive Scores with COSF Entry-Level Age-Expected Skills and Growth in Age-Expected Skills During Time in ESIT

WaKIDS Domain: Cognitive	Model Specifications					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>COSF Scores</i>						
GRM-adjusted Entry Score	0.149*** (0.009)		0.293*** (0.011)	0.285*** (0.011)	0.262*** (0.011)	0.264*** (0.011)
Growth (Exit Score-Entry Score)		0.110*** (0.010)	0.268*** (0.011)	0.262*** (0.011)	0.249*** (0.011)	0.257*** (0.011)
<i>Student Demographics</i>						
Asian				0.063 (0.043)	-0.001 (0.045)	-0.024 (0.045)
Black				-0.445*** (0.050)	-0.344*** (0.050)	-0.428*** (0.051)
Hispanic				-0.198*** (0.022)	-0.083*** (0.027)	-0.072* (0.028)
Other Race/Ethnicity				-0.047 (0.032)	-0.015 (0.032)	-0.027 (0.032)
Female				0.125*** (0.020)	0.117*** (0.020)	0.112*** (0.020)
<i>Student Classifications in Kindergarten</i>						
Free/Reduced-Price Lunch					-0.306*** (0.022)	-0.248*** (0.024)
Learning Disability					-0.168*** (0.030)	-0.178*** (0.030)
English Proficiency Services					-0.034 (0.028)	-0.045 (0.029)
Special Education Services					-0.425*** (0.035)	-0.477*** (0.036)
District FE	No	No	No	No	No	Yes
Constant	-0.555*** (0.009)	-0.555*** (0.009)	-0.556*** (0.009)	-0.519*** (0.015)	0.074* (0.037)	-0.530*** (0.100)
Observations	16,077	16,077	16,077	15,291	15,291	15,291
R-squared	0.015	0.008	0.050	0.062	0.088	0.132

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 5B. Linear Regressions Predicting WaKIDS Language Scores with COSF Entry-Level Age-Expected Skills and Growth in Age-Expected Skills During Time in ESIT

WaKIDS Domain: Language	Model Specifications					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>COSF Scores</i>						
GRM-adjusted entry score	0.139*** (0.009)		0.277*** (0.011)	0.269*** (0.011)	0.246*** (0.011)	0.246*** (0.011)
Growth (exit-entry)		0.107*** (0.009)	0.257*** (0.011)	0.250*** (0.011)	0.236*** (0.011)	0.244*** (0.011)
<i>Student Demographics</i>						
Asian				-0.130*** (0.041)	-0.102** (0.042)	-0.129** (0.043)
Black				-0.367*** (0.047)	-0.252*** (0.047)	-0.334*** (0.048)
Hispanic				-0.301*** (0.021)	-0.111*** (0.026)	-0.093*** (0.027)
Other Race/Ethnicity				-0.057+ (0.030)	-0.023 (0.030)	-0.042 (0.031)
Female				0.136*** (0.019)	0.128*** (0.019)	0.121*** (0.019)
<i>Student Classifications in Kindergarten</i>						
Free/Reduced-Price Lunch					-0.239*** (0.021)	-0.186*** (0.022)
Learning Disability					-0.204*** (0.028)	-0.211*** (0.028)
English Proficiency Services					-0.200*** (0.027)	-0.225*** (0.027)
Special Education Services					-0.466*** (0.033)	-0.518*** (0.035)
District FE	No	No	No	No	No	Yes
Constant	-0.556*** (0.009)	-0.556*** (0.009)	-0.557*** (0.009)	-0.488*** (0.014)	0.112** (0.035)	-0.387*** (0.098)
Observations	15,986	15,986	15,986	15,207	15,207	15,207
R-squared	0.015	0.009	0.05	0.068	0.098	0.138

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 5C. Linear Regressions Predicting WaKIDS Literacy Scores with COSF Entry-Level Age-Expected Skills and Growth in Age-Expected Skills During Time in ESIT

