



Benefit-Cost Analysis of Pre-K 4 SA

Technical Report

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Abstract

This report provides results from the evaluation of the costs, benefits, and returns on investment associated with the Pre-K 4 SA initiative in San Antonio. Recent evaluations have shown that children who received Pre-K 4 SA's full-day, yearlong pre-kindergarten education exhibited improved attendance, reduced grade repetition, lower special or remedial education placement, and higher test scores relative to demographically similar students who have not attended Pre-K 4 SA (Decker-Woodrow et al., 2018, 2019; Villarreal, 2019).

This study weighs these promising results against the program's costs using a benefit-cost framework and examines whether, and to what extent, the program's benefits to society outweigh its costs. This study follows the ingredients method (Levin, 1975, 1983; Levin & McEwan, 2000; Levin et al., 2018) in estimating both the costs and benefits of Pre-K 4 SA. The costs this study evaluates include the value of all resources, or "ingredients," required to generate the program impact and are broader than budgets and expenditures alone. Benefits are calculated based on program effects on

attendance, grade repetition, special or remedial education placement, test scores, and family income (Decker-Woodrow et al., 2019; Villarreal, 2019). Cost-analysis results indicate an average per-child total cost of \$12,760 to provide a full-day, one-year pre-kindergarten education at Pre-K 4 SA education centers. With the assumption the cost of existing San Antonio pre-kindergarten and early childhood programs comparison students attended is about half of Pre-K 4 SA's per-student cost at approximately \$6,800, the results of a benefit-cost analysis suggest Pre-K 4 SA generates societal benefits that exceed the costs. Compared to the monetized benefits of approximately \$10,590, the return to San Antonio is approximately \$3,790 per child; \$7.36 million when aggregated across the total number of children who attended during the 2018-2019 school year. Results are discussed in relation to the method used, the investment made by the citizens of San Antonio, and how these findings contribute to the literature on pre-kindergarten programs.



Introduction

Early childhood education continues to garner attention from researchers, policy makers, parents, and communities. As of this writing, 44 states provide pre-kindergarten programs to a total of more than 1.3 million 4-year-old children annually (Friedman-Krauss et al., 2019). Unlike in the recent past, for many children pre-kindergarten now represents the beginning of their formal education experience. Despite the growth in such early educational opportunities, research suggests half of children from low-income families are not ready for the first day of kindergarten (Isaacs, 2012).

Recent findings on early childhood educational programs are mixed. Previous research has suggested such programs are one of the most effective ways to improve school readiness and longer term outcomes for children (Campbell et al., 2014; Dynarski, Hyman, & Schanzenbach, 2013). For example, a meta-analysis of more than 20 experimental and quasi-experimental studies found significant increases in high school graduation as well as significant reductions in

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special education placement and grade retention for children who participated in early childhood education (McCoy et al., 2017). Other large-scale evaluations have suggested pre-kindergarten has only small effects that may fade over time and be undetectable by third grade (Camilli, Vargas, Ryan, & Barnett, 2010; Lipsey, Farran, & Durkin, 2018; Puma et al., 2012). For example, Lipsey et al. (2018) found that the short-term benefits of Tennessee’s Voluntary Pre-K program had faded by the end of first grade. Bloom and

Weiland (2015) reported widely varying impacts across federal Head Start grantees, with many showing no impact and some showing large effects. In an analysis of the Early Childhood Longitudinal Study data, Magnuson, Ruhm, and Waldfogel (2007) reported a fading out of effects for academic outcomes by the end of first grade.



The mixed findings that exist in the literature may be a result of the multiple hurdles children face, which may preclude them from realizing the full benefits of early childhood education. First, existing levels of federal, state, and local resources are insufficient to reach all children who would qualify for publicly funded programs (Karoly, 2012). Second, participation in early learning programs continues to be divided by income. In fact, less than half of preschool-aged children from low-income families, who would potentially benefit from preschool education the most, participate in some kind of center-based education, while the rate is more than 80% among children from higher income families (Barnett & Nores, 2012). Third, early childhood program quality varies substantially by location and program (Burchinal et al., 2010; Hatfield et al., 2016; Zaslow et al., 2010), implying poor quality programs hinder the potential positive benefits of early childhood education.

Interest in applying benefit-cost analyses to early childhood education has increased (Levin et al., 2018, p. 233). The strongest evidence on the benefits of early childhood programs still

comes from studies of two programs that are now several decades old: Perry Preschool and Abecedarian. Both programs have shown large positive impacts on children's cognitive skills throughout school years (Campbell et al., 2002; Schweinhart, Barnes, & Weikart, 1993). Follow-up studies for both projects have continued to show long-lasting impacts on educational attainment, increased earnings, and decreased criminal behavior into adulthood (Campbell et al., 2012; Nores, Belfield, Barnett, & Schweinhart, 2005). The benefit-cost analyses of these programs show large positive returns to society, with benefit-cost ratios of 7.1 for Perry (Heckman et al., 2010) and 2.49 for Abecedarian (Masse & Barnett, 2002; Barnett & Masse, 2007). However, this evidence stems from evaluations of small-scale, highly enriched, decades-old programs that are challenging to replicate and considered costly to scale. Understanding the benefits and costs for more current and potentially scalable efforts allows for more actionable and policy-relevant implications for the field.

The purpose of the present study was to examine the costs and the benefits of a city-funded early childhood education program currently being delivered in San Antonio, Texas: Pre-K 4 SA. Prior research has shown promising effects on participating children's school readiness and the classroom quality of the full-day, pre-kindergarten education program component Pre-K 4 SA provides (Decker-Woodrow, Diaz, Barfield, & Lamey, 2017; Decker-Woodrow & Price, 2016; Decker-Woodrow et al., 2018; Decker-Woodrow et al., 2019; Edvance Research,¹ 2014, 2015).

