
Report for Minnesota Reading Corps Pre-K Program Cost Analysis

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1. INTRODUCTION

Establishing literacy proficiency early in life is fundamental to ensuring academic success, not only in reading, but across all subjects studied in school. Pre-K programs are a promising avenue for developing literacy skills early in life. However, not all young students have access to a Pre-K education, and when they do, not all programs have the resources required to provide the individualized support that is tailored to struggling readers' needs.

One promising approach for helping struggling readers is to hire certified teachers or specialists as tutors for every classroom (e.g. May *et al.*, 2013; Slavin, Lake, Davis & Madden, 2011). Nevertheless, this can be costly and impractical for under-resourced schools. Alternatively, using volunteers or paraprofessionals as additional support may be a less costly solution; however, uncertified volunteers may yield lower quality instruction. Additionally, volunteer-based programs may require intense supervision and support to be effective and can be challenging to bring to scale (Grossman & Furano, 1999).

The Minnesota Reading Corps (MRC) program is a statewide AmeriCorps early literacy initiative that aims to foster emergent literacy skills of children to ensure reading proficiency by the end of grade 3. MRC and its host organization, Reading & Math, Inc. (RMI), aim to address the resource gaps within under-resourced schools by bringing AmeriCorps members into preschool (Pre-K) classrooms to provide literacy enrichment for the whole class and tutoring services for specific at-risk students.

An impact evaluation of the MRC Pre-K program in the 2013-2014 school year found that the program had significant positive effects on outcome measures of emergent literacy (e.g. phonological awareness and vocabulary) for 3-, 4-, and 5-year-olds (Markovitz, Hernandez, Hedberg & Silbergliitt, 2015). While evidence of program impact is necessary for understanding whether a program is achieving desired outcomes, it is not sufficient for policymakers to make informed decisions about resource allocation or replication of the program without information on costs. A cost analysis of the program is required to understand whether the program is worth the cost, and subsequently, the magnitude of the benefits that are generated as a result of the required investments.

The purpose of this study is to estimate the economic costs of providing the MRC Pre-K program that are associated with the impacts (i.e., increased reading skills) measured by the 2013-

2014 evaluation. Thus, the descriptions and analyses included in this report focus on the Minnesota Reading Corps Pre-K model as it was implemented in the 2013-14 school year. In addition to estimating the average costs per site and per student, this cost study will also assess variation in cost among sites or among different bundles of resources with a specific focus on the portion of costs borne by schools.

Though previous literature has investigated the cost-effectiveness of early literacy programs, evidence suggests high variability in costs depending on program design (Hollands *et al.*, 2013; Simon, 2011). While programs that focus on improving classroom instruction coupled with providing individualized instruction focused on phonics (Slavin *et al.*, 2011) are promising in terms of impact, no cost analysis has been conducted on such a program. A careful cost analysis of the MRC program, which retains many of these promising program components, can help us better understand the resources required to replicate the program impact, how much of each resource is necessary, and how cost-effective the program is relative to alternatives.

2. BACKGROUND AND CONTEXT

The Challenge of Early Literacy

Reading competency is foundational for children’s learning and academic success in all subjects. Children struggling with reading may experience difficulties in other subjects (e.g., Chall, Jacobs & Baldwin, 1990). If not addressed, early challenges in literacy may continue during school years (e.g., Baydar, Brooks-Gunn, & Furstenberg, 1993; Felton, 1998) and into adulthood (Bruck, 1998). A critical task assigned to K-12 schools in the United States today is to ensure that every student becomes a proficient reader.

Nevertheless, the 2015 National Assessment of Educational Progress (NAEP) reading assessment results show that 64 percent of fourth graders are below “Proficient” level, and that 21 percent are below “Basic” level of reading proficiency (NAEP, 2015a). This challenge is exacerbated by evidence of achievement gaps among disadvantaged students. Assessment results among disadvantaged students indicate that 78 percent of fourth grade students eligible for the National School Lunch Program are below “Proficient,” and 44 percent are below the “Basic” level (NAEP, 2015a).