WaKIDS Domain: Literacy	Model Specifications					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>COSF Scores</i>						
GRM-adjusted entry score	0.125*** (0.010)		0.257*** (0.012)	0.253*** (0.012)	0.225*** (0.012)	0.224*** (0.012)
Growth (exit-entry)		0.108*** (0.010)	0.247*** (0.012)	0.242*** (0.012)	0.230*** (0.011)	0.238*** (0.011)
<i>Student Demographics</i>						
Asian				0.240*** (0.047)	0.205*** (0.049)	0.138*** (0.049)
Black				-0.408*** (0.054)	-0.244*** (0.054)	-0.341*** (0.055)
Hispanic				-0.445*** (0.024)	-0.214*** (0.030)	-0.183*** (0.031)
Other Race/Ethnicity				-0.086* (0.035)	-0.030 (0.034)	-0.058+ (0.035)
Female				0.012 (0.022)	0.009 (0.022)	0.008 (0.022)
<i>Student Classifications in Kindergarten</i>						
Free/Reduced-Price Lunch					-0.450*** (0.024)	-0.351*** (0.026)
Learning Disability					-0.233*** (0.033)	-0.241*** (0.033)
English Proficiency Services					-0.150*** (0.031)	-0.176*** (0.031)
Special Education Services					-0.330*** (0.038)	-0.364*** (0.040)
District FE	No	No	No	No	No	Yes
Constant	-0.422*** (0.010)	-0.422*** (0.010)	-0.423*** (0.010)	-0.281*** (0.016)	0.316*** (0.041)	-0.414*** (0.112)
Observations	15,914	15,914	15,914	15,134	15,134	15,134
R-squared	0.009	0.007	0.034	0.062	0.097	0.141

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10



Table 5D. Linear Regressions Predicting WaKIDS Math Scores with C COSF Entry-Level Age-Expected Skills and Growth in Age-Expected Skills During Time in ESIT

WaKIDS Domain: Math	Model Specifications					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>COSF Scores</i>						
GRM-adjusted entry score	0.128*** (0.010)		0.266*** (0.012)	0.263*** (0.012)	0.236*** (0.012)	0.234*** (0.012)
Growth (exit-entry)		0.115*** (0.010)	0.258*** (0.012)	0.253*** (0.012)	0.241*** (0.012)	0.249*** (0.012)
<i>Student Demographics</i>						
Asian				0.270*** (0.045)	0.239*** (0.047)	0.156*** (0.048)
Black				-0.444*** (0.053)	-0.277*** (0.053)	-0.373*** (0.054)
Hispanic				-0.420*** (0.023)	-0.179*** (0.029)	-0.140*** (0.030)
Other Race/Ethnicity				-0.056 (0.034)	0.001 (0.033)	-0.023 (0.034)
Female				-0.103*** (0.021)	-0.106*** (0.021)	-0.104*** (0.021)
<i>Student Classifications in Kindergarten</i>						
Free/Reduced-Price Lunch					-0.445*** (0.023)	-0.330*** (0.025)
Learning Disability					-0.298*** (0.032)	-0.314*** (0.031)
English Proficiency Services					-0.165*** (0.030)	-0.186*** (0.030)
Special Education Services					-0.331*** (0.037)	-0.375*** (0.039)
District FE	No	No	No	No	No	Yes
Constant	-0.424*** (0.010)	-0.424*** (0.010)	-0.425*** (0.010)	-0.254*** (0.016)	0.349*** (0.039)	-0.309*** (0.106)
Observations	16,056	16,056	16,056	15,271	15,271	15,271
R-squared	0.010	0.008	0.038	0.068	0.108	0.146

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 5E. Linear Regression Predicting WaKIDS Physical Scores with COSF Entry-Level Age-Expected Skills and Growth in Age-Expected Skills During Time in ESIT