Also recently released are studies that have examined the impact of prior Pre-K 4 SA participation on various student outcomes during early elementary grades (i.e., kindergarten and grades 1, 2, and 3). Outcomes examined include increased academic achievement (Decker-

Woodrow et al., 2018, 2019; Villarreal, 2019), decreased special education needs (Villarreal, 2019), decreased remedial reading instruction needs (Decker-Woodrow et al., 2019), increased school attendance (Decker-Woodrow et al., 2019; Villarreal, 2019), and decreased disciplinary marks (Villarreal, 2019). Evaluation results are also available on family household income and work outcomes within Pre-K 4 SA, at the end of the pre-kindergarten year (Decker-Woodrow et al., 2019). Several of these evaluation outcomes were analyzed in the current benefit-cost analysis.

Pre-K 4 SA: Description of the Program

The National Institute for Early Education Research recently named San Antonio as a city leader, along with 10 other large cities across the country, in going beyond minimum state requirements/efforts to continue providing early education to young children (Friedman-Krauss et al., 2019). San Antonio has opted to fund the Pre-K 4 SA initiative through a voter-approved 1/8 cent increase in local sales tax rates, which began in 2013. Over the past seven years, Pre-K 4 SA has served many children who are at risk for falling behind their peers and for lacking in kindergarten readiness, with the goal of increasing early childhood education quality and school readiness across the city. In addition to serving children in four geographically dispersed education centers across the city, the Pre-K 4 SA initiative provides professional development for local pre-kindergarten through third grade educators, as well as grants to local districts, parochial schools, and childcare centers.

Components of Pre-K 4 SA

The Pre-K 4 SA initiative is made up of four core components: Educational Centers, Family Engagement, Professional Development, and Competitive Grants.

¹ A wholly owned subsidiary of Westat.

Education Centers

As part of the Pre-K 4 SA initiative, four geographically dispersed education centers actively serve children and are intended to serve as “lab schools” for innovation and high-quality early childhood education. The first two centers were opened in the inaugural year of Pre-K 4 SA (the 2013-2014 school year), with the remaining two centers opening in the second year of the initiative. The initial years of implementation were originally planned as “ramp up” years, and, as of the fourth year of operation, approximately 2,000 children are being served within the centers annually. Eligibility to attend the centers for free mirrors the Texas eligibility requirements for state-funded pre-kindergarten attendance. Additionally, a small percentage of seats are



available for children whose families who do not meet eligibility criteria² but who may attend on a sliding scale tuition basis. The regular program runs from 8 AM to 3 PM from Monday through Friday, and an Extended Day program is available from 3-6 PM for parents/guardians who work or are pursuing educational opportunities, who have additional childcare needs.

Family Engagement

Through parent engagement services, parents/guardians are given access to workshops, classes, adult education, family events, kindergarten transition supports, and a space within each of the four education centers with computer and internet access. Many of these opportunities are offered through the partnership between Pre-K 4 SA and various community partners. Pre-K 4 SA also provides parents with an advisory opportunity on Pre-K 4 SA curriculum and activities; this advisory committee of parents/guardians is referred to as Parents As Partners. Pre-K 4 SA employs a family engagement team of professionals to provide the family engagement supports.

Professional Development

The professional development component is an extended arm of the Pre-K 4 SA initiative that provides professional development opportunities to teachers, coaches, specialists, and administrators publicly across San Antonio.³ Professional development opportunities include workshops, topic-driven events, and group and/or individualized coaching supports. In addition to these professional development services, the Pre-K 4 SA initiative also provides support for individuals to obtain a Child Development Associate certification. Pre-K 4 SA employs more than 15 professional development specialists to provide these supports.

Competitive Grants

To date, two cohorts of district, charter, and early childhood programs across the city have received competitive grant awards from the Pre-K 4 SA initiative. These grant funds are awarded for two main purposes: to increase access to early education and to increase the quality of early education across San Antonio.

² Families who do not reside within partner school district boundaries, but meet state requirements for eligibility, are categorized as scholarship children and the fee to attend is minimal.

³ Professional development to teachers and teaching assistants at education centers is also provided by Pre-K 4 SA as well as delivered by the provider of the HighScore curriculum.

Those entities applying for grants propose how they will use funds to meet either or both of these purposes. Several grant recipients have used Competitive Grant funds to extend state-funded half-day programs into full-day programs (prior to House Bill 3).

With the allocation of sales tax and the potential wide reach of the Pre-K 4 SA initiative, it is important to examine whether the societal benefits appear to be greater than the costs of the initiative. The purpose of this report is to present the results of a cost analysis and a benefit-cost analysis of the initiative.

Research Questions

The following research questions are the focus of this report.

- **What are the total costs** and cost per child of the Pre-K 4 SA initiative?
- **How are the costs distributed** across Pre-K 4 SA's core components? By resource categories?
- **What are the monetary values** of the social benefits produced by Pre-K 4 SA through improvements in achievement, attendance, special education placement, and family household income?
- **Do the benefits of Pre-K 4 SA** exceed the costs associated with those benefits?
- **How much benefit was generated** for each dollar of investment in Pre-K 4 SA?

Research Design

To answer the research questions above, this study analyzed the costs, benefits, and returns on investment of Pre-K 4 SA. First, the study focused on analyzing the costs of Pre-K 4 SA using the “ingredients” method (Levin et al., 2018), which defines “costs” by the concept of opportunity cost. Second, the program's societal benefits

were calculated based on program effects, to date, on attendance, grade repetition, special or remedial education placement, test scores, and family income (Decker-Woodrow et al., 2019; Villarreal, 2019). A benefit-cost analysis was then conducted. Specifically, a net present value (NPV) was obtained to examine whether the benefits of the Pre-K 4 SA initiative exceeded the costs. A benefit-cost ratio was also calculated to estimate the return for each dollar of investment in the Pre-K 4 SA initiative. Finally, the sensitivity of the results was tested to address uncertainties in the parameters (inclusion of attendance benefits). All four program components were analyzed in terms of costs, but the primary focus of benefit estimation was the education and services provided at the four Pre-K 4 SA education centers (i.e., including Education Center and Family Engagement components), since no effectiveness evaluation was available for other components. The benefit-cost analysis consequently also focused on the Pre-K 4 SA education centers. With evaluation outcomes available only for some components of the Pre-K 4 SA initiative, the benefit estimations may be conservative, depending on potential benefits resulting from the Professional Development and Competitive Grant components.

