# It's Dolly's World, We're Just Reading in It: The Effects of an Early Childhood Literacy Program

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**Abstract**

High quality early childhood interventions play an integral role in early human capital development. However, little is known about the impact that pure capital inputs, such as educational resources, have on early skill development. Using the national roll out of a program that gives children new books for free, I assess how access to the program affects elementary academic achievement. I find that having access to the program leads to extremely small effects on both third and fourth grade English Language Art and Math standardized tests. Although still small, results from heterogeneous analysis suggest access to the program slightly widens the distribution of English achievement and shrinks the Math achievement distribution. When interpreted as a precise null effect, the results suggest that small investments of capital alone are not an effective input into the early human capital model.

**Keywords:** Early Childhood Education, Literacy, Human Capital Investment, Imagination Library
**JEL Codes:** I21, I26, J24

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# 1 Introduction

It is well-documented that high quality preschool and other early childhood interventions are an integral part of human capital development. Programs that provide childcare, such as the Perry Preschool Project (Heckman et al., 2010, 2013) and Head Start (Garces et al., 2002; Deming, 2009), have had large impacts on outcomes measured later in life. High quality preschool programs combine both time and capital inputs which yields robust early human capital returns. Specifically, preschool caregivers not only spend time with children, but they also use capital, such as toys, books, or other stimulating resources. The combination of these inputs leads to early skill development, which is critical for later human capital formation in formal schooling (Heckman, 2006).

Less is known about the effects of inputs at home and how productive each input is individually. Examples of inputs at home are parental time, quality of that time, and material resources. Given time and resource constraints on parents, a simple capital investment might seem like the easiest and most efficient way to develop early human capital, even though we know quality investments increase short-term achievement (Currie, 2001). A simple program that sends parenting tips and ideas via text messages helps boost not only engagement between parents and children, but also leads to short-term literacy achievement gains (York et al., 2019). Research has not ruled out the effectiveness of a capital-only investment on improving early childhood human capital development. Increasing cash assistance or tax rebates to families with older children improves high-school achievement and later-life human capital (Dahl & Lochner, 2012; Chetty et al., 2011b), therefore it is plausible that specific capital investments benefit children's development at the earliest stages.

In this paper, I measure the impact of a pure capital investment on early human capital development. Specifically, I estimate the effects of Dolly Parton's Imagination Library, an early childhood literacy program that mails free books to children, on third and fourth grade achievement. There are three primary mechanisms through which the books could influence achievement scores. First, having physical books in the home sets the stage for literacy development down the road (Feng et al., 2014; Sénéchal & LeFevre, 2002; Sénéchal et al., 1998). For instance, the number of books in the home is positively correlated with greater levels of educational attainment (Evans et al., 2010). Second, having books around the home encourages a more positive home learning environment, with increased non-reading engagement between parents and their children. A positive home literary environment is correlated with improved child development, seen in increased literacy and numeracy achievement (Melhuish et al., 2008; Bradley et al., 2001; Hood et al., 2008). Third, books affect achievement by encouraging parents to spend more time reading with their children, an activity that has large positive effects on children's literacy development rates (Hood et al., 2008; Bus et al., 1995; Kalb & Van Ours, 2014). This means that Imagination Library books could nudge parents to read to their children.[1] Additionally, access to the program can also provide educational resources that were previously too expensive.

To investigate the effects of the Imagination Library program on educational achievement, I exploit temporal and geographic variation in its national expansion. Imagination Library launched a nationwide expansion program in 2000. Since its beginning, twenty percent of public school districts in the United States have access to the program. Using a traditional two-way fixed effects difference-in-differences strategy, I compare outcomes between treated and untreated cohorts while controlling for unobserved heterogeneity across cohorts and school districts. I use a longitudinal panel of educational achievement data combined with treatment status information for each cohort-district observation. Because I measure access rather than individual treatment, my results represent intent-to-treat estimates, which can be interpreted as a conservative, lower bound of the true individual treatment effect.

I find that granting free books to children has limited effects on average elementary academic achievement. A cohort with access to the program scores 0.01 standard deviations less on third grade English Language Arts (ELA) exams and 0.01 standard deviations higher on

[1] This nudge would be similar to the text message program in York et al. (2019).

fourth grade math exams, both of which are statistically different from zero. The magnitude of the effects is likely related to the low-intensity nature of the program. Additional time spent reading has large educational achievement gains (Kalb & Van Ours, 2014; Figlio et al., 2018), but my results suggest that simply increasing a capital input (i.e. giving children books) does not have an effect on the full sample of students.

Although there are no effects on the broad sample of students, there are heterogeneous treatment effects. I use unconditional quantile regression to assess how access to the program affects students from across the achievement spectrum (Firpo et al., 2009). Having access to the program leads to a decrease among lower achieving cohorts' scores and an increase among higher achieving cohorts' scores, suggesting a widening of the achievement distribution for cohorts with access. Most of the estimates from the unconditional quantile regression models are also extremely small, however, so they can also be interpreted as a precise null. I also assess whether the results differ across race and socioeconomic status, however, the results there are similar to those from the full sample of students: a precise zero.

This paper contributes to the vast literature on early childhood interventions by investigating an understudied mechanism, pure capital investments. Earlier studies on capital inputs focus on investments that are indirectly related to educational outcomes. For example, expansive public health insurance programs increase children's primary school achievement and lead to increased high school and college completion rates (Levine & Schanzenbach, 2009; Cohodes et al., 2016). In addition, cash assistance, whether provided through a public assistance program or tax credits, allows families to lend greater support to child development, leading to increases in secondary school achievement (Chetty et al., 2011a; Dahl & Lochner, 2012; Duncan et al., 2011). While these studies support capital investments in early childhood, more educational focused capital inputs have less success. In a randomized field experiment, Fairlie & Robinson (2013) finds that giving students computer access at home has no effect on educational achievement outcomes.[2]. Most research on early life

[2]Other studies from developing countries show similarly small effects from pure capital inputs. See Cristia et al. (2017) for evidence from giving laptops to students in Peru and Sabarwal et al. (2014) for evidience

interventions focus on increasing the time parents spend with their children or increasing the quality of that time (Currie, 2001). This paper contributes by providing further evidence that pure capital investments, even at younger ages, have little to no effect on relevant academic achievement outcomes.

Additionally, this study contributes to a smaller field of human capital development that studies how the collective home environment contributes to human capital development. Families that participate in programs aimed to increase the length and quality of time spent with children often have positive effects on academic achievement.[3] For example, a low-intensity text message program that helps parents engage with their children led to increases in letter sound and lowercase alphabet recognition at kindergarten entrance (York et al., 2019). Results from the simple text-messaging program highlight the clash of between the effects of investments that focus on only time improvements or only capital. This paper contributes to this field by suggesting that a pure capital investment fails to improve the home environment for early literacy on its own.

The results that a pure capital input has a null effect on children's academic achievement has important implications for policymakers, parents, and caregivers. Pure capital investments on their own do not affect elementary level achievement, ruling out potential policies that provide specific in-kind educational benefits to families without parental or caregiver guidance. Results from previous studies suggests that a capital input might be more beneficial as a complement to quality investment of time from caregivers.

The structure of the rest of the paper is as follows. In Section 2, I discuss the Imagination Library program in further detail. Section 3 describes the data and Section 4 presents the empirical model. I present the results in Section 5. Section 6 concludes.

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from giving textbooks to students in Sierra Leone.

[3]For example, children whose mothers participate in programs they receive visits from a registered nurse who provides medical and parenting guidance were less likely to display language delays and had higher mental development at age two (Olds et al., 1998).

## 2 Dolly Parton's Imagination Library

Dolly Parton's Imagination Library mails free, age-appropriate books to eligible children from birth to their fifth birthday on a monthly basis. If the program is provided in an area, eligibility only requires satisfying child age requirements; it does not take family type or income into account. Children enrolled for the full time period will receive 60 books by the time they graduate from the program at age five.

After beginning in 1995, the program was quick to spread to other areas. By the year 2000, a national expansion was underway and in 2004, Tennessee, the home state of the program, pledged statewide coverage, which it achieved by 2006. As of June 2018, twenty percent of all school districts nationwide had access to the program. Since the program's inception in 1995, Imagination Library has mailed over 30 million books and has spread across the US into all fifty states and internationally to Canada, the United Kingdom, Australia, and Ireland.

Imagination Library operates through partnerships with local sponsors (hereafter called *affiliates*) such as libraries, school districts, and organizations like the United Way or Lions Club. These affiliates pay a monthly cost of $2.10 per child, advertise the program, and provide support for local families. The central Imagination Library staff manages the nationwide database and selects, purchases, and ships books. To receive books, parents must enroll children individually in the program. Online enrollment is always available, but parents can also enroll their children through the mail or at some hospitals at birth, doctor's offices, and many public libraries. Once enrolled, each child receives a book in the mail monthly until he or she ages out of the program.

There are several layers of selection involved in the research design. The largest layer is at the program provision level. Local affiliates select into program adoption. Many factors could drive this decision, which I further inspect in Section 4 by assessing the validity of pre-treatment Census variables to predict program adoption. The next two layers of selection occur at the family level. First, children must be enrolled in the program by a parent or guardian. I control for this selection with district level fixed effects, assuming that parental attitudes toward education are similar within school districts. The second layer of selection at the family level deals with the decision to use the capital. Parents or guardians can choose to engage with the books and read to their children. Unfortunately, due to data limitations, I cannot control for the third level of selection.[4] Therefore, my research strategy measures the affect of access to the program and provides intent-to-treat estimates.

# 3 Data

My analysis relies upon two main data sources: novel affiliate program information from Imagination Library databases and school district-level measures of academic achievement from the Stanford Education Data Archive (SEDA).

The Imagination Library database logs information about each affiliate program that has sponsored children in it's area. Recall that Imagination Library works through affiliates, which can be libraries or local fraternal organizations for example, to provide financial support for the program in a specified geographical area. The database includes all zip codes covered by the local affiliate, the start date of the relationship between Imagination Library's head office and the local affiliate, the date the affiliate program becomes operational, and any status changes thereafter. Status changes include program suspension, program resumption, and program termination. I used the database to determine treated cohorts based on the geographical coverage and timing of affiliate programs.[5]

[4] Although controlling for individual use of the books would be ideal, data about book use was never collected by Imagination Library.