WaKIDS Domain: Physical	Model Specifications					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>COSF Scores</i>						
GRM-adjusted entry score	0.121*** (0.010)		0.258*** (0.012)	0.251*** (0.012)	0.235*** (0.012)	0.238*** (0.012)
Growth (exit-entry)		0.116 (0.010)	0.256*** (0.012)	0.250*** (0.012)	0.238*** (0.012)	0.243*** (0.012)
<i>Student Demographics</i>						
Asian				0.178*** (0.045)	0.084+ (0.047)	0.089+ (0.048)
Black				-0.244*** (0.052)	-0.211*** (0.053)	-0.241*** (0.054)
Hispanic				0.027 (0.023)	0.019 (0.029)	0.044 (0.030)
Other Race/Ethnicity				0.074* (0.034)	0.083* (0.034)	0.081* (0.034)
Female				0.165*** (0.021)	0.155*** (0.021)	0.155*** (0.021)
<i>Student Classifications in Kindergarten</i>						
Free/Reduced-Price Lunch					-0.158*** (0.023)	-0.124*** (0.025)
Learning Disability					-0.093** (0.032)	-0.096** (0.031)
English Proficiency Services					0.094** (0.030)	0.096** (0.030)
Special Education Services					-0.407*** (0.037)	-0.464*** (0.039)
District FE	No	No	No	No	No	Yes
Constant	-0.537*** (0.010)	-0.537*** (0.010)	-0.538*** (0.010)	-0.609*** (0.016)	-0.130*** (0.039)	-0.535*** (0.106)
Observations	16,108	16,108	16,108	15,321	15,321	15,321
R-squared	0.009	0.008	0.038	0.044	0.056	0.100

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 5F. Linear Regressions Predicting WaKIDS Social-Emotional Scores with COSF Entry-Level Age-Expected Skills and Growth in Age-Expected Skills During Time in ESIT

WaKIDS Domain: Social-Emotional	Model Specifications					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>COSF Scores</i>						
GRM-adjusted entry score	0.166*** (0.009)		0.310*** (0.011)	0.304*** (0.011)	0.284*** (0.011)	0.286*** (0.011)
Growth (exit-entry)		0.101*** (0.010)	0.268*** (0.011)	0.262*** (0.011)	0.249*** (0.011)	0.257*** (0.011)
<i>Student Demographics</i>						
Asian				0.005 (0.043)	-0.111* (0.045)	-0.110* (0.046)
Black				-0.343*** (0.050)	-0.291*** (0.050)	-0.357*** (0.051)
Hispanic				0.008 (0.022)	0.013 (0.027)	0.013 (0.029)
Other Race/Ethnicity				0.004 (0.032)	0.021 (0.032)	0.008 (0.033)
Female				0.255*** (0.020)	0.245*** (0.020)	0.241*** (0.020)
<i>Student Classifications in Kindergarten</i>						
Free/Reduced-Price Lunch					-0.237*** (0.022)	-0.215*** (0.024)
Learning Disability					-0.062* (0.030)	-0.067* (0.030)
English Proficiency Services					0.111*** (0.028)	0.102*** (0.029)
Special Education Services					-0.454*** (0.035)	-0.510*** (0.037)
District FE	No	No	No	No	No	Yes
Constant	-0.575*** (0.009)	-0.575*** (0.009)	-0.576*** (0.009)	-0.652*** (0.015)	-0.087** (0.037)	-0.488*** (0.101)
Observations	16,117	16,117	16,117	15,330	15,330	15,330
R-squared	0.019	0.007	0.053	0.066	0.085	0.123

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 6A. Linear Regressions Predicting 3<sup>rd</sup> Grade ELA Scores with COSF Entry-Level Age-Expected Skills and Growth in Age-Expected Skills During Time in ESIT