The next section provides more detail on the design and methods used to estimate costs, benefits, and benefit-cost results of the Pre-K 4 SA initiative.

Cost Estimation

Measuring Economic Costs of Educational Interventions

The economic “costs” of educational interventions refers to the value of all resources used to generate program impacts, regardless of who bears the costs, whether services/facilities/supplies are provided in kind or through purchase, or how

⁶ The benefit-cost ratio is calculated by dividing present value benefits by present value costs.

the costs are financed (Levin, 1975, 1983; Levin & McEwan, 2000; Levin et al., 2018). In other words, the costs of pursuing an educational intervention should be understood based on the economic principle of opportunity cost (Levin et al., 2018). This means that all resources should be counted as costs if they contribute to program impact, even if the costs are off-set through in-kind donations, like volunteer time, donated books, contributions from households, or parents' time. When conceptualizing costs this way, expenditure and budget data provide only partial information about resources and are, therefore, limited and not inclusive of the true costs. Throughout this report, costs refer to the value of all resources, regardless of who contributed them, a substantially different concept from spending or financing.

Cost Analysis by the Ingredients Method

The first step in the ingredients method of cost analysis entails the identification of all ingredients—such as personnel, materials and equipment, facilities, and other resources—used to implement the program being analyzed. A review of Pre-K 4 SA's theory of change was conducted based on previous program evaluation reports (Decker-Woodrow, Diaz, Barfield, & Lamey, 2017; Decker-Woodrow & Price, 2016; Decker-Woodrow et al., 2018, 2019; Edvance Research, 2015), as well as the program description available online (City of San Antonio, n.d.). This process resulted in an initial list of ingredients and information necessary to determine the quality and quantity of the identified ingredients.

Next, data collection focused on the cost of the program as implemented, not as designed. A variety of documents were gathered through communications with key program administrators, including employment records,

program schedules, student attendance records, lists of contracted services, and descriptions of program activities. Based on the gathered information, both the quantitative and qualitative characteristics of ingredients were determined. For personnel resources, for example, these documents helped ascertain the specific functions, qualifications, and time commitments of each staff member. Telephone meetings with Pre-K 4 SA administrators in each of the four program components (i.e., Education Centers, Family Engagement, Professional Development, and Competitive Grants) provided additional details.



After ingredients had been identified and detailed, the individual costs of all ingredients were established. An appropriate market, or estimated market equivalent, for each ingredient was assigned and identified using San Antonio prices in 2018 U.S. dollars. The use of the local price was appropriate in the current investigation, as San Antonio aims to raise the quality of pre-kindergarten education across the city, and the cost information for a local, high-quality pre-kindergarten model would be informative in such effort.

⁷ As the main purpose of this analysis and report was to inform local citizens and policy makers, local pricing was used. Additional investigations might use national pricing to inform a broader audience interested in bringing the initiative to scale in other geographic locations.

For personnel ingredients, prices were drawn from the U.S. Department of Labor’s Bureau of Labor Statistics (BLS) Occupational Employment Statistics for the San Antonio-New Braunfels, Texas, area (BLS, 2019a). These included Pre-K 4 SA central office administrators, teachers, directors, and other staff at the education centers; family engagement specialists; professional development coaches; grant administrators; parents; and community partner staff. For fringe benefits, the BLS regional average for all salaried workers was used (BLS, 2019b). For facilities ingredients, national data on median price per square foot for elementary school building construction was drawn from the College Planning and Management (2015), with a 21% uprate for furnishing and adjustment for Texas metropolitan area with the CostOut online tool (CBCSE, 2015). After valuing each ingredient, the quantity and value were multiplied and aggregated to establish the costs for each ingredient. Finally, the costs of Pre-K 4 SA were calculated and analyzed by the four program components and by resource types.

Benefit Estimation

Review of Pre-K 4 SA Evaluation Results

One way to contextualize existing evaluation results on Pre-K 4 SA is to translate the program effects into monetary values, or economic “benefits.” In particular, the present study considers the societal benefits of Pre-K 4 SA, which refers to the sum of all measured economic benefits generated by the Pre-K 4 SA initiative for the society, regardless of who (i.e., individuals who participated in the program, government, or the general public) receives the

benefit. To capture such societal benefits of Pre-K 4 SA, a range of existing program effects were considered for monetization.

To identify the benefits of Pre-K 4 SA, existing evaluation results were obtained and examined. Two sources of evaluation results were identified: The Urban Education Institute at the University of Texas at San Antonio’s report on outcomes from the elementary grades (Villarreal, 2019) and Westat’s annual independent evaluation reports (Decker-Woodrow, Diaz, Barfield, & Lamey, 2017; Decker-Woodrow & Price, 2016; Decker-Woodrow et al., 2018, 2019; Edvance Research, 2015). These existing evaluations all focused on the effects of education and services provided at the four

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Pre-K 4 SA education centers; no effectiveness evaluation was available for the Professional Development or Competitive Grant support that Pre-K 4 SA provides city-wide. Benefit estimation consequently focused primarily on benefits generated by Pre-K 4 SA education centers and may be considered conservative, as potential benefits for all components could not be included.

To estimate the effect of full-day, one-year participation at a Pre-K 4 SA education center on various outcomes during the early elementary grades, Villarreal (2019) compared the first cohort of Pre-K 4 SA children, who attended the initial two education centers during the 2013-2014

⁹ It is important to note that more than 700 children attended the Pre-K 4 SA education centers during the 2013-2014 school year; however, slightly more than 400 children were available for the Villarreal (2019) analyses according to the author of that report.

¹⁰The propensity score model that includes only demographics and socioeconomic variables is limited in its capacity to mitigate the confounding effect of unobservable child and family characteristics that may bias the results. Participation in Pre-K 4 SA involved an open application process, and therefore families who applied are likely to be systematically different from families who did not apply, even after the data have been re-weighted by propensity scores. Therefore, some caution is warranted.