[5] The Imagination Library affiliate data was originally formatted at the zip code level. The educational achievement data that I use is measured at the school-district level. I reformat all data to the school-district level, since it is the larger geographical measurement unit. I use the National Center for Education Statistic's Education Demographic and Geographic Estimates (EDGE) data to match each zip code in the Imagination Library affiliate database to the respective public school district. Because multiple zip codes can compose one school district, I assume that if one zip code has access to the program, then the whole school district has access. In school districts that have more than one zip code and where at least once zip code has access, an average of half the zip codes are treated. To combat measurement issues driven by this discrepancy, I

To estimate the effect of Imagination Library program access on children's educational achievement, I combined Imagination Library affiliate program data with a nationwide database of third and fourth grade standardized test scores for school years 2008/2009 through 2014/2015 available from SEDA (Reardon et al., 2019). My analysis relies on academic achievement data that is comparable across school district, county, and state borders. The SEDA dataset exploits information that was reported to the National Center for Education Statistics (NCES) under federal mandate by the No Child Left Behind Act. This act mandated that states annually test all public school students in grades 3-8 in both Math and English Language Arts (ELA) and report the number of students scoring in each proficiency level. States are allowed to create their own exams, which previously made comparisons across state lines difficult. Using the National Assessment of Educational Progress (NAEP), SEDA provides mean test scores at the school district level on a common scale disaggregated by racial group, grade, and subject. Average achievement is reported for student subgroups if there were more than 20 students in that subgroup tested (i.e. if there were more than 20 students in that grade, year, school district, and subject group).

In my analysis, I use estimates of school district-level average achievement that are standardized within subject and grade and measured in national student-level standard deviation units. The average achievement measurement can be interpreted as an effect size; a 1 unit increase in average achievement can be interpreted as the average student within a school-district scoring approximately one standard deviation higher than the national reference cohort in that same grade. I also use covariates from the SEDA database, which include variables from both the American Community Survey (ACS) and the Common Core of Data (CCD).[6]

My research strategy relies on the ability to observe cohorts before formal schooling and

present results using both a raw and a population weighted indicator variable that weights the IL indicator variable using decennial census population information at the zip code level.

[6]The ACS data describe the demographics of the total populations that lives within the school district geographic bounds. SEDA found that these measures were highly correlated with estimates restricted to only include families with school-aged children (Reardon et al., 2019). The CCD data describe school district characteristics and varies at the cohort-district-year level.

again during elementary school. Figure 1 shows the birth cohorts, their treatment windows, and their reappearance in the SEDA dataset in elementary school. I assume traditional kindergarten entry based on state-specific cutoff dates. Most children enter around the age of five, if not older, which coincides with the age at which children are no logner eligible for Imagination Library. Children born between August 2000 and August 2001 ($C_1$) are treated between 2000 and August 2006, dependent on the treatment status of their residence and their birth month. The $C_1$ cohort enters kindergarten in the 2006–2007 school year and are first observed as third graders in the 2009–2010 school year. Figure 1 represents the gap between treatment and outcome observation.

Summary statistics are reported in Table 1. The table presents average values of all outcome and control variables used for the whole sample of third and fourth grade observations. Column (1) represents the sample of untreated observations, column (2) represents summary statistics for the sample of treated observations, and column (3) represents all school districts. Around thirteen percent of all observations had access to the program. School districts with access to the program had it for almost four years. Asian and white students (with or without the program) scored above average. Black, Hispanic, and economically disadvantaged students scored below average.

# 4 Empirical Model

The basic model follows a two way fixed effects difference-in-differences strategy, where I compare elementary school achievement outcomes for those with early childhood exposure to Imagination Library to those without, either because they were born into an earlier cohort or their school district had yet to implement the program. Because of the delay between program participation and standardized tests, I assume students participated in the program and sit for exams in the same school district, or that they don't migrate to different school districts. The results are robust to varying measures of migration, as seen in Section 5.3.

To assess the effects of Imagination Library, I estimate

$$Y_{dct} = \lambda_c \ + \eta_d + \delta IL_{dc} \ + \ X_{dct}\beta_1 + Z_{dt}\beta_2 + t\theta_{dc} + \epsilon_{dc} \tag{1}$$

where the dependent variable is the achievement level for cohort $c$ at school district $d$ in year $t$.[7]

$IL_{dc}$ represents one of two Imagination Library access measurements. The first measure is an indicator variable that equals one if the cohort living in the school district had access to the Imagination Library program for at least one month and zero otherwise. The second access measure is a population weighted treatment variable.

I include several controls in my preferred specification to ensure comparisons across treatment groups are confounded with as little outside variation as possible. The covariates, $X_{dct}$, include time varying cohort-by-district controls for the percent of students across race and ethnicity groups (percent non-Hispanic white, percent non-Hispanic Black, percent Hispanic, and percent Asian), the percent of students eligible for free or reduced price lunch, and the percent of students categorized as English Language Learners (ELL). In addition to those controls, I also include vector $Z_{dt}$, which controls for district-specific controls that are representative of the entire population that lives inside the school district's geographic bounds. These include the log of median income, educational attainment (the percent of residents that hold a Bachelor's degree or higher), the poverty level, the unemployment level, the percentage of households receiving SNAP benefits, and the percentage of households led by a single mother. In addition to the two vectors of control variables, estimates from my preferred specification include unrestricted cohort effects $\lambda_c$ and unrestricted school district effects $\eta_d$ to control for unobserved heterogeneity that could affect standardized test scores. Standard errors are clustered at the school district level.

I also estimate an alternate specification to assess how enrolling in the program for multiple years affects achievement and human capital development. One might assume that

[7] I assume normal kindergarten entrance based on annual kindergarten start dates set by state legislatures.

more capital (more books) directly leads to better outcomes. To do so, I replace the indicator variable with a measurement of the number of years a cohort has access to the program and a quadratic of the same variable, holding all other controls constant. The polynomial in the specification accounts for diminishing marginal returns to the books, such that the first ten books might have a different effect on the child's literacy development than the fortieth book does.

In using the differences-in-differences strategy, it is important to consider the experiment created by the national program rollout. In an ideal situation, school districts would gain access to the program at random, or at least independent of any factor that could influence student achievement scores. Additionally, school districts that adopt the program should not be different from districts that do not adopt the program in any time-varying characteristics. Finally, students in school districts with access would have experienced changes in achievement scores similar to those in districts without access in absence of the program. If these conditions are met, my main specification will provide an unbiased estimate of the average treatment effect.

Therefore, the validity of my identification strategy relies on the exogenous introduction of Imagination Library across school districts, conditional on exogenous changes in time-varying characteristics, and a parallel trends assumption. To address these concerns, I conduct a covariate balance test, assess the ability of pre-treatment characteristics of school districts to predict program adoption, and run an event study.

The covariate balance test is a placebo test that ensures that IL program adoption does not predict covariates included in the model, which should not be affected by IL program adoption. These tests use a single right hand side variable as the dependent variable in a model similar to my main specification. If IL is an insignificant predictor of these variables, the composition of a school district does not drastically change when it adopts the program. Results for the covariate balance test on the sample of third grade cohorts are displayed in Table 2.[8] Many of the coefficients presented are very small, and most are statistically insignificant for third grade exams.

Similar to Hoynes & Schanzenbach (2009), I also assess the ability of pre-treatment characteristics of school districts to predict program adoption as a means to test the exogeneity of the program. The pre-treatment characteristics I analyze come from the 2000 Census, which was the first year of Imagination Library's national expansion.[9] The outcome variable I use to assess program exogeneity is an index of the month and year a school district gained access to the program normalized to one in January 2000 (such that January 2001 is equal to 13). The Census characteristics include the percent of the 2000 population that lives in an urban area, is less than five years of age, is older than sixty-five years of age, and is Black. I also include the natural log of population served by the school district and the natural log of the median income in the school district.

Table 3 presents results from this test.[10] A negative coefficient indicates the independent variable of interest is likely to lead to earlier program adoption. I find that more populous school districts and those with a higher proportion young children are likely to access the program earlier, once unobserved state heterogeneity is accounted for. A one percent increase in the population under five years old leads to a school district gaining access almost four months earlier. However, a school district in an urban area and one with a higher proportion of Black people is likely to adopt the program later than average. Although several of these parameters are statistically significant, they fail to explain a large share of the overall variation in the timing of program adoption. The weak fit of the model suggests that many of the deciding factors to adopt Imagination Library appear to be idiosyncratic. Nonetheless, to control for differences in observable population trends that may be correlated with program adoption as well as later achievement, I include interactions of these pre-treatment values with time trends in my main specification (as in Hoynes & Schanzenbach (2009)).

[8] Although almost identical, results using the sample of fourth grade cohorts are in Table A.1.

[9] Although it coincides with a few program start dates, the majority of programs started much later than 2000.

[10] Summary statistics for all variables used in the covariate balance test are in Table A.2.

In addition to the exogenous adoption assumption, the canonical difference-in-differences model requires the traditional common trends assumption, which relies on the assumption that important unmeasured variables are either time invariant group attributes that are captured by the district fixed effect or time varying factors that are group invariant and thus captured by the cohort fixed effect.[11]. In other words, identification relies on the assumption that in absence of Imagination Library adoption, the outcome variables of treatment and control districts would have evolved similarly. Although it is impossible to know the counterfactual distribution of outcomes, it is more likely that school districts would have continued to trend together after the treatment date if they were trending together before, in absence of program adoption. To test pre-treatment trends, I estimate an event study with the following specification:

$$Y_{dc} = \lambda_c \ + \eta_d \ + \sum_{\tau \neq -4} \gamma_\tau ILAccess_\tau \ + \ X_{dc}\beta \ + (t \times \theta_{dc}) + \epsilon_{dc} \tag{2}$$

where all arguments are the same as in Equation 1, except the argument inside the summation term. $ILAccess_\tau$ are relative time to treatment indicators, which equal 1 for ever-treated school districts if time $t$ is $\tau$ periods from the initial treatment year. The coefficients of interest, $\gamma_\tau$, represent the average change in exam scores between time $\tau$ and the period four years prior to treatment among students ever exposed to Imagination Library relative to those who were never exposed. The results are presented in Figure 2. Overall, the figures suggest small evidence of differential group trends in the third grade sample, but little to no difference in the fourth grade sample. In the years prior to treatment in the third grade sample in Figures 2a and 2b, two coefficients reach statistical significance at the ten percent level, but are not larger than 0.025 standard deviations in magnitude. However, the pre-treatment estimates of third grade ELA exams are jointly insignificant ($F = 1.91$, $p = 0.129$). Variation in the third grade pre-treatment estimates would be troublesome if these differences

[11] I present results that acknowledge the negative weighting issues a staggered treatment design can trigger in Section 5.3 (de Chaisemartin & D'Haultfœuille, 2020)

were negative prior to treatment, suggesting that treated school districts were performing at a lower level than untreated school districts prior to program adoption. The figures suggest an opposite story, such that districts that adopted the program were performing at a higher level than untreated districts in the years immediately prior to program adoption. Adoption could still be endogenous, but the endogeneity is more likely related to factors that also predict higher average achievement scores, which I control for, and less likely caused by school districts adopting the program to increase test scores, which would be difficult to control for. Results from the fourth grade sample, presented in Figures 2c and 2d, show less variance among pre-treatment groups. Only one of the pre-treatment coefficients from the fourth grade sample between both subjects reach statistical significance, none are larger than 0.012 in magnitude, and are jointly insignificant for both subjects.