Pre-K programs can be an effective vehicle to reduce these gaps because building literacy skills early in life can prevent later difficulties in reading. Nevertheless, providing enough support at the Pre-K level can be challenging because schools with struggling readers are more likely to lack sufficient resources. Moreover, at the Pre-K level, no “one-size-fit-all” policy works due to the complexity of how Pre-K programs are organized. In the absence of one overarching entity that governs “Pre-K education,” public preschools, Head Start programs, and community child care centers are all regulated and funded differently. Several different models of reading programs have been examined and evaluated at the Pre-K level. Understanding costs of these approaches together with their effectiveness can contribute to the knowledge base that policymakers can use for effective decision making.

These challenges are particularly salient in Minnesota, where the state’s reading achievement gaps remain some of the highest in the nation. In 2015, only 20 percent of low income (as defined by eligible for free or reduced lunch) fourth graders and 16 percent of African-American fourth graders were proficient in reading as measured by NAEP (2015b). While addressing these literacy gaps early in life is an important policy objective, access to Pre-K programs in Minnesota still remains among the lowest in the nation. In 2015, only 56 percent of Minnesota’s 3- and 4-year-olds were enrolled in preschool (Bridges, 2015). Hence, understanding how to address these resource constraints in the Minnesota context, and to do so at a reasonable cost, is now more important than ever.

Previous Evidence on Early Literacy Interventions

Rigorous evaluations of literacy interventions show that one-on-one tutoring delivered by certified teachers is effective in improving reading performance (e.g., May *et al.*, 2013; Slavin, *et al.*, 2011), even relative to alternative interventions such as small group tutorials, classroom instructional approaches and computer assisted learning (Slavin *et al.*, 2011). A review of 96 evaluations of alternative literacy interventions for struggling readers in grades K-5 concluded that a promising approach to addressing gaps in literacy for students lagging behind is combining improved classroom instruction with individualization focused on phonics (Slavin *et al.*, 2011).

Nevertheless, providing one-on-one tutoring by trained teachers is both time and resource intensive. Hiring additional specialists or certified teachers as tutors can be costly and may not be practical for already resource-constrained schools. An alternative approach to certified teachers is

that of enlisting volunteers or paraprofessionals, which are less costly, but may yield lower quality instruction. There is recent literature documenting the effectiveness of placing paraprofessionals or volunteer tutors in schools to improve the reading proficiency of students lagging behind (e.g., Jacob, Armstrong & Willard, 2015). However, the literature on the effectiveness of this approach remains thin, and still somewhat mixed. For instance, Slavin *et al.* (2011) reviews three evaluations of such interventions—*Experience Corps* (Morrow-Howell, Jonsen-Reid, McCrary, Lee, & Spitznagel, 2009), *Book Buddies* (Meier & Invernizzi, 2001) and *HOST* (Ramey, 1991)—however, the findings were inconsistent. Additionally, evidence suggests that bringing to scale interventions that rely on volunteers may be challenging (Grossman & Furano, 1999; Hager & Brudney, 2004). In particular, the success of volunteers can depend heavily on the support that they receive (Grossman & Furano, 1999).

Cost analyses of effective early literacy interventions for students in grades K-3 find significant variation in the costs required to implement these various interventions (Hollands *et al.*, 2013; Simon, 2011). Cost variation is found to depend critically on program design and implementation. An evaluation of a literacy intervention using community volunteers to provide one-one-one instruction found such interventions can be a low-cost option for schools when the majority of the costs are in-kind contributions (Jacob, Armstrong, Bowden, & Pan, 2016).

The challenge of addressing early literacy is three-fold: How can early literacy programs ensure (1) quality instruction, (2) at a reasonable cost, and (3) using resources that can be operationally viable at scale? To address these challenges in early literacy, the Minnesota Reading Corps and its host organization, Reading & Math, Inc., undertook an approach to bring AmeriCorps members into Pre-K classrooms to provide literacy enrichment for the whole class and tutoring services for at-risk students.

3. MINNESOTA READING CORPS PRE-K PROGRAM

Minnesota Reading Corps: Theory of Change

The Minnesota Reading Corps (MRC) program is a statewide AmeriCorps early literacy initiative that aims to foster emergent reading skills of children to ensure reading proficiency by the end of grade 3. The theory of change underlying the program is designed to specifically address three aspects of the early literacy challenge. First, there are resource insufficiencies in some

schools, by which schools alone are unable to provide students with the individualized support that they need to become kindergarten ready. Second, even though additional support may be available through paraprofessionals or volunteers, such resources may yield lower quality instruction than a certified teacher. Third, even if paraprofessionals or volunteers are effective at a small scale, bringing such programs to scale across the nation is a significant challenge due to the amount of support required and uncertainty about the supply of volunteers.