¹¹The same cautions from the Villarreal (2019) comparison group also apply here.

school year (N=433), with socioeconomically similar Bexar County children of the same age cohort who did not attend one of the Pre-K 4 SA education centers (N= 11,473). Using propensity-score weighted regression analyses, the outcomes presented in that report include grade 3 mathematics and reading test scores (grade 3), as well as grades K-3 attendance, special education placement, grade repetition, and disciplinary incident records. Results and effect sizes are summarized in Table 1.

Table 1. Summary of Villarreal’s (2019) Results

Outcome	Coeff	SE	Obs
Grade 3 STAAR mathematics	0.095	0.039	11,688
Grade 3 STAAR reading	0.112	0.042	11,689
Grades K-3 attendance (# of days present)	13.371	1.384	11,906
Grades K-3 special education placement	-0.033	0.015	11,906
Grade K-3 grade repetition	-0.004	0.002	11,906
Grade K-3 disciplinary incident record	0.022	0.015	11,906

Note: Coeff = coefficient; SE = standard error; obs = observations or sample size

Decker-Woodrow et al. (2019) used propensity-score matching to explore the relationship between Pre-K 4 SA participation within the education centers during the first three program years (2013-2014, 2014-2015, 2015-2016 school years) and included various student outcomes during the early elementary grades, such as kindergarten readiness (at the beginning of kindergarten), school attendance (at grades K-2), and remedial reading instruction needs (at grades K-2). The analytic sample for the first cohort of children included 797 treatment children and 2,246 matched comparison children; the second cohort included 967 treatment children and 2,698 comparison children; and the third cohort included 1,330 treatment children and 1,187 comparison children. All comparison samples were drawn from a larger pool of children who had not participated in Pre-K 4 SA but were enrolled in public elementary schools in San Antonio and were from the same age cohort. Additionally, Decker-Woodrow et al. (2019) compared parents whose children participated in the extended day program with parents whose children did not attend the extended day program within Pre-K 4 SA. They found that parents who used extended day services had statistically and significantly greater working hours and weekly income. The key results are summarized in Table 2.

Table 2. Summary of Decker-Woodrow et al.’s (2019) results

Outcome	Effect	SE	Obs
Grade 3 attendance (rate)	0.5-0.7 percentage points	–	10,088
Grade K eligible for remedial reading instruction	-1.40 ¹	–	2,517
Grade 1 eligible for remedial reading instruction	-1.18 ²	–	3,665
Grade 2 eligible for remedial reading instruction	No sig	–	3,043
Kindergarten readiness (at the beginning of K)	-0.83-3.76 ³	–	–
Difference in weekly income, extended day parents	approx. \$240	–	336

Notes: SE = standard error; obs = observations or sample size.

¹Odds ratio, 40% less likely to be remedial instruction eligible; difficult to monetize because units are not in percentage point difference.

²Odds ratio, 18% less likely to be remedial instruction eligible; difficult to monetize because units not are not in percentage point difference.

³Points; Difficult to monetize because of the unit by which the effect was measured. There are multiple sample sizes because districts across the State of Texas use multiple assessments and comparison samples, and analyses were completed for each assessment separately.

Specification of benefits and valuation

The following effectiveness evaluation outcomes were identified as “able to be monetized” and were matched to appropriate values, either by finding a competitive market price or equivalent or by utilizing a shadow pricing technique based on existing research, as described below.

Improved mathematics test scores¹² at grade 3 (Villarreal, 2019) can be monetized through their projected association with educational attainment: more education (1) benefits individuals in the form of higher earnings and better health and (2) benefits the society through higher tax payment, lower crime rate, reduced welfare dependency, and less use of the health system. Using the program effect on mathematics test gains, the benefits of educational attainment have been projected, which is a method called benefit transfer. There is an extensive literature on the value of educational attainment/achievement, as well as consensus on its value (e.g., Belfield & Levin, 2007a, 2007b, 2009). In particular, the total lifetime value of societal benefit¹³ per child that is generated by 1 standard deviation increase in mathematics test scores is used (Belfield & Levin, 2009, Table 5). In the current study, the following three adjustments have been made to this methodology: (1) discounting the value to age 4 (grade 8 in Belfield & Levin), (2) inflation adjustment of the price, and (3) expressing the price in 2018 dollars (originally 2006 dollars).

The value of reduced grade repetition during grades K-3 (Villarreal, 2019) is estimated by the savings created in the public education system. Grade repetition implies the school system must finance an additional year of education for each grade repeater. Preventing or reducing grade repetition in this context represents savings to

the education system. This analysis used the Texas Education Agency's (2019) latest (i.e., 2017-2018 school year) average per pupil expenditure, with an adjustment for inflation when converted to 2018 dollars.

The value of reduced special education placement during grades K-3 (Villarreal, 2019) was similarly estimated from the savings to the education system created by reduced needs to provide special education programs/services. The average per-pupil expenditure for special education students in Texas was not readily available, and therefore the benefit estimation used the average per-pupil expenditure figure in Texas (Texas Education Agency, 2019), with an assumption that an additional special education student would incur an additional 40% of per-pupil expenditure.

Increased student attendance during grades K-3 (Villarreal, 2019) was valued through shadow pricing, in other words, by answering the question of how much the society is willing to pay for a day of school attendance. For this analysis, Texas state aid for K-12 student attendance was used as a proxy of the society's willingness to pay. Note that the concept of benefit (or cost) is different from expenditures, and therefore school districts' increased revenue through increased student attendance should not be confused with benefits.

Finally, increased family weekly income was translated into increased family earnings during the program year. Table 3 lists the effects of Pre-K 4 SA that were valued in monetary terms and included in the current analysis.

¹² Although results were also reported for reading test scores, potential benefits were not monetized because they had already been accounted for from the improved mathematics scores. Including both reading and mathematics in the benefit estimations would result in the double counting of benefits.

¹³ This includes fiscal savings from the reduced welfare, criminal, and health systems use and increased tax revenues.

