Abstract Title Page
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Title:
Costs and Effects of Dual-Language Immersion in the Portland Public Schools

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Abstract Body

Limit 4 pages single-spaced.

Background / Context:

Description of prior research and its intellectual context.

Though it is estimated that about half of the world's population is bilingual, the estimate for the United States is well below 20% (Grosjean, 2010). Amid growing recognition of the need for second language skills to facilitate international commerce and national security and to enhance learning opportunities for non-native speakers of English, many U.S. public, charter, and private schools have developed dual-language immersion (DLI) programs. The goal of these programs is to help the growing number of language minority students learn English and achieve academically, while giving language majority students the opportunity to develop proficiency in another language.

Study of another language has been viewed by some as an important but not entirely essential ingredient of a world-class education system. However, others point out that dual-language education can be a powerful intervention for closing the achievement gap for English language learners (ELLs) and that it may enhance outcomes for both ELLs and English native speakers (Collier & Thomas, 2004; Thomas & Collier, 2003; Lindholm-Leary & Block, 2010). At the same time, substantial evidence attests to the cognitive benefits of bilingualism (Bialystok et al., 2008; Bialystok & Craik, 2010) and supports the relationship between early learning of another language and success in other academic subjects (Genesee, 2012). Though numerous studies have established a positive relationship between dual-language education and student achievement, as cited above, important questions about the relationship between the two remain. Prior studies, which are largely descriptive, leave open the question of selection bias because we do not know whether the students who gain access to dual language programs have other characteristics that might contribute to the observed outcome of higher academic achievement.

Our study attempts to address this limitation using random assignment to immersion programs. The proposed paper presents data from the second and third years of a three-year study that capitalizes on random-assignment lottery data from the Portland Public Schools in Portland, Oregon. This urban district serves about 47,000 students and is currently the second-largest school district in the Pacific Northwest.

Purpose / Objective / Research Question / Focus of Study:

Description of the focus of the research.

This paper presents evidence from the second and third years of a three-year, lottery-based study of dual-language immersion in Portland Public Schools in Oregon. It updates initial student achievement findings with two additional years of outcome data and also augments these findings with evidence about program costs and administration. The research questions addressed in the paper are as follows:

(1) What is the causal effect of dual-language immersion education on student achievement in mathematics and reading in grades 3 through 8, on student attendance in grades K through 8, and on initial English language learners' exit from ELL status in grades 1 through 8?
(2) Does this effect differ for English language learners versus native speakers of English or by instructional model (90 versus 50 percent of time in the partner language)?
(3) What does it cost to implement dual-language immersion programs relative to non-immersion programs? What are the components of these costs, and do they vary by instructional model?

Setting:

Description of the research location.

The study takes place in the Portland Public School district (PPS) in Portland, Oregon, the largest school district in the Pacific Northwest. PPS serves approximately 47,000 students in grades pre-kindergarten through 12. The district includes 85 regular-education schools, as well as alternative schools, charter schools, and education services provided at other locations for students with special needs. The study focuses in particular on the district's 19 dual-language immersion schools, which include 14 schools with Spanish programs, 3 with Japanese programs, 3 with Russian programs, and 2 with Mandarin programs. (Two schools are home to more than one immersion language.)

Population / Participants / Subjects:

Description of the participants in the study: who, how many, key features, or characteristics.

The study examines seven cohorts of PPS students who entered kindergarten in the academic years 2004–05 through 2010–11. The study includes 3,468 lottery applicants, 1,973 of whom were randomly assigned to a language immersion program (the treatment condition), and 1,495 of whom were assigned to the control condition, defined as business as usual. Economically disadvantaged students make up about 29% of the DLI program population, and minorities about 30%; these groups constitute 45% and 45%, respectively, of the district as a whole. English language learners make up about 14% of DLI participants and 14% of the district as a whole. Students in the analytic dataset are in grades kindergarten through six.

Intervention / Program / Practice:

Description of the intervention, program, or practice, including details of administration and duration.

Dual-language immersion programs are designed to provide both majority and minority language speakers with an academically challenging learning environment. Students enter these programs as early as kindergarten and continue through high school, studying the same academic content as their peers, but in two languages. Such programs aim to help students become bilingual, bi-literate, and academically proficient, with strong cross-cultural communication skills.

In Portland, the Russian program and all but one of the Spanish programs follow a *two-way* model in which up to half of the students speak the partner language—Russian or Spanish—as their first language, and the remaining students speak English as their first language. Students in these programs receive up to 90 percent of their instruction in the partner language. The other PPS language programs (Japanese, Mandarin, and one Spanish program), offer a *one-way* immersion model. They serve mostly native speakers of English and deliver about half of instruction in the partner language and half in English.

Research Design:

Description of the research design.

In an effort to obtain an unbiased estimate of the effect of immersion on student outcomes, the research design capitalizes on the district's randomized lottery mechanism for assigning DLI program slots. By comparing the outcomes of students who won the kindergarten DLI lottery to students in the same lottery stratum who lost the lottery and hence were not admitted to a DLI program in kindergarten, we can estimate the causal effect of DLI programs on student outcomes.

Data Collection and Analysis:

Description of the methods for collecting and analyzing data.