The MRC Pre-K program addresses these challenges through three key components of the program: (1) additional classroom support through a full-time or part-time tutor (either a Community Corps or an Educator Corps) that implements classroom activities and provides one-on-one and group tutoring sessions, (2) a dedicated training and a supervisory support structure that enhances instructional skills of AmeriCorps members and supports them in their day-to-day activities; and (3) an interactive and skills-focused literacy curriculum model, called “SEEDS of Emergent Literacy,” which is based on current research in early childhood. This model includes classroom based strategies and daily targeted one-on-one and small group interventions. The model also uses a Response-to-Intervention (RTI) framework that identifies at-risk students, through defined benchmarks and regular assessments, who are targeted for individualized intervention.

These features of the program enable AmeriCorps members to provide tiered support that targets students falling behind by assessing students’ learning levels and providing one-on-one or small group literacy sessions to at-risk students throughout the school day. Through regular assessment of the students, daily classroom activities for all students, and targeted interventions for students lagging behind, the MRC Pre-K program is designed to help students improve their academic performance in literacy and achieve Minnesota state “Kindergarten Ready” targets before entering kindergarten.

Description of the Program

The core activities of MRC and its host organization, Reading & Math, Inc. (RMI), are to recruit, place, train and monitor AmeriCorps members who are placed into Pre-K classrooms to implement research-based literacy interventions and tutoring services. The program includes both an immersive “push-in” component, where AmeriCorps members provide literacy enrichment to the entire Pre-K classroom as well as individualized interventions to students struggling with

emergent literacy skills. Struggling students are identified using a Response-to-Intervention framework.

Target Population and Selection Criteria

The Minnesota Reading Corps Pre-K program provides literacy enrichment support to 3-, 4-, and 5-year-old students at already existing preschool settings across Minnesota, including Head Start sites, public schools, and community-based programs. Existing Pre-K programs throughout the state can apply to be a part of the MRC program, and are selected and awarded AmeriCorps members based on need and ability to supply the required support staff. In the 2013-14 school year, the Minnesota Reading Corps Pre-K and K-3 programs placed more than 1,100 AmeriCorps members in 712 elementary schools, Head Start centers, and pre-schools to serve over 30,000 students across the state.

Personnel Structure

Classroom Personnel. The key personnel supplied by MRC are the AmeriCorps members who are placed in Pre-K classrooms to implement the literacy rich schedule and individualized interventions. There are two types of AmeriCorps members: Educator Corps and Community Corps. Educator Corps are personnel currently employed at the site comprised of either a lead teacher or assistant teacher who are trained to incorporate Minnesota Reading Corps strategies into their instruction alongside their regular teaching. Community Corps members are typically recruited by the community and brought into Pre-K classrooms full-time or part-time to implement MRC strategies. The lead teachers in classrooms where Community Corps members are placed also actively implement MRC activities. Since lead teachers host Community Corps members and collaborate with them throughout the day, they enter into an agreement that stipulates the roles and expectations over the course of the program.

Supervisory Staff. Classroom personnel are supported by Internal Coaches and Master Coaches, who play an important role by both ensuring the MRC activities are implemented with fidelity and by providing in-depth training and regular support to the tutors to optimize their success with students. Internal Coaches are typically school employees who are trained to provide on-site literacy support, coaching, and oversight to AmeriCorps members. Master Coaches are typically literacy experts contracted by the program to support Internal Coaches with regular

feedback based on monthly observations. All personnel also attend regular training, including an annual three-day Summer Training Institute and additional professional development, that are taught by Master Coaches, and, in some cases, Internal Coaches.

Key Components of the Program

The MRC Pre-K program is designed to address the challenges of early literacy through three key components: (1) additional tutors in the classroom, (2) curriculum and literacy content focused on the “Big Five” Essential Early Literacy Predictors, and (3) dedicated training and support to standardize the quality of instruction across Pre-K sites and classrooms.