# 5 Results

## 5.1 Full Sample Results

I begin with estimates for the full sample of students and school districts, regardless of their racial or socioeconomic composition. I consider four main outcome variables: third and fourth grade English and Math average achievement levels. The outcome variables are standardized such that a 1 unit increase in the outcome achievement variable can be interpreted as an increase in the school district's average achievement by 1 standard deviation above the national reference cohort.

The basic difference-in-differences results for third and fourth grade achievement scores are presented in Tables 4 and 5, respectively. The estimates in panel A show the effects of Imagination Library access on English Language Arts (ELA) Exams and panel B shows the effects on math exams. In these tables, I define IL access equal to one if the cohort was exposed to at least one month of the program during their eligibility period. The fourth columns display the results from models that include the full panel of control variables, a district specific fixed effect, a cohort fixed effect, and 2000 Census level time trends. The estimates in the last column of Panel A in Table 4 suggests that gaining access to Imagination Library has a very small, negative effect on third grade ELA average exam scores. On average, a cohort with access scored 0.01 standard deviations lower on third grade ELA exams than a cohort without access. The estimate for fourth grade ELA exams is similarly negative, however, does not reach statistical significance. The confidence interval for the fourth grade exams rules out positive effects larger than 0.0065. These estimates imply that having access to IL for at east one month has a null effect on average school district achievement on third and fourth grade ELA exams. The effects on fourth grade exams, as seen in Table 5, are imprecisely estimated and extremely small.

Tables 6 and 7 display results from a similar model but use the population weighted IL indicator as the treatment variable. These results are similar to those presented in tables 4 and 5 in magnitude and direction of effects. Again, there is a small, negative effect on third grade ELA and Math exams and a positive effect on fourth grade Math exams with an effect size of 0.01 standard deviations.

Tables 8 and 9 display results from the alternative specification that measures a quadratic dosage effect to capture any differential trends based on the length of program enrollment. Of school districts that have access to the program, cohorts have access for an average of four years. Marginal effects at the average enrollment length conditional on being treated are also listed in the table. Estimates in column (4) of Table 8 suggest that an additional year of IL access above the average has a positive effect of less than a tenth of a standard deviation on both ELA and Math exams. The results from the main specification in Table 9 are very similar to the results from the third grade sample.

## 5.2 Heterogeneity

I also explore heterogeneity in treatment effects, as different subgroups could be more responsive to participation in the program. Specifically, I consider heterogeneous effects by achievement level, race, and socioeconomic status.

First, to examine if there is treatment effect heterogeneity among low and high-achieving students, I examine how access to Imagination Library affects students at different points in the average achievement distribution using unconditional quantile regression as described in Firpo et al. (2009).[12] Tables 10–15 and Figure 3 display results from estimates using the treatment indicator variable. The tables present the average effect and the unconditional quantile estimates from the $10^{\text{th}}$, $25^{\text{th}}$, $50^{\text{th}}$, $75^{\text{th}}$, and $90^{\text{th}}$ percentiles in the average achievement score distribution. The estimates in Table 10 show that access to IL widens the distribution of average achievement scores for the third grade ELA exams, such that the average score decreases in school districts with lower performing students and rises in higher performing districts. The results in Panel B suggest access to the program shrinks the distribution towards the lower end. While access to the program decreases achievement scores of school districts above the twenty-fifth percentile in the distribution, school districts in the lowest $10^{\text{th}}$ percentile of achievement distribution see an increase in their average standardized test scores by 1 percent of a standard deviation. Results among fourth grade achievement are similar for ELA exams. Access to Imagination Library causes fourth grade math scores across the achievement distribution to increase. School districts in the lowest ten percent of relative achievement on fourth grade math exams see very large relative increases – close to a three and a half percentage increase in standard deviations.

Tables 12 and 13 use the population weighted indicator variable as the variable of interest. These results are similar to those from the binary treatment, but if anything, are more exaggerated in magnitude and statistical significance. A key result from table 13 suggests that the lowest performing school districts on the fourth grade math exams see increases in scores by 0.04 standard deviations once they adopt the program.

Next, I assess how access to IL affects students of different races or ethnicity groups. The SEDA dataset includes achievement scores that differ by student characteristics. Tables

[12] This method allows for investigation of treatment on different quantiles of the achievement distribution without changing the distribution of control variables.

16 and 17 present the effects of the IL indicator variable, both population weighted and unweighted, on the full sample of students, Non-Hispanic White students, Non-Hispanic Black students, and Hispanic students. Table 16 presents results from the third grade sample and Table 17 presents results from the fourth grade sample. The estimates from panel A suggest that simply gaining access to the program leads to decreases in achievement of all students on third grade ELA exams when not controlling for population. After factoring in the population weights, the effects for Non-Hispanic Black and Hispanic students flip to a positive effect, however, they are still extremely small. Effects on third grade Math exams are similar to those on ELA exams. There are some small differential effects across racial groups at the fourth grade level. Non-Hispanic Black students in school districts with access score 0.02 standard deviations higher on fourth grade Mathematics exams than their peers in school districts without access to the program. The other estimates for Non-Hispanic White and Hispanic students are also positive and suggest an increase in 0.01 standard deviations on fourth grade Math exams. The results from Tables 16 and 17 suggest there are few differential affects across students of different races from gaining access to the program. Fourth grade Math exams are the only outcome that has significant, positive effects for more than one group of students.

Tables 18 and 19 present estimates from models using the quadratic dosage estimator. Across all race-grade-subject subgroups, the marginal effect of one additional treatment year above average for school districts that have access has an extremely small, positive marginal effect on students' average exam scores. It is important to note that conditional on having a program, the average length of time a cohort has access is around four years. Therefore, an additional year would almost reach the maximum time limit for a cohort, since the program ends when children reach five years of age. Non-Hispanic Black students see the greatest return when compared with other students. Having access to the program for an additional year above the average leads to increases between 0.008 - 0.02 standard deviations for Non-Hispanic Black students on third grade exams. All other marginal effects, while positive, are less than 1 percent of a standard deviations.

I now turn to heterogeneous treatment effects across socioeconomic status (SES). Imagination Library gives free books to all age-eligible children, regardless of family income. However, one might expect children from families of low-socioeconomic status to benefit greater from participation in the program because these families might own less books due to financial constraints. To investigate effects across heterogeneous socioeconomic status, I estimate the basic differences-in-differences model on achievement scores for low-socioeconomic students across all school districts. Column 2 in Table 20 present results on third grade scores of low-SES students. If anything, estimates are even smaller in magnitude among low-socioeconomic students than of the full sample and are still negative for both third grade subjects. The results from fourth grade achievement are presented in Table 21. The estimate in Column 2 of Panel B suggests that access to Imagination Library in childhood increases fourth grade math scores of economically disadvantaged students by 0.01 standard deviations. Although small, this estimate is similar in magnitude to other positive, statistically significant results.

Tables 22 and 23 show how additional years of access to the program affect economically disadvantaged students. All the estimates for marginal effects are positive. One additional year of access to the program leads to an increase in standardized test scores for low-socioeconomic students by 0.004 standard deviations on third grade ELA exams. Although statistically different from zero, the economic significance of an additional year is minuscule.

I also present an alternative method of assessing affects across the socioeconomic spectrum. Table A.3 present results from a model that splits the sample according to the economic disadvantage status of the school district. Each column represents an estimate from a quartile of the data, with the most disadvantaged schools in the sample used in the last two columns. Again, there does not seem to be any differential trends across socioeconomic status.

## 5.3 Robustness Specifications

### 5.3.1 Migration and Private School Enrollment

Using additional data from the American Community Survey, I estimated two additional specifications in Tables 24 and 25. In both tables, Column 4 repeats results from the primary specification with full controls on the third grade ELA samples. This specification controls for the full vector of school district characteristics as well as unobserved heterogeneity at the school district and cohort level. Columns 1-3 use the same controls, but restrict the sample based on migration or enrollment. Column 1 of Table 24 presents results from the main specification on the sample of third grade ELA observations restricted to observations with the lowest relative migration rate. The sample used in Column 2 includes observations with migration rates below the median. Column 3 includes observations with migration rates below the 75th percentile of relative migration rates. Because there is a four year gap between students exiting the program and taking their first standardized tests, the main specifications would be biased if there were large amounts of migration, either in or out of the school district. Here, I control for rates of migration into the school district. In each column, the sign matches and magnitude roughly matches the estimates in column 4.

Columns 1-3 of Tables 25 follow the same pattern explained above, but restrict the sample based on public school enrollment. Because the federal mandatory reporting requirement only applied to public schools, private school data is not included in the SEDA dataset. If a large amount of Imagination Library participants attended private schools, the results from the main specification would not pick up on the full effects of program access. The positive coefficients in Columns 1 and 2 suggest that Imagination Library has a positive effect on average achievement scores in school districts with low public school enrollment relative to other districts.

### 5.3.2 Variation in Treatment Timing and Heterogeneous Effects

An additional concern with my empirical strategy is that the traditional two-way fixed effects (TWFE) difference-in-differences (DID) estimator works best when the treatment timing is the same for all treatment groups. de Chaisemartin & D'Haultfœuille (2020) shows that DID may produce biased estimates when the treatment effects differ across either fixed effect dimension. Specific to my research design, the DID estimator might be biased if treatment effects differ across time or school district. The average treatment effect (ATE) is a weighted average of the comparisons between all group-period pairs. Differences in treatment period or effects across groups could cause negative weights, leading to an ATE that is a non-convex combination of all treatment effects (de Chaisemartin & D'Haultfœuille, 2020). This is a concern in my analysis as school districts differ in their adoption of the program and effects are heterogeneous across district.

I follow de Chaisemartin & D'Haultfœuille (2020)'s prescription to assess the problem and it's potential affects on my original DID estimate and to generate new estimates of the ATE with their new estimator. This includes initially assessing the weights and calculating a test statistic to determine the extent of the issue they could cause. Using Stata code provided by the authors, I assess whether my basic specification suffers from bias due to negative weights. In the two way fixed effects (TWFE) regression of achievement on IL access and school district and cohort fixed effects, there are 13,035 total ATEs estimated. In the model, 70 percent are strictly positive and 30 percent are strictly negative. The negative weights sum to -0.094. The negative weights could cause the TWFE estimator from my primary specification may be of a different sign than the average treatment on the treated if the standard deviation of those ATEs is equal to 0.006, a plausible magnitude.