We estimate the effect of immersion on student outcomes through several model specifications. Our naïve specification is an ordinary least squares regression analysis that includes all preK and kindergarten students in the seven targeted cohorts, regardless of whether they applied to an immersion lottery. However, our causal dentification strategy capitalizes on the aforementioned randomization, in an effort to ensure that *within* any given lottery subgroup or stratum, the unobserved characteristics of winners and losers will be identical in expectation. We estimate the effects of assignment to DLI using a model that accounts for this within-block randomization using fixed effects for each subgroup lottery in each immersion program and each cohort. The model is specified as follows:

$$y_{ij}^{G} = a_1 + \beta_1 z_{ij} + \boldsymbol{\delta_1 X_{ij}} + \boldsymbol{\gamma_1 L_j} + \varepsilon_{1ij} \text{ , G=K, 1, 2, 4, 5, 6, 7} \quad (1)$$

where the dependent variable, y_{ij}^{G}, represents the outcome of interest at grade G for student *i* in lottery *j*. In other words, we are tracking the outcomes of student *i* longitudinally across grades kindergarten through 7 (noting that attendance is observed all years, ELL status as an outcome is observed in grades 1 through 7, and standardized test scores are observed in grades 3 through 7). Each lottery in *j* refers to a particular school, cohort, and randomization subgroup (e.g., within or out of neighborhood, native speaker of partner language, etc.). Treatment variable z_{ij} is a dichotomous indicator of random assignment to the treatment in the lottery for student *i* in lottery *j*; $\mathbf{L_j}$ is a vector of dichotomous school × randomization subgroup × cohort lottery indicators, and $\boldsymbol{\gamma_1}$ is a corresponding vector of lottery fixed effects; $\mathbf{X_i}$ is a vector of student demographic characteristics, and $\boldsymbol{\delta_1}$ is a corresponding parameter vector; α_1 is an intercept term, and ε_{1ij} is a normally distributed, mean-zero error term with standard deviation σ_1. The parameter of interest is β_1, which represents the precision-weighted causal effect of z_{ij} on the dependent variable, y_{ij}^{G}.

Because attrition from the sample is observed to be higher among those not offered an immersion slot (see Figure 1), we also examine sensitivity of the intent-to-treat analysis to the inclusion of propensity score weights estimated separately for each grade level. To obtain an estimate of the average treatment effect (ATE), we construct a weighting variable for the full analytic sample, where the individual-level weight, $w_{i,ATE}$, is calculated as follows (Austin, 2011):

$$w_{i,ATE} = \frac{z_i}{\hat{z}_i} + \frac{1 - z_i}{1 - \hat{z}_i} \quad (2)$$

In equation 2, z_{is} is the observed treatment status (1 or 0) for student *i*. Variable $\hat{z}_{is}$ is the student's estimated propensity score, which is the estimated probability of enrolling in an immersion program in each grade beyond kindergarten, as a function of baseline characteristics including race/ethnicity, gender, free/reduced-price meal eligibility, English language learner status in kindergarten, special education status in kindergarten, and lottery stratum.

Instrumental Variables Analysis

Insofar as lottery winners and those not placed fail to comply with their assigned status, the intent-to- treat estimate may understate the true effect of DLI participation on students' performance. To estimate the effect of DLI enrollment in kindergarten on those who complied with their initial lottery-assignment status (also known as the Local Average Treatment Effect, or LATE), we use lottery assignment status (as a function of the student's lottery number and

number of slots in his/her stratum) as an instrument for actual DLI enrollment in kindergarten, specifying a two-stage least squares regression model.

Cost Analysis

To understand costs of the immersion program, we conducted interviews with 9 central office personnel and 14 of 19 immersion school principals, inquiring in detail about the allocation of staff members' time to particular tasks and the proportion of that time allocated to immersion-specific tasks during the 2012-13 academic year. We also asked about teacher workload and expectations, parent volunteerism, fieldtrips, classroom technology, and external funding sources, including how each of these inputs differed between immersion and non-immersion programs in the schools. We then calculated immersion effort ratios by dividing the fraction of immersion-specific time for each task and/or school by the fraction of immersion students in the school. These relative input ratios are then attached to dollar estimates based on the interviews and on publicly available budget data from the district.

Findings / Results:

Description of the main findings with specific details.

Simply comparing immersion and non-immersion students in the district and adjusting for baseline demographic characteristics, we find that immersion students substantially outperform non-immersion students on all outcomes. However, these estimates may be driven in part by the motivation levels and characteristics of families who choose immersion. For this reason, we turn to data from the pre-K and kindergarten immersion lotteries, in which students are randomized to immersion or non-immersion conditions.

In some model specifications, we find positive and significant or marginally significant effects of immersion on reading scores in grades 4-5 and non-significant effects in other years. However, immersion effects in mathematics, attendance, and ELL status appear not statistically distinguishable from 0. Using propensity scores to statistically adjust for differences in district enrollment rates between lottery winners and those not placed in immersion does not markedly change the estimates.

In terms of costs, the proportion of time that principals reported devoting specifically to their DLI programs was almost exactly proportional to the proportion of DLI students in their schools. The share of effort devoted to immersion programs was also relatively similar across schools, regardless of school level (elementary, middle, high) and instructional models.

Conclusions:

Description of conclusions, recommendations, and limitations based on findings.

Findings to date suggest that immersion may improve student achievement in reading (in English) without diminishing other performance and while still promoting bilingualism, but estimates are somewhat sensitive to model specification. Moreover, it appears that the costs of these programs in terms of principals' time are not greatly out of sync with traditional instruction. The paper will briefly touch on logistical issues that other districts wishing to replicate the model might also consider.

Appendices

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Appendix A. References

References are to be in APA version 6 format.

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Appendix B. Tables and Figures

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Figure 1. CONSORT Sample Attrition Diagram