Table 3. List of outcomes to be monetized

Whose outcome	Effect	Benefits	Benefits from perspective of
Child	Improved mathematics test score at grade 3 ¹	Private (earnings) and social benefits of improved math skills	Participants and general public
Child	Reduced grade repetition during grades K-3 ²	Savings on spending related to grade repeaters	Government
Child	Reduced special education placement during grades K-3 ³	Savings on special education spending	Government
Child	Increased student attendance during grades K-3 ⁴	Society's willingness to pay for attendance, as proxied by Texas state aid for student attendance	General public
Parent	Increased weekly income among extended day parents/guardians ⁵	Increased family earnings (regional mean wage, BLS, 2018)	Participants (only extended day)

^{1,2,3,4} Villarreal (2019);⁵ Decker-Woodrow et al. (2019).

Benefit-Cost Analysis

Components of focus

Costs and benefits analyzed in the benefit-cost analysis focus only on the costs of services provided at the Pre-K 4 SA education centers. This is because the program effectiveness estimates (i.e., Villarreal, 2019; Decker-Woodrow et al., 2019) from which the selected program benefits were calculated, and to which the cost estimates were matched, were only available for the services provided at the Pre-K 4 SA Education Centers. Evaluation results are not currently available for the Professional Development and Competitive Grant components. Therefore, the cost analysis included all four program components, while costs estimates used for the benefit-cost analysis were only for the Education Center and Family Engagement components.

Total cost vs. incremental cost

Note that the focus of the cost analysis was to estimate the total cost per student of Pre-K 4 SA. This means the total cost estimate reflects the value of all resources or “ingredients” required to provide Pre-K 4 SA. Total costs are reported as

a result as they are informative in documenting all resources required for replicating the intervention and studying the complete cost structure of the Pre-K 4 SA initiative. However, for the benefit-cost analysis, an incremental costs estimate was used because total costs would be an overestimation of the costs required to generate the benefits. The correct representation of the costs utilized to generate the program effectiveness estimates, from which the benefits were calculated, would be a contrast between all costs associated with the intervention condition (total cost) and costs associated



with the “business-as-usual” condition. This is because evaluation outcomes were obtained by the contrast between gains among treatment groups and gains among business-as-usual groups. To ensure the cost estimates plausibly reflect this contrast, benefit-cost analysis uses incremental cost, which is, by definition, obtained by the total cost minus business-as-usual costs. Figure 1 presents this concept graphically.

Figure 1. Total cost vs. incremental cost



Fully estimating the business-as-usual costs of Pre-K 4 SA would entail another full cost study investigating the total cost of a representative sample of public and private pre-kindergarten programs as well as various childcare options in San Antonio, which is not the focus of (nor feasible within) the current study. Instead, this study used three hypothetical scenarios for business-as-usual costs to obtain incremental costs. These scenarios assume the business-as-usual cost represents 75%, 50%, or 25% of the total cost of Pre-K 4 SA, which makes the incremental costs (i.e., difference between total and business-as-usual) 25%, 50%, or 75% of the total cost, respectively. All three scenarios assumed Pre-K 4 SA education centers’ total

costs would be greater than the business-as-usual early childhood programs. These different scenarios create a possible range for the incremental costs of Pre-K 4 SA.

Benefit-cost results

The first benefit-cost result that was obtained was net present value (NPV). Simply, NPV shows whether the benefits generated by the program exceed its costs. More formally, NPV is defined as the discounted value of the benefits minus the discounted value of the costs (Levin et al., 2018, p. 223). Projects with present value (PV) benefits exceeding their PV costs can be justified for investment, and higher NPV is generally preferred. The NPVs larger than 0 can serve as an economic rationale for accepting the investment because it implies the gains are higher than the costs. The NPV of a program can be calculated by subtracting the PV costs from the PV benefits:

$$NPV = B_{PV} - C_{PV}$$

Another main result to be obtained is the Benefit-cost (BC) ratio. Simply put, the BC ratio indicates the size of benefits relative to the size of cost. The easiest interpretation of this ratio would be how much PV benefit is generated by 1 PV dollar of investment. The BC ratios greater than 1 indicate that the benefits are higher than the costs. The BC ratio can be obtained by simply dividing the PV benefits by PV costs (Levin et al., 2018, p. 224):

$$BCR = \frac{B_{PV}}{C_{PV}}$$

⁹ It is important to note that more than 700 children attended the Pre-K 4 SA education centers during the 2013-2014 school year; however, slightly more than 400 children were available for the Villarreal (2019) analyses according to the author of that report.

¹⁰The propensity score model that includes only demographics and socioeconomic variables is limited in its capacity to mitigate the confounding effect of unobservable child and family characteristics that may bias the results. Participation in Pre-K 4 SA involved an open application process, and therefore families who applied are likely to be systematically different from families who did not apply, even after the data have been re-weighted by propensity scores. Therefore, some caution is warranted.

¹¹The same cautions from the Villarreal (2019) comparison group also apply here.

Sensitivity Analysis

The final step of the benefit-cost analysis entailed testing the sensitivity of the results to address uncertainties in various parameters used to specify costs and benefits. The main sensitivity analysis conducted was on the specification of benefits. The main specification included both the benefits from increased mathematics test scores and increased school attendance; however, the effect test scores might be mediated through better attendance and, if so, the same benefits would be double-counted. Therefore, the results were calculated and are reported with and without benefits from increased school attendance.

Results

Results are presented for the costs, benefits, and benefit-cost analysis.

Cost Analysis

Two research questions were posed and investigated within the cost analysis: (1) What are the total costs and cost per child of the Pre-K 4 SA initiative? and (2) How are the costs distributed across Pre-K 4 SA's core components and by resource categories?