Because it is possible that the negative weights cause the sign of the two way fixed effects estimator to differ from the ATE, I estimate the model using a new estimator that corrects for the bias. Table 26 shows the estimates on the treatment variable from the primary TWFE difference-in-differences model ($\beta_{FE}$), the new estimator that corrects for the bias ($DID_M$), and three estimates from a pretrend analysis that also corrects for the negative weights. The estimate from the corrected model is not statistically different than the estimate from the basic model (t-statistic = 0.08), which suggests the negative weights were not an issue in this sample. The additional three coefficients $DID_M^{p1}$, $DID_M^{p2}$, and $DID_M^{p3}$ are estimates of pretreatment trends for one, two, and three periods prior to treatment, respectively. These results slightly differ from 2a. They are all much smaller in magnitude and none reach statistical significance.

## 6 Discussion and Conclusion

In an effort to further understand how individual inputs affect early human capital development, I present the effects of an early childhood intervention that gives free books to children on elementary age standardized test scores. I exploit the variation from the nationwide rollout of the program in a two way fixed effects difference-in-differences framework. My findings suggest that access to the program has a precise null effect on aggregate test scores. A cohort with access to Imagination Library for at least one month has lower third grade English Language Arts scores than cohorts without access by only one percent of a standard deviation, a result so small that I consider it a null result.

Access to Imagination Library has differential effects across the achievement spectrum. While still extremely small in magnitude, results from unconditional quantile analysis analysis on English Language Arts exams suggest that low-achieving cohorts in treated school districts have slightly lower achievement scores than their peers in untreated districts, by about 0.02 standard deviations. However, treated high-achieving cohorts see a statistically insignificant increase in scores, widening the achievement gap. This suggests that a family environment that produces low-achieving students isn't going to be receptive to a small nudge like a book. Those families might require more intervention to impact test scores. However, high-achieving students likely already come from home environments with positive attitudes towards education and might double down on their efforts once a book arrives in the mail. In this case, a pure capital input could serve as an instrument of achievement inequality, which is the opposite effect one might expect.

These results suggest that a pure capital educational input during early formative years is not effective at improving overall test scores at the third and fourth grade level. This is not equivalent to saying that a pure capital investment is pointless; giving free books to children is not harming students, and if anything, my estimates are a conservative lower bound. Further, the program could follow a similar path of other early interventions and the effects could fade out and be unrecognizable in third and fourth grade achievement (Chetty et al., 2011a; DeCicca, 2007; Currie & Thomas, 1995). Although treatment effects of early childhood interventions on cognitive skills fade out by middle school grades, there are often positive effects on outcomes later in life that can be attributed to permanent personality skill changes (Heckman et al., 2013). Personality skills, such as aggressive behavior or social behavior, might not be accurately measured in cognitive exams designed to measure specific aptitudes. However, these skills (or lack of, in the case of aggressive behavior) can improve a number of labor market and health outcomes later in life. The data do not exist to examine long-term effects of Imagination Library, but it is possible that a similar early literacy intervention has positive long-run effects.

Due to program limitations, I leave for future work the question of how complementary in-kind capital inputs and parental time are in early human capital development. Understanding which features of a compound program (capital, time, or the combination of the two) would be valuable to those designing and the policymakers implementing early interventions. I have shown here that capital on its own fails to leave a lasting effect on academic achievement and other research suggests that time inputs are successful (York et al., 2019). However, it remains unknown whether a program that capitalizes on both inputs, like pairing parental guidance with the Imagination Library program, could be more successful at increasing early human capital development in the early years of a child's life at home.

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**Table 1:** Descriptive Statistics

| | School Districts without IL | School Districts with IL | All School Districts |
|---|---|---|---|
| IL Program Indicator | 0 | 1 | 0.127 |
| | | | [0.333] |
| Pop. Weighted IL Program Indicator | 0 | 0.864 | 0.110 |
| | | [0.303] | [0.308] |
| Number of Years with IL | 0 | 3.904 | 0.497 |
| | | [2.014] | [1.486] |
| ***Achievement Outcomes*** | | | |
| Total Student Achievement | 0.0727 | 0.0534 | 0.0702 |
| | [0.360] | [0.316] | [0.354] |
| Asian Student Achievement | 0.461 | 0.400 | 0.453 |
| | [0.360] | [0.316] | [0.354] |
| Black Student Achievement | -0.335 | -0.382 | -0.341 |
| | [0.309] | [0.297] | [0.308] |
| Hispanic Student Achievement | -0.215 | -0.226 | -0.216 |
| | [0.304] | [0.269] | [0.300] |
| White Student Achievement | 0.321 | 0.323 | 0.322 |
| | [0.312] | [0.267] | [0.306] |
| ECD Student Achievement | -0.273 | -0.275 | -0.273 |
| | [0.254] | [0.225] | [0.250] |
| ***ACS Controls*** | | | |
| Urban Location | 0.381 | 0.420 | 0.386 |
| | [0.486] | [0.494] | [0.487] |
| Rural Location | 0.0505 | 0.113 | 0.0585 |
| | [0.219] | [0.317] | [0.235] |
| Natural Log of Median Income | 11.02 | 10.93 | 11.01 |
| | [0.302] | [0.284] | [0.301] |
| Rate of Bachelor's Degree | 0.335 | 0.308 | 0.331 |
| | [0.134] | [0.107] | [0.131] |
| Poverty Rate | 0.147 | 0.173 | 0.151 |
| | [0.0925] | [0.0867] | [0.0922] |
| Unemployment Rate | 0.0822 | 0.0800 | 0.0819 |
| | [0.0290] | [0.0249] | [0.0286] |
| Rate of Food Stamp Receipt | 0.0921 | 0.111 | 0.0945 |
| | [0.0617] | [0.0571] | [0.0614] |
| Female Headed Household Rate | 0.190 | 0.190 | 0.190 |
| | [0.0681] | [0.0617] | [0.0673] |
| ***CCD Controls*** | | | |
| Total Cohort Size | 2074.3 | 2689.3 | 2152.5 |
| | [3075.2] | [3544.3] | [3145.4] |
| Percent Native American Students | 0.00641 | 0.0120 | 0.00712 |
| | [0.0146] | [0.0245] | [0.0163] |
| Percent Asian Students | 0.0847 | 0.0526 | 0.0806 |
| | [0.0901] | [0.0634] | [0.0879] |
| Percent Hispanic Students | 0.268 | 0.192 | 0.258 |
| | [0.216] | [0.165] | [0.211] |
| Percent Black Students | 0.166 | 0.196 | 0.170 |
| | [0.162] | [0.165] | [0.163] |
| Percent White Students | 0.475 | 0.547 | 0.484 |

| | School Districts without IL | School Districts with IL | All School Districts |
|---|---|---|---|
| | [0.239] | [0.208] | [0.236] |
| Percent FRPL Eligible* | 0.477 | 0.517 | 0.482 |
| | [0.222] | [0.190] | [0.219] |
| Percent Economically Disadvantaged | 0.488 | 0.524 | 0.493 |
| | [0.225] | [0.193] | [0.222] |
| Percent English Language Learners | 0.106 | 0.0821 | 0.103 |
| | [0.102] | [0.0654] | [0.0983] |

Parameters listed are mean values for all cohorts. ECD refers to economically disadvantaged students, as defined by the SEDA composite variable. Standard deviations are in brackets where applicable. * FRPL stands for Free/Reduced Price Lunch

**Table 2:** Covariate Balance Test: Third Grade

| | (1)<br>Imagination Library Access |
|---|---|
| Number of Students | 0.422 |
| | [1.899] |
| Urban Neighborhood | -0.00384 |
| | [0.00705] |
| Percent Black | -0.000106 |
| | [0.000296] |
| Percent Free/Reduced Price Lunch | 0.000955 |
| | [0.00156] |
| Percent English Language Learners | 0.000717 |
| | [0.000440] |
| Log Median Income | -0.00102 |
| | [0.00134] |
| Unemployment Rate | 0.000134 |
| | [0.000162] |
| Observations | 74571 |

Each parameter is from a separate regression of that parameter on an indicator variable that equals one when a school district gains access to Imagination Library. The sample includes all observations from third grade exams. Standard errors are in brackets and are clustered at the school district level. $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

**Table 3:** Determinants of Imagination Library program start date using the 2000 Census

| | Index | |
|---|---|---|
| | (1) | (2) |
| Percent of population urban | 0.337*** | 0.201* |
| | [0.0451] | [0.102] |
| Percent of population age $< 5$ | -9.221*** | -3.832* |
| | [1.052] | [2.093] |
| Percent of population age $> 65$ | -0.608** | 0.776 |
| | [0.298] | [0.492] |
| Percent of population Black | 0.376*** | 0.679*** |
| | [0.0820] | [0.204] |
| Log median income | 8.367* | 11.01 |
| | [4.270] | [10.85] |
| Log population | -2.003*** | -2.534* |
| | [0.682] | [1.410] |
| State Fixed Effect | | X |
| Observations | 5396 | 4804 |
| $R^2$ | 0.03 | 0.27 |

The 2000 Census data are all at the school district level. The dependent variable is equal to the calendar month (normalized to one in January 2000) that the school district gained access to Imagination Library. The control variables come from the 2000 Census.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 4:** Effects of IL program availability on Total Average School District Achievement: Third Grade Sample

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Panel A: ELA** | | | | |
| IL Access Indicator | -0.0374*** | -0.000673 | -0.0110** | -0.0104** |
| | (0.00323) | (0.00248) | (0.00499) | (0.00500) |
| Observations | 80209 | 75686 | 75397 | 74590 |
| **Panel B: Mathematics** | | | | |
| IL Access Indicator | -0.0148*** | 0.0247*** | -0.00339 | -0.00917 |
| | (0.00362) | (0.00302) | (0.00622) | (0.00625) |
| Observations | 79875 | 75369 | 75078 | 74269 |
| Control Variables | | X | X | X |
| Cohort FE | | | X | X |
| District FE | | | X | X |
| 2000 Census Time Trends | | | | X |

Each parameter is from a separate regression of the outcome variable on an indicator variable equal to one if the school district had access to Imagination Library for at least one month. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 5:** Effects of IL program availability on Total Average School District Achievement: Fourth Grade Sample

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Panel A: ELA** | | | | |
| IL Access Indicator | -0.0403*** | 0.00193 | -0.00609 | -0.00612 |
| | (0.00350) | (0.00261) | (0.00542) | (0.00543) |
| Observations | 69724 | 66186 | 65900 | 65225 |
| **Panel B: Mathematics** | | | | |
| IL Access Indicator | -0.0185*** | 0.0266*** | 0.0135** | 0.00821 |
| | (0.00400) | (0.00325) | (0.00651) | (0.00656) |
| Observations | 69310 | 65795 | 65504 | 64829 |
| Control Variables | | X | X | X |
| Cohort FE | | | X | X |
| District FE | | | X | X |
| 2000 Census Time Trends | | | | X |