Third Grade Subject: ELA	Model Specifications						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>COSF Scores</i>							
GRM-adjusted Entry Score	0.050*** (0.014)		0.105*** (0.019)	0.086*** (0.019)	0.064*** (0.018)	0.026 (0.017)	0.023 (0.017)
Growth (Exit-Entry)		0.006 (0.014)	0.076*** (0.019)	0.061*** (0.018)	0.055** (0.017)	0.020 (0.017)	0.017 (0.017)
<i>Student Demographics</i>							
Asian				0.324*** (0.061)	0.207*** (0.059)	0.151** (0.054)	0.107+ (0.056)
Black				-0.440*** (0.069)	-0.228*** (0.064)	-0.203*** (0.059)	-0.262*** (0.061)
Hispanic				-0.436*** (0.030)	-0.149*** (0.036)	-0.093*** (0.033)	-0.095** (0.034)
Other Race/Ethnicity				-0.116** (0.045)	-0.027 (0.041)	-0.042 (0.038)	-0.039 (0.039)
Female				0.140*** (0.028)	0.127*** (0.026)	0.080*** (0.024)	0.076** (0.024)
<i>Student Classifications in Kindergarten</i>							
Free/Reduced-Price Lunch					-0.637*** (0.029)	-0.398*** (0.028)	-0.311*** (0.030)
Learning Disability					-0.650*** (0.036)	-0.429*** (0.034)	-0.422*** (0.034)
English Proficiency Services					-0.119*** (0.036)	-0.001 (0.033)	-0.028 (0.034)
Special Education Services					-0.276*** (0.042)	-0.204*** (0.039)	-0.208*** (0.042)
<i>WaKIDS Domain Scores</i>							
Cognitive						0.078*** (0.021)	0.080*** (0.022)
Language						0.086*** (0.019)	0.086*** (0.020)
Literacy						0.112*** (0.020)	0.105*** (0.020)
Math						0.179*** (0.019)	0.172*** (0.020)
Physical						-0.041** (0.014)	-0.035* (0.014)
Social-Emotional						0.035* (0.016)	0.041* (0.017)
District FE	No	No	No	No	No	No	Yes
Constant	-0.434*** (0.013)	-0.433*** (0.013)	-0.438*** (0.013)	-0.326*** (0.021)	0.405*** (0.045)	0.246*** (0.043)	0.142 (0.105)
Observations	5,753	5,753	5,753	5,470	5,470	5,289	5,289
R-squared	0.002	0.000	0.005	0.061	0.208	0.349	0.398

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10

Table 6B. Linear Regressions Predicting 3<sup>rd</sup> Grade Math Scores with COSF Entry-Level Age-Expected Skills and Growth in Age-Expected Skills During Time in ESIT

Third Grade Subject: Math	Model Specifications						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>COSF Scores</i>							
GRM-adjusted Entry Score	0.055*** (0.015)		0.110*** (0.021)	0.096*** (0.021)	0.071*** (0.019)	0.038* (0.018)	0.036+ (0.018)
Growth (Exit-Entry)		0.005 (0.015)	0.078*** (0.020)	0.069*** (0.020)	0.060** (0.018)	0.029+ (0.017)	0.025 (0.018)
<i>Student Demographics</i>							
Asian				0.448*** (0.065)	0.284*** (0.064)	0.204*** (0.057)	0.191** (0.058)
Black				-0.475*** (0.074)	-0.268*** (0.069)	-0.233*** (0.061)	-0.250*** (0.064)
Hispanic				-0.393*** (0.032)	-0.141*** (0.038)	-0.067+ (0.034)	-0.081** (0.036)
Other Race/Ethnicity				-0.105* (0.048)	-0.017 (0.044)	-0.034 (0.040)	-0.017 (0.041)
Female				-0.112*** (0.030)	-0.128*** (0.028)	-0.169*** (0.025)	-0.166*** (0.025)
<i>Student Classifications in Kindergarten</i>							
Free/Reduced-Price Lunch					-0.663*** (0.031)	-0.377*** (0.029)	-0.310*** (0.031)
Learning Disability					-0.712*** (0.039)	-0.438*** (0.035)	-0.430*** (0.036)
English Proficiency Services					-0.046 (0.038)	0.065* (0.035)	0.047 (0.036)
Special Education Services					-0.289*** (0.045)	-0.214*** (0.040)	-0.213*** (0.044)
<i>WaKIDS Domain Scores</i>							
Cognitive						0.067** (0.022)	0.064** (0.023)
Language						0.019 (0.020)	0.027 (0.021)
Literacy						0.128*** (0.021)	0.134*** (0.021)
Math						0.277*** (0.020)	0.267*** (0.020)
Physical						0.008 (0.015)	0.016 (0.015)
Social-Emotional						0.050** (0.017)	0.056** (0.017)
District FE	No	No	No	No	No	No	Yes
Constant	-0.407*** (0.014)	-0.406*** (0.014)	-0.411*** (0.014)	-0.236*** (0.022)	0.529*** (0.049)	0.336*** (0.044)	0.609*** (0.110)
Observations	5,749	5,749	5,749	5,465	5,465	5,285	5,285
R-squared	0.002	0.000	0.005	0.054	0.197	0.382	0.422

Standard errors in parentheses \*\*\*p<.001 \*\*p<.01 \*p<.05 + p<.10