Total costs and cost per child of the Pre-K 4 SA initiative

Table 4 reports the total costs of the Pre-K 4 SA initiative in aggregate and in average cost per-child terms. These figures, as well as all other reported values, are expressed in present values using 2018 U.S. dollars and rounded to the nearest \$10 in order to avoid false precision. The total cost of providing the Pre-K 4 SA initiative for one year, including all four components (Education Centers, Family Engagement, Professional Development, and Competitive Grants), which encompassed an estimated 21,872 children, is \$33,454,290. Simply dividing the total cost by the total number of children served

across all components provides an average cost per child of \$1,530. However, the implication of this figure is difficult to interpret since different Pre-K 4 SA components were provided to different groups of children. An analysis by component is more informative and therefore is presented in the following paragraphs.

Table 4. Total cost of Pre-K 4 SA, in aggregate and average per-child terms

Total Cost	Value
Aggregate (all components, all resource types)	\$33,454,290
Per child (unweighted average)	\$1,530

Note: Present value cost in 2018 dollars, rounded to the nearest \$10. The total number of all children reached by the four components during the 2018-2019 school year was 21,872.

Distribution of costs by the four components of the Pre-K 4 SA initiative

When costs were attributed to, or weighted by, the four core components of the Pre-K 4 SA initiative, costs per child varied across components. (Table 5 shows the variation in average cost per child by program component.) Cost per child of the Education Center component is the largest at \$12,760, while costs per child of the Professional Development component, Family Engagement, and Competitive Grants were much smaller, at \$140, \$830, and \$1,540, respectively; the differences in per-child costs are due, in part, to the number of children reached by each component. This variation is not surprising because the Education Center costs represent the cost of running a high-quality pre-kindergarten education program while other components are add-on services and supports provided to other early childhood and elementary programs. For instance, various professional development supports and events the Professional Development component provides to the partnering local school districts are in addition to the regular operation of pre-kindergarten

and elementary programs in these districts. Moreover, the differences in the number of children served also derive variation in per student cost. For example, the per student costs of the Professional Development and Competitive Grants components are smaller than the Education Center costs per student because these two major “external” arms of the Pre-K 4 SA initiative serve much larger numbers of children at district, charter, parochial, pre-kindergarten and early care and education programs across San Antonio. This reach and the add-on nature of costs makes the cost per child for these components considerably smaller.

Table 5. Distribution of total costs by program component, aggregate and per-child terms

Component	Aggregate	Per child	# of Children
Education Center	\$24,793,710	\$12,760	1,943
Family Engagement	\$1,616,100	\$830	–
Professional Development	\$2,367,760	\$140	16,900
Competitive Grant	\$4,676,720	\$1,540	3,029
Total	\$33,454,290	\$15,270	21,872

Note: Present value cost in 2018 dollars, rounded to the nearest \$10. The Education Center and Family Engagement components are represented by the same 1,943 children.

Distribution of costs by ingredient method resource category and program component

Table 6 presents the distribution of costs across resource category (i.e., personnel, materials and equipment, facility, and other) and by each Pre-K 4 SA core component. The largest component of the initiative, in terms of costs, was the Education Centers (74%), followed by the Competitive Grant component (14%). As is often found in educational interventions, the bulk of the costs

to deliver the Pre- K 4 SA initiative were classified under the category of personnel, including instructional staff, special education staff, school administrators, Pre-K 4 SA administrators, professional development coaches, etc. In fact, personnel costs were the largest costs for three of the four components of the initiative (excluding Competitive Grants), representing 76.4%, 80.7%, and 78.6% of per-child cost within Education Centers, Family Engagement, and Professional Development, respectively.

The bulk of the Services sub-category mapped under the Other category consists of training.



Items such as training of education center teachers on the HighScope curriculum, special training sessions for partner school districts under the Professional Development component, and professional development events open to the public all use specific expertise through service contracts and are included in this category. Services delivered through partnership with local community-based organizations and provided for parents/guardians of the education center children are also mapped under Other, Services.

Table 6. Distribution of per-child costs by program component and cost category

Component/Category	Education Centers	Family Engagement	Professional Development	Competitive Grants
Personnel	\$9,750	\$670	\$110	\$220
Materials and equipment	\$270	<\$5	<\$5	–
Facility	\$1,060	\$70	<\$5	<\$5
Other				
Services	\$1,470	\$80	\$30	–
Grants	–	–	–	\$1,320
Fees	\$200	–	<\$5	–
Total	\$12,760	\$830	\$140	\$1,540
Percentage	74%	5%	7%	14%

Note: Present value cost in 2018 dollars, rounded to the nearest \$10.

The total cost per child to provide full-day, one-year pre-kindergarten education at Pre-K 4 SA centers is estimated to be \$13,590 (per-child value of Education Center and Family Engagement components combined). Because other early childhood experiences available in San Antonio are also associated with a cost greater than \$0, later in this section this total cost figure will be adjusted to represent the incremental cost of Pre-K 4 SA.

Benefit Estimation

One research question was posed and investigated for benefit estimation: (1) What are the monetary values of the social benefits produced by Pre-K 4 SA through improvements in achievement, attendance, special education placement, and family household income?

Per-child estimates of monetized social benefits

The following outcomes are attached to an appropriate value identified in the literature.

Improved Mathematics Skills: Assuming that the program’s effect on mathematics score was linear, the average increase in mathematics

test score by 0.095 standard deviation among program participants (Villarreal, 2019) can be translated into the social benefit of **\$1,830 per participant** in 2018 dollars, discounted to age 4 and rounded to the nearest \$10 to avoid false precision.

Reduced Grade Repetition: This analysis assumed that (1) each additional grade repeater in a K-12 public school makes the school system spend an additional \$13,370 and (2) the average reduction in grade repetition for the first four years of elementary school (grades K-3) is 0.4 percentage points, based on Villarreal (2019). The estimated savings in education expenditure is then **\$200 per participant** in 2018 dollars, discounted to age 4 and rounded to the nearest \$10.

Reduced Special Education Placement: This analysis assumed that (1) a special education student would incur an additional 40% of per-pupil expenditure (i.e., \$13,370 in 2018 dollars) and (2) for each student who received Pre-K 4 SA, there was a reduction in the probability of special education placement by, on average, 0.033 during grades K-3, based on Villarreal’s (2019) research. Thus, the estimated value of Pre-K 4 SA’s effect on reduced special education placement is approximately

\$650 per participant in 2018 dollars, discounted to age 4 and rounded to the nearest \$10.