Each parameter is from a separate regression of the outcome variable on an indicator variable equal to one if the school district had access to Imagination Library for at least one month. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 6:** Effects of Population Weighted IL Indicator Variable on Total Average School District Achievement: Third Grade Sample

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Panel A: ELA** | | | | |
| Population Weighted IL Indicator | -0.0394*** | -0.00440 | -0.00992** | -0.00874* |
| | (0.00349) | (0.00269) | (0.00504) | (0.00505) |
| Observations | 80209 | 75686 | 75397 | 74590 |
| **Panel B: Mathematics** | | | | |
| Population Weighted IL Indicator | -0.0132*** | 0.0249*** | 0.00203 | -0.00355 |
| | (0.00392) | (0.00325) | (0.00630) | (0.00634) |
| Observations | 79875 | 75369 | 75078 | 74269 |
| Control Variables | | X | X | X |
| Cohort FE | | | X | X |
| District FE | | | X | X |
| 2000 Census Time Trends | | | | X |

Each parameter is from a separate regression of the outcome variable on a population weighted variable that indicates access to the Imagination Library program based on zip code populations. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 7:** Effects of Population Weighted IL Indicator Variable on Total Average School District Achievement: Fourth Grade Sample

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Panel A: ELA** | | | | |
| Population Weighted IL Indicator | -0.0389*** | 0.00159 | -0.00216 | -0.00185 |
| | (0.00380) | (0.00285) | (0.00553) | (0.00556) |
| Observations | 69724 | 66186 | 65900 | 65225 |
| **Panel B: Mathematics** | | | | |
| Population Weighted IL Indicator | -0.0153*** | 0.0277*** | 0.0150** | 0.0102 |
| | (0.00436) | (0.00354) | (0.00668) | (0.00673) |
| Observations | 69310 | 65795 | 65504 | 64829 |
| Control Variables | | X | X | X |
| Cohort FE | | | X | X |
| District FE | | | X | X |
| 2000 Census Time Trends | | | | X |

Each parameter is from a separate regression of the outcome variable on a population weighted variable that indicates access to the Imagination Library program based on zip code populations. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 8:** Effects of additional years of access to Imagination Library on Total Average School District Achievement: Third Grade Sample

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Panel A: ELA** | | | | |
| Years of IL Access | -0.0207056*** | -0.0066434*** | -0.0036073 | -0.0040134 |
| | (0.0033676) | (0.0025523) | (0.0032694) | (0.0032598) |
| Years of IL Access Squared | 0.0024225*** | 0.0013622*** | 0.0005723 | 0.0008295* |
| | (0.0005995) | (0.0004563) | (0.0004895) | (0.0004895) |
| Average Years of Access† | 3.895418 | 3.892277 | 3.890951 | 3.888661 |
| Marginal Effects at the Mean | -0.001832 | 0.0039609 | 0.0008464 | 0.0024381 |
| | (0.0015513) | (0.0011965) | (0.0016463) | (0.0016936) |
| Observations | 80212 | 75662 | 75377 | 74571 |
| **Panel B: Mathematics** | | | | |
| Years of IL Access | -0.0075175* | 0.0093051*** | 0.0029165 | 0.0011127 |
| | (0.0038905) | (0.0031654) | (0.004018) | (0.0040261) |
| Years of IL Access Squared | 0.0009192 | -0.0005931 | 0.0005857 | 0.0004781 |
| | (0.0006878) | (0.0005604) | (0.0006091) | (0.0006098) |
| Average Years of Access† | 3.905798 | 3.902984 | 3.901412 | 3.899121 |
| Marginal Effects at the Mean | -0.0003367 | 0.0046756*** | 0.0074863*** | 0.0048413** |
| | (0.0017472) | (0.0014389) | (0.0020722) | (0.0021186) |
| Observations | 79878 | 75344 | 75058 | 74250 |
| Control Variables | | X | X | X |
| Cohort FE | | | X | X |
| District FE | | | X | X |
| 2000 Census Time Trends | | | | X |

†The average years of access used here is conditional on having access to Imagination Library.

Each parameter is from a separate regression of the outcome variable on a dosage variable that measures the length of time a school district had access to IL in years and its quadratic term. Panel A presents results from a sample of ELA exams. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 9:** Effects of additional years of access to Imagination Library on Total Average School District Achievement: Fourth Grade Sample

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **Panel A: ELA** | | | | |
| Years of IL Access | -0.0211874*** | -0.0038251 | 0.0017991 | 0.0028165 |
| | (.0036137) | (.0026692) | (.0036464) | (.0036674) |
| Years of IL Access Squared | 0.0023825*** | 0.0009681** | -0.0001436 | -0.0001583 |
| | (.0006521) | (.0004839) | (.0005165) | (.0005172) |
| Average Years of Access† | 3.78133 | 3.764681 | 3.762895 | 3.760367 |
| Marginal Effects at the Mean | -0.0031698** | 0.0034641*** | 0.0007183 | 0.0016258 |
| | (0.0016136) | (0.0012036) | (0.001699) | (0.0017765) |
| Observations | 69727 | 66178 | 65893 | 65218 |
| **Panel B: Mathematics** | | | | |
| Years of IL Access | -0.0026513 | 0.0172658*** | 0.0094639** | 0.0070596 |
| | (.0042546) | (.0033824) | (.0043958) | (.0044089) |
| Years of IL Access Squared | -0.0003495 | -0.0022135*** | -0.0004322 | -0.0003111 |
| | (.0007647) | (.000609) | (.0006459) | (.0006468) |
| Average Years of Access† | 3.796184 | 3.778977 | 3.776858 | 3.774325 |
| Marginal Effects at the Mean | -0.0053052*** | 0.0005361 | 0.0061989*** | 0.0047112** |
| | (0.0018707) | (0.0014936) | (0.0022342) | (0.002295) |
| Observations | 69313 | 65786 | 65496 | 64822 |
| Control Variables | | X | X | X |
| Cohort FE | | | X | X |
| District FE | | | X | X |
| 2000 Census Time Trends | | | | X |

†The average years of access used here is conditional on having access to Imagination Library.

Each parameter is from a separate regression of the outcome variable on a dosage variable that measures the length of time a school district had access to IL in years and its quadratic term. Panel A presents results from a sample of ELA exams. The sample in panel B includes results from math exams. The outcome variable for all estimates is the average achievement score for the entire school district in the respective subject. Standard errors are in brackets and are clustered at the district level where appropriate.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 10:** Effects of IL program availability on achievement: Third Grade

| | | | Quantiles of Average Achievement | | | |
|---|---|---|---|---|---|---|
| | OLS | 0.10 | 0.25 | 0.50(Median) | 0.75 | 0.90 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: ELA** | | | | | | |
| IL Access Indicator | -0.0104** | -0.0219* | -0.0300*** | -0.0159* | 0.00973 | 0.00626 |
| | (0.00500) | (0.0129) | (0.00965) | (0.00876) | (0.00986) | (0.0105) |
| Observations | 74590 | 74861 | 74861 | 74861 | 74861 | 74861 |
| **Panel B: Mathematics** | | | | | | |
| IL Access Indicator | -0.00917 | 0.00384 | -0.00898 | -0.0229*** | -0.0133 | -0.00578 |
| | (0.00625) | (0.0160) | (0.00892) | (0.00836) | (0.0133) | (0.0142) |
| Observations | 74269 | 74543 | 74543 | 74543 | 74543 | 74543 |

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for at least one month on the school district average score on third grade exams. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column (1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets. $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

**Table 11:** Effects of IL program availability on achievement: Fourth Grade

| | | | Quantiles of Average Achievement | | | |
|---|---|---|---|---|---|---|
| | OLS | 0.10 | 0.25 | 0.50(Median) | 0.75 | 0.90 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: ELA** | | | | | | |
| IL Access Indicator | -0.00612 | -0.0273* | -0.00841 | -0.0000718 | -0.0227 | 0.0178 |
| | (0.00543) | (0.0146) | (0.0106) | (0.00935) | (0.0102) | (0.0109) |
| Observations | 65225 | 65491 | 65491 | 65491 | 65491 | 65491 |
| **Panel B: Mathematics** | | | | | | |
| IL Access Indicator | 0.00821 | 0.0298* | 0.00179 | -0.00571 | 0.0178 | 0.00911 |
| | (0.00656) | (0.0156) | (0.0109) | (0.00987) | (0.0137) | (0.0133) |
| Observations | 64829 | 65099 | 65099 | 65099 | 65099 | 65099 |

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for at least one month on the school district average score on fourth grade exams. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column (1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets. $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

**Table 12:** Effects of Population Weighted IL program availability on achievement: Third Grade

| | OLS | 0.10 | 0.25 | 0.50(Median) | 0.75 | 0.90 |
|---|---|---|---|---|---|---|
| | | | Quantiles of Average Achievement | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: ELA** | | | | | | |
| Population Weighted IL Indicator | -0.00874* | -0.0244* | -0.0278*** | -0.0125 | 0.0132 | 0.0110 |
| | (0.00505) | (0.0136) | (0.0103) | (0.00797) | (0.00973) | (0.0112) |
| Observations | 74590 | 74861 | 74861 | 74861 | 74861 | 74861 |
| **Panel B: Mathematics** | | | | | | |
| Population Weighted IL Indicator | -0.00355 | 0.0178 | -0.00178 | -0.0131 | -0.00865 | -0.00707 |
| | (0.00634) | (0.0159) | (0.0136) | (0.00869) | (0.0108) | (0.0107) |
| Observations | 74269 | 74543 | 74543 | 74543 | 74543 | 74543 |

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for at least one month on the school district average score on third grade exams. The population weighted indicator variable is used as the main variable of interest. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column [1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets. $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

**Table 13:** Effects of Population Weighted IL program availability on achievement: Fourth Grade

| | OLS | 0.10 | 0.25 | 0.50(Median) | 0.75 | 0.90 |
|---|---|---|---|---|---|---|
| | | | Quantiles of Average Achievement | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: ELA** | | | | | | |
| Population Weighted IL Indicator | -0.00185 | -0.0172 | -0.0103 | 0.00138 | 0.00213 | 0.0236* |
| | (0.00556) | (0.0136) | (0.00959) | (0.00956) | (0.0106) | (0.0130) |
| Observations | 65225 | 65491 | 65491 | 65491 | 65491 | 65491 |
| **Panel B: Mathematics** | | | | | | |
| Population Weighted IL Indicator | 0.0102 | 0.0374** | 0.000133 | 0.00228 | 0.0142 | 0.0230* |
| | (0.00673) | (0.0169) | (0.0109) | (0.0103) | (0.0105) | (0.0136) |
| Observations | 64829 | 65099 | 65099 | 65099 | 65099 | 65099 |

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for at least one month on the school district average score on fourth grade exams. The population weighted indicator variable is used as the main variable of interest. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column (1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets. $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