AmeriCorps Members. The first key aspect of the program embraces the AmeriCorps members, either Community Corps or Educator Corps, who are put into Pre-K classrooms to develop their students’ emergent literacy skills. AmeriCorps members complete student assessments, implement the Literacy Rich Schedule and enact the SEEDS of emergent literacy curriculum, and provide small group and one-one-one interventions to students falling behind.

Literacy Curriculum. The second key component is the research based literacy curriculum designed to address each of the following “Big Five” Essential Early Literacy Predictors (Lonigan & Shanahan, 2009): conversational skills, vocabulary and background knowledge, book and print rules, phonological awareness (i.e., rhyming and alliteration), and alphabetic knowledge (i.e., letter name recognition and letter sound correspondence). There are three main channels through which the MRC Pre-K program is designed to develop these Big Five skills.

First, instructional staff at participating sites together with AmeriCorps members provide classroom- and evidence-based literacy enrichment strategies (called “Literacy Rich Schedules”) to create a stimulating literacy learning environment focused on the Big Five. Literacy Rich Schedules include 12 distinct activities (i.e., Arrival, Sign-in, Meal Time, Large Group, Daily Message, Repeated Read Aloud, Tier 1 Small Group, Journal, Choice Time/Active Learning, Tier 2 or Tier 3 Small Group, Big 5 transitions, and Family) that engage children in daily routines, conversations, and activities (i.e., games, songs, etc.) aimed at enhancing their Big Five early literacy skills.

Second, an instructional approach called “SEEDS of Emergent Literacy” (Horst & Passe, 2004) guides AmeriCorps members and teachers to interact with children in a way that promotes children’s broader cognitive and social-emotional development. Specifically, high quality

interactions with children are expected in the areas of: sensitivity to each child’s needs, encouragement through verbal and non-verbal communications, embedded “Big 5” literacy skills in daily routines, development of skills through practical application, and support for the child’s feeling of being respected and capable. Third, MRC offers add-on, tiered support that targets the needs of at-risk and struggling students in reading.

These tiers of students are determined based on a Response to Intervention (RTI) framework that matches student needs with an appropriate intensity of additional instruction. Periodic assessment is an integral part of this framework, and AmeriCorps members use a standardized, individually administered assessment tool called Individual Growth and Development Indicators (IGDI) for assessing rhyming, picture naming, and alliteration on a regular basis. For students identified as Tier 2 (at-risk) and Tier 3 (high-needs), individual or small group literacy tutoring is offered by AmeriCorps members. These students receive 15 minutes of additional instruction each day.

Training and Support. The third key aspect of the program is the training and support AmeriCorps members receive through interactions with supervisory staff (Internal Coaches and Master Coaches) and the training received through both the annual Summer Institute training and the on-going professional development sessions throughout the year. The Summer Institute training is a three-day training session attended by all AmeriCorps members on an annual basis that provides expert training in the evidence-based literacy interventions used by the MRC program. Members also receive additional professional development, called Pre-K Fundamentals, throughout the year through sessions on topics such as oral language, child confidentiality, repeated read aloud method, and social and emotional development, as well as additional trainings on SEEDs.

4. COST ANALYSIS IN A BROADER EVALUATION FRAMEWORK

Previous Evaluations of the Minnesota Reading Corps Pre-K Program

The impact of the MRC Pre-K program was evaluated in the 2013-2014 school year by the University of Chicago-based research center, NORC (Markovitz *et al.*, 2015). The evaluation studied fifty Pre-K sites in the Minnesota area: twenty-five sites that were receiving the MRC program (the treatment condition) and twenty-five comparison sites that carried on with “business

as usual” operations (the control condition), matched based on a number of educationally important pre-treatment characteristics. The impact evaluation found that the MRC Pre-K program had significant positive effects ranging from 0.4 to 0.72 standard deviations on five Individual Growth and Development Indicators (IGDI) outcome measures of emergent literacy for 4- and 5-year-olds (letter sound and letter name fluency, rhyming and alliteration fluency, and picture name fluency), and significant and positive effects on two of the four IGDI measures developmentally appropriate for 3-year-olds (letter name recognition and alliteration fluency). Effects were equally distributed across student demographics and type of site, indicating the possibility of replicating the program with similar impacts in multiple Pre-K settings.