Increased School Attendance: Increased student attendance among former Pre-K 4 SA participants during grades K-3 can be valued through how much Texas values a day of student attendance in the form of state allocation. Note that this value will likely be an underestimation of the full value of attendance;



at the same time, care must be given to avoid the double-counting of similar benefits from mathematics achievement, since attendance may mediate achievement. For this reason, this analysis conservatively accounted for the value of attendance by 50%. It was further assumed that (1) the state provided approximately 50% of per student spending, (2) the average number of days in a school year was 180, and (3) Pre-K 4 SA participants attended an average of 13.37 more school days, as calculated by Villarreal (2019). Under these terms, the program effect on increased student attendance can be valued at **\$230 per participant**.¹⁵

Increased Family Earnings: Based on findings from Decker-Woodrow et al. (2019), parents whose children were enrolled in the Extended Day Program earned, on average, approximately \$240 more per week than parents who did not use Extended Day services (approximately \$1,050 vs. \$810 weekly). Responses to other items on the parent survey showed that Extended Day parents were also significantly more likely to be employed (96% vs. 66%) and to work longer hours (40 hours vs. 36 hours). Average hourly wages for Extended Day and non-Extended Day parents were obtained using this information on average weekly wages and average hours worked; as expected, the average hourly wage was higher for Extended Day parents (approximately \$30 vs. \$20). These findings point to an insight that the higher weekly wages for the Extended Day parents are probably because of the combined effect of longer working hours and higher hourly wage, and it is likely that Extended Day parents are engaged in full-time positions. This analysis was based on (1) the assumption that Extended Day parents had full-time contracts that provided non-salary compensation worth 27.85% of salaries (West South Central average estimates from BLS, 2019), (2) the extrapolation of weekly income into yearly income (i.e., 52 weeks), and (3) the fact that, of the 1,943 families enrolled in Pre-K SA, 945 took advantage of Extended Day services. Benefits from increased family income during the program year were approximately **\$7,690¹⁶ per Pre-K 4 SA participant** in 2018 dollars, discounted to age 4 and rounded to the nearest \$10.

When all monetized evaluation outcome benefits were aggregated, an estimated total societal benefit of the Pre-K 4 SA initiative was estimated at **\$10,590 per participating child**. Without the benefits from the attendance effect, the figure

¹⁵ While a conservative approach was taken to estimate the value of attendance, this report also later provides estimated benefits with and without this value, for those who may be interested in the entire removal of this benefit..

¹⁶ The full estimated result for Extended Day participants is \$15,800 with salary and non-salary compensation considered. However, to appropriately attribute evaluation outcome effects across all education center participants, that value is spread across all 1,943 children, producing a value of \$7,690.

is slightly lower, at \$10,360 per participating child. About 81%, or \$8,530, is short-term benefits (including savings to school systems and increased family income) and about 19%, or \$2,050, is long-term benefits (including long-term social benefits and benefit of attendance)¹⁷. Table 7 summarizes the results presented in this section.

Table 7. Estimated benefits per child

Effects	Estimated benefits (per child)
Improved mathematics test score at grade 3	\$1,830
Reduced grade repetition during grades K-3	\$200
Reduced special education placement during grades K-3	\$650
Increased student attendance during grades K-3	\$230
Increased weekly income among Extended Day parents	\$7,690
Total	\$10,590¹

Note: Present value cost in 2018 dollars, rounded to the nearest \$10.

¹ The total sum may not exactly equal the dollar values across all rows in the table due to rounding.

Benefit-Cost Analysis

Two questions were investigated for the benefit-cost analysis: (1) Do the benefits of Pre-K 4 SA exceed the costs associated with those benefits? and (2) How much benefit was generated for each dollar of investment in Pre-K 4 SA?

Adjusting cost estimates to allow comparison with benefit

To enable an appropriate comparison between costs and benefits, the total cost estimate presented above was converted to incremental cost. Specifically, the incremental cost of the two Pre-K 4 SA components associated with evaluation outcomes (Education Centers and Family Engagement¹⁸) was assumed to be between 75% and 25% of the total cost. With these assumptions, the incremental cost of Pre-K 4 SA was between **\$10,190** and **\$3,400** in 2018 dollars, discounted to age 4 and rounded to the nearest \$10. Incremental cost estimates are presented in Table 8. The rest of the analyses use the intermediate estimate of **\$6,800 per child**, which assumes 50% of the total cost is the incremental cost.

Table 8. Education Center cost, total and incremental

Component	Education Centers	Incremental		
		75% of total	50% of total	25% of total
Education Center	\$12,760	\$9,570	\$6,380	\$3,190
Family Engagement	\$830	\$620	\$420	\$210
Total	\$13,590	\$10,190	\$6,800	\$3,400

Note: Present value cost in 2018 dollars, rounded to the nearest \$10.

¹⁷ Breakdown of benefits does not exactly equal the total benefits due to rounding

¹⁸ To ensure that the analysis included all possible costs associated with identified benefits, the cost of the Family Engagement component was included even though the explicit benefits of this component have not been examined. This is also to prevent potential double-counting of benefits.

Benefit-cost results

To examine whether the identified benefits of Pre-K 4 SA exceeded the associated costs, the net present value (NPV) was estimated, and a benefit-cost ratio was calculated to analyze how much benefit to the society is generated per dollar of investment in Pre-K 4 SA. The NPV of Pre-K 4 SA based on incremental cost and benefit estimates was approximately \$3,790, which means the full-day, one-year Pre-K 4 SA program generated benefits to the society that exceeded costs. Depending on the assumptions about incremental cost, the NPV ranged between \$390 and \$7,190 (see Table 9).

The benefit-cost ratio of Pre-K 4 SA was approximately 1.56, which means that every dollar invested in Pre-K 4 SA generated, on average, \$1.56 of benefits to society. Depending on the assumptions regarding incremental costs, the benefit-cost ratios ranged between 1.04 and 3.12. Excluding benefits from attendance (for the conservative reasons discussed above), the rates were similar and ranged from 1.02 to 3.05.