**Table 14:** Effects of IL program availability on achievement: Third Grade

| | | | Quantiles of Average Achievement | | | |
|---|---|---|---|---|---|---|
| | OLS | 0.10 | 0.25 | 0.50 (Median) | 0.75 | 0.90 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: ELA** | | | | | | |
| Years of IL Access | -0.00239 | -0.0152* | -0.0157*** | -0.000871 | 0.0130** | 0.00160 |
| | [0.00326] | [0.00850] | [0.00560] | [0.00581] | [0.00567] | [0.00756] |
| Years of IL Access Squared | 0.000474 | 0.00220* | 0.00295*** | -0.000243 | -0.00208** | -0.000669 |
| | [0.000489] | [0.00128] | [0.000800] | [0.000879] | [0.000853] | [0.00109] |
| Average Years of Access† | | 3.890255 | 3.890255 | 3.890255 | 3.890255 | 3.890255 |
| Marginal Effects at the Mean | | .0018519 | .0072373 | -.0027604 | -.0031652 | -.0036077 |
| Observations | 74571 | 74838 | 74838 | 74838 | 74838 | 74838 |
| **Panel B: Mathematics** | | | | | | |
| Years of IL Access | 0.00348 | 0.00854 | 0.00105 | -0.00356 | 0.00434 | 0.0107 |
| | [0.00401] | [0.00926] | [0.00672] | [0.00598] | [0.00723] | [0.00766] |
| Years of IL Access Squared | 0.000142 | 0.00127 | 0.00170 | 0.000888 | -0.00123 | -0.00191 |
| | [0.000606] | [0.00127] | [0.00107] | [0.000811] | [0.00100] | [0.00125] |
| Average Years of Access† | 3.900969 | 3.900969 | 3.900969 | 3.900969 | 3.900969 | |
| Marginal Effects at the Mean | | .0184719 | .0143321 | .0033663 | -.0052636 | -.0041415 |
| Observations | 74250 | 74519 | 74519 | 74519 | 74519 | 74519 |

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for an additional year on the school district average score on third grade exams. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column (1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 15:** Effects of IL program availability on achievement: Fourth Grade

| | | | Quantiles of Average Achievement | | | |
|---|---|---|---|---|---|---|
| | OLS | 0.10 | 0.25 | 0.50 (Median) | 0.75 | 0.90 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: ELA** | | | | | | |
| Years of IL Access | 0.00349 | -0.0153** | 0.00498 | 0.00848 | 0.00859 | 0.0114 |
| | [0.00366] | [0.00707] | [0.00736] | [0.00739] | [0.00642] | [0.00711] |
| Years of IL Access Squared | -0.000274 | 0.00276** | -0.000321 | -0.000975 | -0.00116 | -0.00140 |
| | [0.000516] | [0.00114] | [0.00102] | [0.00101] | [0.000992] | [0.00112] |
| Average Years of Access† | | 3.762696 | 3.762696 | 3.762696 | 3.762696 | 3.762696 |
| Marginal Effects at the Mean | | .0184719 | .0143321 | .0033663 | -.0052636 | -.0041415 |
| Observations | 65218 | 65483 | 65483 | 65483 | 65483 | 65483 |
| **Panel B: Mathematics** | | | | | | |
| Years of IL Access | 0.00929** | 0.0163 | 0.00654 | 0.00419 | 0.0155* | 0.0143 |
| | [0.00444] | [0.0109] | [0.00785] | [0.00627] | [0.00858] | [0.0101] |
| Years of IL Access Squared | -0.000642 | -0.00194 | 0.000604 | 0.000400 | -0.00259** | -0.00187 |
| | [0.000648] | [0.00148] | [0.00110] | [0.000886] | [0.00122] | [0.00130] |
| Average Years of Access† | | 3.776999 | 3.776999 | 3.776999 | 3.776999 | 3.776999 |
| Marginal Effects at the Mean | | .0184719 | .0143321 | .0033663 | -.0052636 | -.0041415 |
| Observations | 64822 | 65091 | 65091 | 65091 | 65091 | 65091 |

Results in this table come from an unconditional quantile regression that estimates the effect of having access to Imagination Library for an additional year on the school district average score on fourth grade exams. All estimates include the full panel of control variables, both district and cohort fixed effects, and 2000 Census level time trends. Column (1) represents the effect of an additional year of access to Imagination Library as estimated by an Ordinary Least Squares model for comparison. Standard errors are presented in brackets.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 16:** Effects of IL program availability on average school district achievement by race: third grade sample

| | All Enrolled Students (1) | Non-Hispanic White Students (2) | Non-Hispanic Black Students (3) | Hispanic Students (4) |
|---|---|---|---|---|
| **Panel A: ELA Exams** | | | | |
| IL Access Indicator | -0.0104** | -0.00882* | -0.00360 | -0.00103 |
| | (0.00500) | (0.00524) | (0.0114) | (0.0104) |
| Population Weighted IL Indicator | -0.00874* | -0.00558 | 0.00536 | 0.00903 |
| | (0.00505) | (0.00529) | (0.0114) | (0.0107) |
| Observations | 80212 | 66619 | 16929 | 22076 |
| **Panel B: Math Exams** | | | | |
| IL Access Indicator | -0.00917 | -0.00597 | 0.00595 | -0.00536 |
| | (0.00625) | (0.00647) | (0.0137) | (0.0120) |
| Population Weighted IL Indicator | -0.00355 | 0.00175 | 0.00538 | 0.00358 |
| | (0.00634) | (0.00661) | (0.0136) | (0.0126) |
| Observations | 74269 | 66363 | 16897 | 22335 |
| District & Cohort FE | X | X | X | X |
| 2000 Census Time Trends | X | X | X | X |

All results in this table regress an Imagination Library access parameter on the average school district achievement levels for a specific race. To measure access,the odd columns use an Imagination Library indicator variable and the even columns use the length of time a cohort has access. All estimates include the full panel of results, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 17:** Effects of IL program availability on average school district achievement by race: fourth grade sample

| | All Enrolled Students (1) | Non-Hispanic White Students (2) | Non-Hispanic Black Students (3) | Hispanic Students (4) |
|---|---|---|---|---|
| **Panel A: ELA Exams** | | | | |
| IL Access Indicator | -0.00612 | -0.00124 | -0.0117 | -0.00510 |
| | (0.00543) | (0.00560) | (0.0128) | (0.0115) |
| Population Weighted IL Indicator | -0.00185 | -0.000523 | -0.00395 | 0.00733 |
| | (0.00556) | (0.00573) | (0.0127) | (0.0114) |
| Observations | 65225 | 57908 | 14717 | 19152 |
| **Panel B: Math Exams** | | | | |
| IL Access Indicator | 0.00821 | 0.00767 | 0.0292* | 0.00301 |
| | (0.00656) | (0.00668) | (0.0154) | (0.0130) |
| Population Weighted IL Indicator | 0.0102 | 0.0130* | 0.0276* | 0.0117 |
| | (0.00673) | (0.00696) | (0.0152) | (0.0133) |
| Observations | 64829 | 57655 | 14737 | 19419 |
| District & Cohort FE | X | X | X | X |
| 2000 Census Time Trends | X | X | X | X |

All results in this table regress an Imagination Library access parameter on the average school district achievement levels for a specific race. To measure access,the odd columns use an Imagination Library indicator variable and the even columns use the length of time a cohort has access. All estimates include the full panel of results, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 18:** Effects of IL program availability on average school district achievement by race: Third Grade Sample

| | All Enrolled Students (1) | Non-Hispanic White Students (2) | Non-Hispanic Black Students (3) | Hispanic Students (4) |
|---|---|---|---|---|
| **Panel A: ELA Exams** | | | | |
| Years of IL Access | -0.00401 | -0.00380 | -0.00359 | -0.0114* |
| | (0.00326) | (0.00339) | (0.00796) | (0.00685) |
| Years of IL Access Squared | 0.000830* | 0.000994* | 0.00152 | 0.00200* |
| | (0.000489) | (0.000512) | (0.00109) | (0.00110) |
| Average Years of Access† | 3.889 | 3.878 | 3.923 | 3.940 |
| Marginal Effects at the Mean | 0.0024381 | 0.0039087** | 0.0082964** | 0.0043702 |
| | 0.0016936 | 0.0017644 | 0.0036062 | 0.0041509 |
| Observations | 74590 | 66675 | 16934 | 22083 |
| **Panel B: Math Exams** | | | | |
| Years of IL Access | 0.00111 | 0.00270 | 0.00904 | -0.00258 |
| | (0.00403) | (0.00412) | (0.00900) | (0.00837) |
| Years of IL Access Squared | 0.000478 | 0.000449 | 0.00140 | 0.00122 |
| | (0.000610) | (0.000622) | (0.00132) | (0.00134) |
| Average Years of Access† | 3.899 | 3.888 | 3.936 | 3.956 |
| Marginal Effects at the Mean | 0.0048413** | 0.0061919*** | 0.0200598*** | 0.0070606 |
| | 0.0021186 | 0.0021766 | 0.0045865 | 0.0051275 |
| Observations | 74269 | 66363 | 16897 | 22335 |
| District & Cohort FE | X | X | X | X |
| 2000 Census Time Trends | X | X | X | X |

†The average years of access used here is conditional on having access to Imagination Library
All results in this table regress an Imagination Library access parameter and its squared value on the average school district achievement levels for a specific race. All estimates include the full panel of covariates, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in parenthesis. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 19:** Effects of IL program availability on average school district achievement by race: Fourth Grade Sample

| | All Enrolled Students (1) | Non-Hispanic White Students (2) | Non-Hispanic Black Students (3) | Hispanic Students (4) |
|---|---|---|---|---|
| **Panel A: ELA Exams** | | | | |
| Years of IL Access | 0.00169 | 0.00141 | -0.00360 | -0.00613 |
| | (0.00366) | (0.00375) | (0.00840) | (0.00769) |
| Years of IL Access Squared | 0.0000220 | 0.000431 | 0.000749 | 0.000836 |
| | (0.000517) | (0.000537) | (0.00116) | (0.00119) |
| Average Years of Access† | 3.760 | 3.748 | 3.813 | 3.883 |
| Marginal Effects at the Mean | 0.001855 | 0.0046441** | 0.0021111 | 0.0003679 |
| | (0.0017597) | (0.0018365) | (0.0038567) | (0.0046196) |
| Observations | 65225 | 57908 | 14717 | 19152 |
| **Panel B: Math Exams** | | | | |
| Years of IL Access | 0.00706 | 0.00797* | 0.0176* | 0.000905 |
| | (0.00441) | (0.00454) | (0.00956) | (0.00939) |
| Years of IL Access Squared | -0.000311 | -0.000304 | -0.00129 | 0.000918 |
| | (0.000647) | (0.000667) | (0.00136) | (0.00143) |
| Average Years of Access | 3.774 | 3.762 | 3.829 | 3.898 |
| Marginal Effects at the Mean | 0.0047112** | 0.0056883** | 0.0077154* | 0.0080615 |
| | (0.002295) | (0.0024024) | (0.0046052) | (0.0057039) |
| Observations | 64829 | 57655 | 14737 | 19419 |
| District & Cohort FE | X | X | X | X |
| 2000 Census Time Trends | X | X | X | X |