The Need for Cost Analysis

The impact evaluation was one of several complementary studies of the Minnesota Reading Corps program conducted to understand both implementation details and program impacts (Diaconis *et al.*, 2015; Markovitz *et al.*, 2015; Markovitz, Hernandez, Hedberg & Silberglitt, 2014; Hafford *et al.*, 2013). However, in order to fully explore the resources required to generate the impacts measured and to better understand the magnitude of the benefits relative to the investments made, an estimation of the costs of the program is required. This will give policymakers and decision makers information to understand how to improve the program for the future, and the resources required to replicate the program in a new context.

This cost study, conducted by the Center for Benefit-Cost Studies of Education (CBCSE) at Teachers College, Columbia University, estimates the costs of replicating the MRC Pre-K program that produced the impacts on students’ reading skills measured by the 2013-2014 NORC outcome assessment in the twenty-five treatment sites evaluated. In addition to estimating the average costs per site and per student, this cost study also addresses and quantifies the variation in costs across sites and the distribution of costs, with a specific focus on the portion of costs borne by the schools. Consequently, this study will provide an understanding of the resources utilized to implement the program, as well as the mechanisms through which these resources contribute to the program impacts (i.e., increased reading skills).

This cost analysis complements the existing impact and process evaluations of the Minnesota Reading Corps Pre-K program in two key ways. First, it builds upon the rich data collected in the process assessment (Diaconis *et al.*, 2015) that documents the resources required

to implement the Minnesota Reading Corps Pre-K program with fidelity, and the activities involved in the program's delivery. This cost analysis carefully documents all of the resources provided by both the program (i.e. RMI) and by the community that enter into providing the program at Minnesota Pre-K sites. In addition, it identifies who provides these resources and how they vary along multiple dimensions. In doing so, this cost analysis can provide a bridge between implementation and impact evaluations by addressing the question of what it takes to implement the Minnesota Reading Corps Pre-K program in order to achieve the observed impacts.

Second, a cost analysis can contribute to a better understanding of the program's replicability and scalability. This analysis can contribute to an understanding of whether the program itself can be implemented with fidelity in other contexts across the United States, and if so, which basic conditions must be in place in order to achieve comparable impacts. It can aid in the identification of ingredients necessary, at both the school and program levels, to ensure fidelity of program implementation. Finally, it can help uncover potential efficiency gains for cost savings. This study will analyze which program components or ingredients are more or less costly and which may be contributing more or less to program impacts based on an analysis of both site-level variation and an analysis of whether certain bundles of resources, for example certain classroom personnel structures, are efficient relative to other potential configurations.

Research Questions

The primary research questions being addressed in this cost analysis are:

- What is the average cost per site and average cost per student for the MRC Pre-K program?
- How were these costs financed? Specifically, what portion of the costs was born by schools and what portion by other entities?
- As secondary research questions, we also investigate how costs, descriptions of ingredients, or allocation of resources might differ among sites in the evaluation.

5. DATA AND METHODS

Measuring Costs in Education

Estimating the costs of a program involves identifying and accounting for all of the resources used to implement activities that generate the program's impact on the outcomes of interest regardless of how they are budgeted and financed (Levin, McEwan, Belfield, Bowden, & Shand, 2018). In this study, we refer to the costs of a program as the value of the resources that are required to implement and/or replicate an intervention or program. Thus, for the purposes of this study, costs are explicitly different from finance, which focuses on the way the costs are paid and who pays for them.

For example, consider an education program that relies on volunteer time for its implementation, which is a similar case to the MRC program, which utilizes the service of AmeriCorps members. For volunteer-based programs, volunteer time is a resource that is necessary for the implementation of the program and the impact generated on student educational outcomes. However, this resource will not appear in any budget or financial analysis, since the time devoted by volunteers is usually unpaid. If one were to replicate the program elsewhere, in an area where there are no available volunteers, one would need to hire workers to replace volunteer time. Therefore, restricting costs only to those accounted for in financial budgets would understate the overall costs of the program because they do not include costs borne by sources other than the program itself.

Economic analysis of costs is based on the foundational concept of opportunity cost, the value of what is sacrificed by using a specific resource in one way rather than in its next best use (Levin, 1975, 1983; Levin *et al*, 2018). The ingredients method is a cost accounting approach developed at the Center for Benefit-Cost Studies of Education (CBCSE) that uses this underlying concept to address costs (Levin, 1975, 1983; Levin *et al.*, 2018). This method has been widely validated in the fields of economics and accounting and provides consistency in cost estimation to allow for comparison across programs and interventions by basing estimates on the economic principle of opportunity cost (Levin *et. al*, 2018).