Table 9. Summary of benefit-cost analysis results

Estimates	Assumptions regarding incremental cost		
	75% of total	50% of total	25% of total
Estimates from main specification			
Net present value	\$390	\$3,790	\$7,190
Benefit-cost ratio	1.04	1.56	3.12
Estimates without attendance			
Net present value	\$160	\$3,560	\$6,960
Benefit-cost ratio	1.02	1.52	3.05

Note: Present value cost in 2018 dollars, rounded to the nearest \$10..

Discussion/Limitations

This study examined the costs, benefits, and returns on investment of the Pre-K 4 SA initiative. The cost analysis focused on the value of all resources associated with providing Pre-K 4 SA during the 2018-2019 school year, including all four core components (Education Centers, Family Engagement, Professional Development, and Competitive Grants).

This study contributes to the literature on pre-kindergarten program evaluations because rigorous cost analyses of pre-kindergarten programs are still rare. Existing evaluations of the Pre-K 4 SA's Education Center component indicated positive gains in language, physical,

and social-emotional development and longer term outcomes for standardized assessments, showing potential for scale-up or replication. This study directly adds to these evaluations by measuring the costs to derive the impacts measured and reported in those evaluations. The total costs of the Pre-K 4 SA initiative, across the four core components, are approximately \$33 million per year; of this cost, more than \$24 million is the total cost (or \$12,760 in per-child terms) for Education Centers, representing the value of resources that generated the documented program impacts.

The cost estimates laid a foundation for the benefit-cost analysis. The benefit-cost analysis included a broad array of program outcomes

with economic value based on existing literature on the economic benefits of early childhood education (e.g., Barnett & Masse, 2007; Currie, 2001; Duncan & Magnuson, 2013; Karoly, 2012, 2016; National Academy of Science & National Research Council, 2014; Temple & Reynolds, 2015). Outcomes included (1) third-grade state test scores of former Pre-K 4 SA center children, (2) their special education placement, (3) their grade retention, (4) their attendance, and (5) work hours and earnings of the families of Education Center children.

The benefit-cost results indicate a societal return from the Pre-K 4 SA initiative of approximately \$3,790 per child. Aggregated by the number of children within the program during the 2018-2019 school year, the return totals approximately \$7.4 million in societal benefit to the city of San Antonio.

It is important to note the findings reported here are likely conservative and on the lower bound due to the limited evaluation results available. The benefit-cost analysis was limited to the benefits and costs of the Pre-K 4 SA Education Centers and Family Engagement components. Additionally, the outcomes explored to date have been focused primarily on academic outcomes. Other potential outcomes that should be investigated include social-emotional and

“The benefit-cost results indicate a societal return from the Pre-K 4 SA initiative of approximately \$3,790 per child...the return totals approximately \$7.4 million in societal benefit to the city of San Antonio.”

physical (health) outcomes as well as longer term academic outcomes. For example, evaluation efforts have not explored potential outcomes associated with the education centers' focused efforts on nutrition and physical health. Also, the larger Pre-K 4 SA initiative includes various

other activities, such as financial and technical assistance provided to existing elementary grades, pre-kindergarten programs, and early care and education centers across San Antonio, through the Professional Development and Competitive Grant components. As no results are yet available for three of the four major program



components—Family Engagement, city-wide Professional Development, and Competitive Grants to districts, charter schools, and early care and education centers—it is possible that Pre-K SA has produced benefits other than those included in the current analysis. First, although Family Engagement is housed within the education centers, no evaluation findings have explicitly explored potential outcomes for children and families as a result of participation in and/or potential changes for families and children as a result of Family Engagement participation. For instance, the effects of Family Engagement may result in the transfer of benefits to younger (and older) siblings in the home.

Second, evaluation results for Competitive Grant recipients may reveal benefits for children, families, and school districts. For example, some grant recipients have used funds to increase half-day state funding for pre-kindergarten to full-day offerings (prior to the implementation of HB3), and research literature suggests greater benefits from full-day programs (Atteberry, Bassok, & Wong, 2019). Future evaluations should consider

examining available information on those programs prior to the implementation of HB3, to assess potential additional benefits as a result of the Pre-K 4 SA initiative.



Third, evaluation outcomes are not available to investigate the effect of increasing credentialing and salaries of Pre-K 4 SA teachers (and others through professional development and grants from Pre-K 4 SA). Such investments may also lead to increased income being spent back into the commerce of the city, providing additional societal benefit.

Fourth, additional longer term benefits may exist for children, families, and the community; however, it is not possible to value those potential outcomes because the first cohort of children have not yet completed schooling. For example, Pre-K 4 SA has outdoor play and nutrition components within its program. It is

possible these program facets could lead to health outcomes for children and families that could result in the reduction of medical and prescription costs in the future.

Several limitations of the current work warrant mention. First, there is a lack of evaluation outcomes for the Family Engagement, Professional Development, and Competitive Grant components of the Pre-K 4 SA initiative. If possible, such evaluation outcomes should be obtained and included in an updated benefit-cost analysis. Second, cost analyses using the ingredients method are not currently available for other local pre-kindergarten or early childhood care and education programs, to create a more even more precise incremental cost and benefit-analysis of Pre-K 4 SA in comparison with the other pre-kindergarten and early childhood care and education programs San Antonio children are experiencing.

Finally, the State of Texas is now implementing funding (through HB3) for full-day pre-kindergarten for eligible children, which is a shift in climate since the inception of the Pre-K 4 SA initiative. Therefore, future comparative evaluation outcomes, incremental costs, and resulting benefit-cost analyses will likely differ from the analysis and findings presented here. This study represents the current known societal benefits of the initiative; however, the initiative may change direction if reauthorized, and it will be important to carefully consider the new direction and associated outcomes moving forward.

Taken together, the results of the current cost analysis and benefit-cost analysis suggest positive societal returns to San Antonio as a result of the investment in the Pre-K 4 SA initiative.

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