†The average years of access used here is conditional on having access to Imagination Library
All results in this table regress an Imagination Library access parameter and its squared value on the average school district achievement levels for a specific race. All estimates include the full panel of covariates, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in parenthesis. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 20:** Effects of IL program availability on students of low-socioeconomic status (SES): third grade sample

| | All Enrolled Students (1) | Low-SES Students (2) |
|---|---|---|
| **Panel A: English Language Arts** | | |
| IL Access Indicator | -0.0104** | -0.00607 |
| | (0.00500) | (0.00572) |
| Population Weighted IL Indicator | -0.00874* | -0.00623 |
| | (0.00505) | (0.00584) |
| Observations | 74590 | 58245 |
| **Panel B: Mathematics** | | |
| IL Access Indicator | -0.00917 | -0.00167 |
| | (0.00625) | (0.00683) |
| Population Weighted IL Indicator | -0.00355 | -0.000720 |
| | (0.00634) | (0.00694) |
| Observations | 74269 | 58164 |
| District & Cohort FE | X | X |
| 2000 Census Time Trends | X | X |

Results in this table are estimates from the standard DD model with and without district level time trends. Results from columns 1 and 2 are estimates based on the full sample of students while results from the latter two columns are based only on exam scores of low-socioeconomic status school districts, as defined by SEDA (Reardon et al., 2019). Estimates in the even numbered columns include a district level time trend of pre-treatment Census controls. Robust standard errors are clustered at the school district level and presented in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 21:** Effects of IL program availability on students of low socioeconomic status (SES): Fourth Grade Sample

| | All Enrolled Students (1) | Low-SES Students (2) |
|---|---|---|
| **Panel A: English Language Arts** | | |
| IL Access Indicator | -0.00612 | -0.00157 |
| | (0.00543) | (0.00645) |
| Population Weighted IL Indicator | -0.00185 | 0.00434 |
| | (0.00556) | (0.00643) |
| Observations | 65225 | 51088 |
| **Panel B: Mathematics** | | |
| IL Access Indicator | 0.00821 | 0.0170** |
| | (0.00656) | (0.00724) |
| Population Weighted IL Indicator | 0.0102 | 0.0172** |
| | (0.00673) | (0.00731) |
| Observations | 64829 | 51082 |
| District & Cohort FE | X | X |
| 2000 Census Time Trends | X | X |

Results in this table are estimates from the standard DD model with and without district level time trends. Results from columns 1 and 2 are estimates based on the full sample of students while results from the latter two columns are based only on exam scores of low-socioeconomic status school districts, as defined by SEDA (Reardon et al., 2019). Estimates in the even numbered columns include a district level time trend of pre-treatment Census controls. Robust standard errors are clustered at the school district level and presented in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 22:** Effects of IL program availability on students of low socioeconomic status (SES): Third Grade Sample

| | All Enrolled Students (1) | Low-SES Students (2) |
|---|---|---|
| **Panel A: English Language Arts** | | |
| Years of IL Access | -0.0040134 | -0.0012486 |
| | (.0032598) | (.0037053) |
| Years of IL Access Squared | 0.0008295* | 0.0007101 |
| | (.0004895) | (.0005571) |
| Average Years of Access† | 3.888661 | 3.830633 |
| Marginal Effects at the Mean | 0.0024381 | 0.0041917** |
| | (0.0016936) | (0.0019297) |
| Observations | 74590 | 58245 |
| **Panel B: Mathematics** | | |
| Years of IL Access | 0.0011127 | 0.0040328 |
| | (.0040261) | (.0043504) |
| Years of IL Access Squared | 0.0004781 | 0.0005802 |
| | (.0006098) | (.00067) |
| Average Years of Access† | 3.899121 | 3.847952 |
| | 0.0048413** | 0.0084978*** |
| | (0.0021186) | (0.0023539) |
| Observations | 74269 | 58164 |
| District & Cohort FE | X | X |
| 2000 Census Time Trends | X | X |

Results in this table are estimates from the standard DD model that uses the quadratic Imagination Library access measurement. All estimates include both district and cohort fixed effects and a time trend of pre-treatment Census values. Results from column 1 are estimates based on the full sample of students while results from the latter column is based only on exam scores of low-socioeconomic status school districts, as defined by SEDA (Reardon et al., 2019). Robust standard errors are clustered at the school district level and presented in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 23:** Effects of IL program availability on students of low socioeconomic status (SES): Third Grade Sample

| | All Enrolled Students (1) | Low-SES Students (2) |
|---|---|---|
| **Panel A: English Language Arts** | | |
| Years of IL Access | 0.0016898 | 0.0072906* |
| | (0.0036552) | (0.0041457) |
| Years of IL Access Squared | 0.000022 | -0.0006585 |
| | (0.0005167) | (0.0005903) |
| Average Years of Access† | 3.760367 | 3.698936 |
| Marginal Effects at the Mean | 0.001855 | 0.002419 |
| | (0.0017597) | (0.0019094) |
| Observations | 65225 | 51088 |
| **Panel B: Mathematics** | | |
| Years of IL Access | 0.0070596 | 0.0128212*** |
| | (0.0044089) | (0.0047837) |
| Years of IL Access Squared | -0.0003111 | -0.000827 |
| | (0.0006468) | (0.0007062) |
| Average Years of Access† | 3.774325 | 3.718667 |
| Marginal Effects at the Mean | 0.0047112** | 0.0066704*** |
| | (0.002295) | (0.00245) |
| Observations | 64829 | 51082 |
| District & Cohort FE | X | X |
| 2000 Census Time Trends | X | X |

Results in this table are estimates from the standard DD model that uses the quadratic Imagination Library access measurement. All estimates include both district and cohort fixed effects and a time trend of pre-treatment Census values. Results from column 1 are estimates based on the full sample of students while results from the latter column is based only on exam scores of low-socioeconomic status school districts, as defined by SEDA (Reardon et al., 2019). Robust standard errors are clustered at the school district level and presented in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 24:** Robustness Specifications: Migration

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| IL Access Indicator | -0.00602 | -0.0145* | -0.00680 | -0.0117* |
| | [0.0107] | [0.00787] | [0.00702] | [0.00604] |
| Observations | 13625 | 27098 | 40663 | 54439 |

The estimates are from the basic specification on the third grade ELA sample. Each column represents a subset of the data restricted by the relative amount of migration into the school district. Column 1 is restricted to the lowest 25 percent of migration. Each additional column adds another 25 percent, such that column 4 represents the whole sample. The outcome variable for all estimates is the average achievement score for the entire school district. Standard errors are in brackets and are clustered at the district level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 25:** Robustness Specifications: Public School Enrollment

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| IL Access Indicator | 0.00877 | 0.00172 | -0.00924 | -0.0116* |
| | [0.0115] | [0.00790] | [0.00642] | [0.00604] |
| Observations | 12597 | 26259 | 40272 | 54424 |

The estimates are from the basic specification on the third grade ELA sample. Each column represents a subset of the data restricted by the relative amount of public school enrollment. Column 1 is restricted to the lowest 25 percent of enrollment. Each additional column adds another 25 percent, such that column 4 represents the whole sample. The outcome variable for all estimates is the average achievement score for the entire school district. Standard errors are in brackets and are clustered at the district level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table 26:** Alternative Estimates on 3$^{\text{rd}}$ Grade Achievement

| | Estimate | Standard Error | Observations |
|---|---|---|---|
| $B_{fe}$ | -.009981** | .0049725 | 75378 |
| $DID_M$ | -.009524 | .0058219 | 50266 |
| $DID_M^{p1}$ | .0027008 | .006729 | 38587 |
| $DID_M^{p2}$ | .0070911 | .0064246 | 29856 |
| $DID_M^{p3}$ | -.0026929 | .0075401 | 21662 |

**Figure 1:** Cohorts represented in the IL and SEDA Data

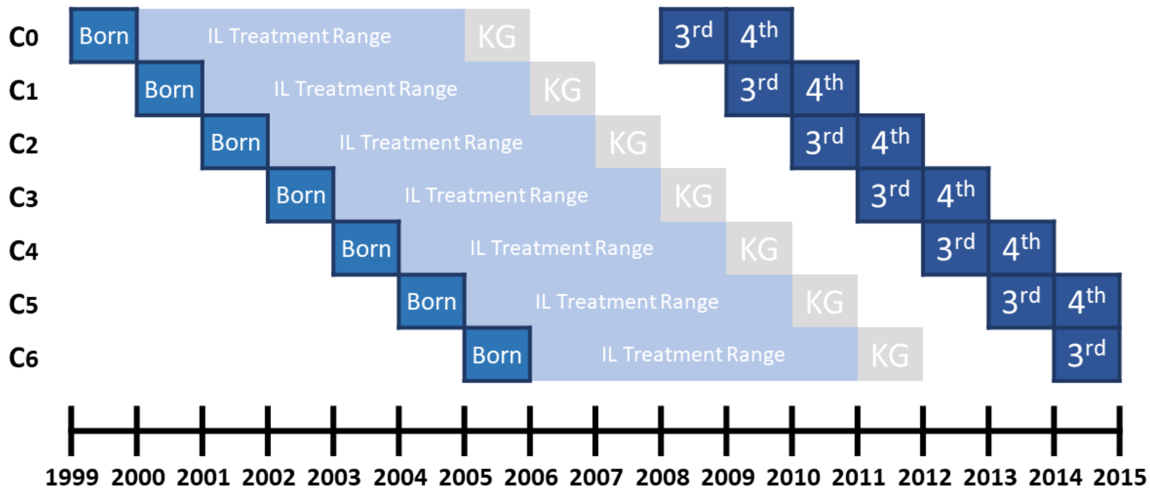
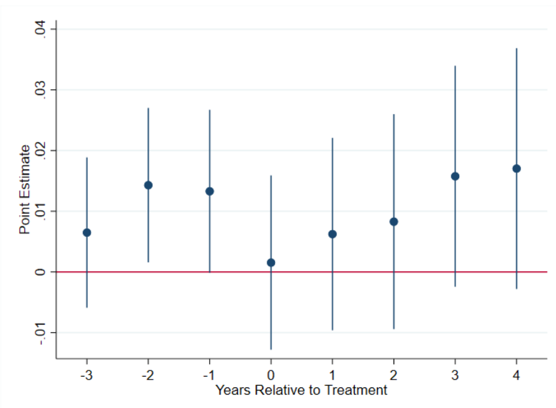
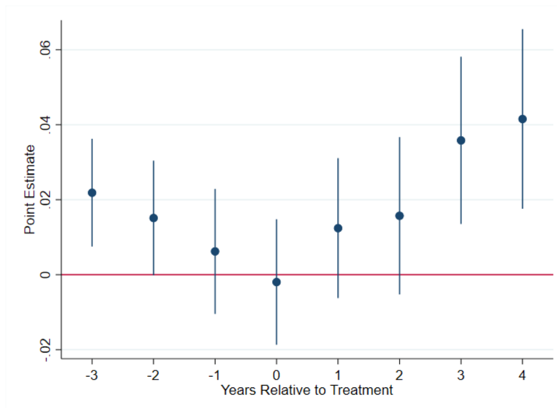


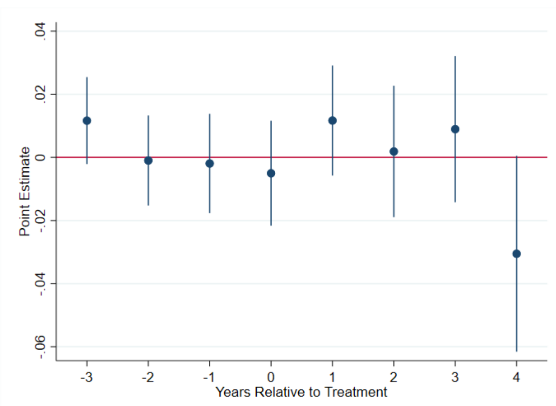
**Figure 2:** Event Study Estimates of the Effects on Average Achievement



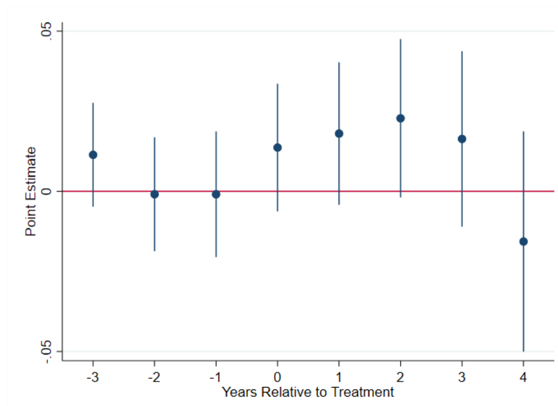

**(a)** Third Grade ELA




**(b)** Third Grade Math

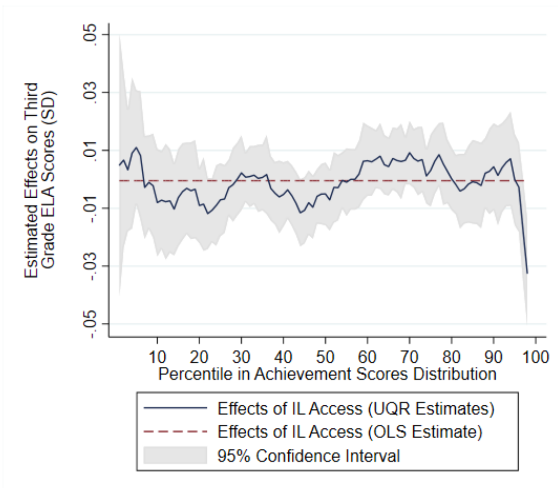



**(c)** Fourth Grade ELA

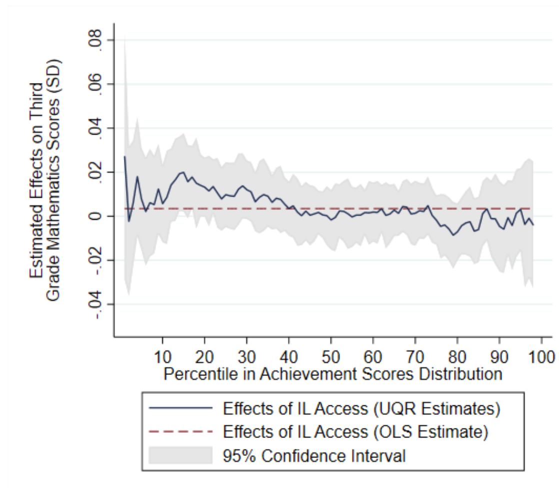



**(d)** Fourth Grade Math

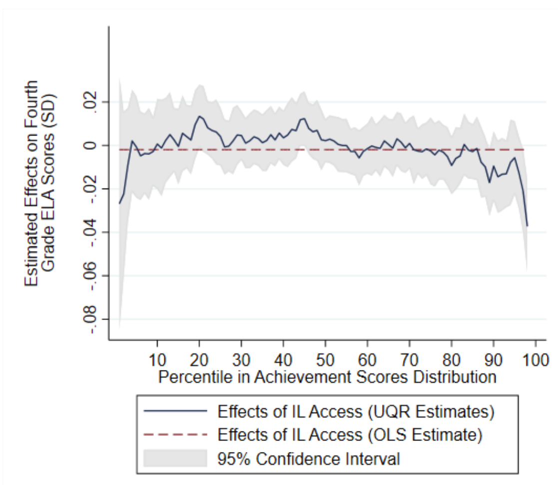
**Figure 3:** Estimated Effects on Percentiles of Average Achievement Distribution



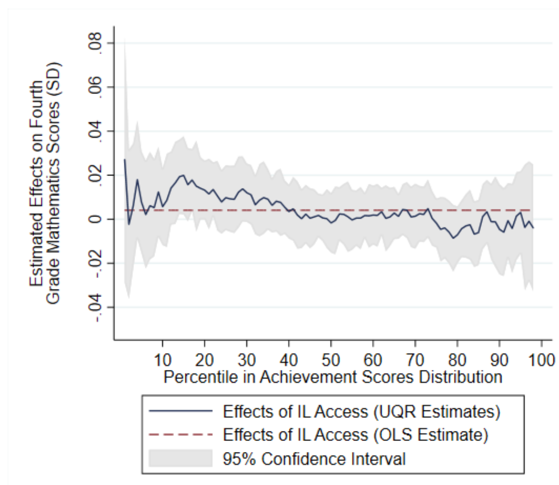

**(a)** Third Grade ELA




**(b)** Third Grade Math




**(c)** Fourth Grade ELA




**(d)** Fourth Grade Math

# Appendices

**Table A.1:** Covariate Balance Test: Fourth Grade

| | (1)<br>Imagination Library Access |
|---|---|
| Number of Students | -3.008* |
| | [1.739] |
| Urban Neighborhood | -0.00516 |
| | [0.00639] |
| Percent Black | -0.000440 |
| | [0.000306] |
| Percent Free/Reduced Price Lunch | 0.000373 |
| | [0.00155] |
| Percent English Language Learners | 0.00120*** |
| | [0.000451] |
| Log Median Income | -0.000917 |
| | [0.00127] |
| Unemployment Rate | 0.0000942 |
| | [0.000154] |
| Observations | 65218 |

Each parameter is from a separate regression of that parameter on an indicator variable that equals one when a school district gains access to Imagination Library. The sample includes all observations from fourth grade exams. Standard errors are in brackets and are clustered at the school district level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Table A.2:** Descriptive Statistics: 2000 Census Values

| | School Districts without Imagination Library | School Districts with Imagination Library | All School Districts |
|---|---|---|---|
| Percent under 5 years old | 0.0715 | 0.0715 | 0.0715 |
| Percent over 65 years old | 0.111 | 0.106 | 0.110 |
| Percent Black | 0.108 | 0.144 | 0.115 |
| Log of Population | 22.64 | 22.83 | 22.67 |
| Log of Median Income | 10.80 | 10.72 | 10.79 |
| Percent living in Urban areas | 0.923 | 0.845 | 0.909 |

**Table A.3:** Effects of IL program availability on average school-district achievement by economic disadvantage status

| | Least Disadvantaged | | | | | | Most Disadvantaged | |
|---|---|---|---|---|---|---|---|---|
| | First Quantile | | Second Quantile | | Third Quantile | | Fourth Quantile | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A: Third Grade ELA Exams** | | | | | | | | |
| IL Access Indicator | -0.00246 | | -0.00558 | | -0.0179** | | -0.0105 | |
| | [0.00999] | | [0.0105] | | [0.00904] | | [0.0114] | |
| Population Weighted IL Indicator | | -.0004893 | | -.001045 | | -.0238171** | | -.0073247 |
| | | [.0103222] | | [.010198] | | [.0092473] | | [.0117647] |
| Observations | 18252 | 18252 | 16379 | 16379 | 17169 | 17169 | 18455 | 18455 |
| **Panel B: Third Grade Math Exams** | | | | | | | | |
| IL Access Indicator | -0.00549 | | -0.000854 | | -0.0160 | | 0.00137 | |
| | [0.0127] | | [0.0123] | | [0.0111] | | [0.0136] | |
| Population Weighted IL Indicator | | .0023168 | | .0052662 | | -.0137696 | | -.0023025 |
| | | [.0133234] | | [.0119863] | | [.0114924] | | [.0131809] |
| Observations | 18187 | 18187 | 16272 | 16272 | 17088 | 17088 | 18367 | 18367 |
| **Panel C: Fourth Grade ELA Exams** | | | | | | | | |
| IL Access Indicator | 0.00745 | | -0.00443 | | -0.00792 | | -0.00240 | |
| | [0.0117] | | [0.0109] | | [0.0104] | | [0.0126] | |
| Population Weighted IL Indicator | | .0023168 | | .0052662 | | -.0137696 | | -.0023025 |
| | | [.0133234] | | [.0119863] | | [.0114924] | | [.0131809] |
| Observations | 15574 | 15574 | 14515 | 14515 | 15191 | 15191 | 15903 | 15903 |
| **Panel D: Fourth Grade Math Exams** | | | | | | | | |
| IL Access Indicator | 0.00591 | | 0.00833 | | 0.0258** | | 0.0136 | |
| | [0.0144] | | [0.0140] | | [0.0118] | | [0.0153] | |
| Population Weighted IL Indicator | | .0113298 | | .0017136 | | .038374*** | | -.0018073 |
| | | [.0153468] | | [.0133326] | | [.0125067] | | [.0153833] |
| Observations | 15498 | 15498 | 14425 | 14425 | 15093 | 15093 | 15767 | 15767 |

Results in this table regress an Imagination Library access parameter on average school district achievement levels. To measure access,the odd columns use an Imagination Library indicator variable and the even columns use the length of time a cohort has access. Each set of two columns represents the effect size for school districts in a specific quantile based on the number of students from low socioeconomic backgrounds. For example, the models in columns (1) and (2) show results from a model run on school districts that are in the lowest quantile of low-socioeconomic students. All estimates include the full panel of results, both district and cohort fixed effects, and a linear time trend of 2000 Census controls. Standard errors are presented in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$