The ingredients method of cost analysis begins with the identification of the resources or *ingredients* that are required and used to implement the program being evaluated. Since one purpose of this cost analysis is to estimate the resources required to replicate a particular effect in a cost-effectiveness framework (see Section 4), our focus is on estimating the costs of the program as actually implemented, not as a theoretical goal. Both quantitative and qualitative characteristics of each ingredient are identified in order to identify the true opportunity cost of each resource. For example, the precise types and amounts of personnel are specified according to their qualifications, functions, and time commitments. A similar exercise is carried out for facilities, equipment, and other program inputs.

Under the ingredients method framework, ingredients or resources that are required and used to implement the MRC Pre-K program are identified and valued according to their market prices or equivalents. With this information, the true economic cost of the intervention can be estimated and then matched to effectiveness measures obtained from the 2013-14 outcome assessment in order to understand the resources that are required to obtain the impact realized. For this study, information on ingredients was obtained from existing documents of the process assessment and outcome evaluation of the MRC Pre-K program (Diaconis *et al.*, 2015; Markovitz *et al.*, 2015), from administrative data provided by RMI, and from both interviews with the program's personnel and observations from site visits. Data collection procedures and instruments are described in more detail below. All ingredients required for the intervention are identified and specified regardless of how they are financed.

Once the ingredients are identified, the next step entails establishing their economic costs. Market prices are used to establish the true economic value of each ingredient as the economic opportunity cost is usually considered to be approximated by the market price, i.e. the price that equates supply and demand in the competitive marketplace. Nonetheless, many markets do not have competitive market conditions that provide a true price of the resource and, in some cases, a market for the resource does not exist (for example, a unique source of talent). A deeper discussion of the methods and the assumptions used to estimate the opportunity costs of these resources is included below.

Data collection for this study began with developing a hypothesized list of ingredients under the categories of personnel, facilities, materials and equipment, training, and others, based on a thorough review of program documentation. These documents include the process assessment and the outcome evaluation of the MRC Pre-K program (Diaconis *et al.*, 2015; Markovitz *et al.*, 2015). In addition to these documents, the team had access to administrative data provided by RMI with important information of resource use during the implementation of the program in the academic year of 2013-14. This administrative data included the program's administrative records on the allocation of Educator and Community Corps personnel to each site.

Furthermore, reports on training expenses and site-level records of in-kind contributions of personnel time devoted to AmeriCorps member supervision, and of facilities and material use allowed us to recover relevant information for our analysis. From this hypothesized list, we identified gaps in our knowledge and developed interview protocols with targeted questions for Internal Coaches, lead teachers, Master Coaches, and other relevant RMI staff. Additional information on resource allocation was gained through on-site observation of the implementation of the MRC Pre-K program. Finally, current Master Coaches were surveyed via Qualtrics, an online survey research platform, with questions that allowed a deeper understanding of how different personnel structures were allocated across sites and their perceived effectiveness in terms of implementation and student outcomes.

The costs estimated here are intended to reflect the contrast between the MRC Pre-K program and what would have happened in the absence of the program ("business-as-usual"). By estimating the costs that are incremental to, or above and beyond, business-as-usual, this cost analysis is designed to uncover the costs related to the production of the program's documented impact. While our data are extensive, there are some aspects of program delivery for which the information was unavailable. In particular, we were not able to obtain the specific personnel structures within each of the classrooms in the previous evaluation, since the data were organized at the site level. Furthermore, we were not able to obtain information on the level of Educator and Community Corps' experience with the program; that is, whether they were new or returning members. This piece of information was crucial because new members implied longer training time and more intensive supervision and support by Coaches.

Thus, some ingredients data were complemented by assumptions based on information provided by the program and regarding typical Pre-K practices in Minnesota. These assumptions are explained in greater depth and are tested in a sensitivity analysis in Section 6. In cost analysis, it is important to examine sources of uncertainty in estimates and test the robustness of results to assumptions via sensitivity analysis. Cost analysis is more limited than other forms of economic evaluation, such as cost-effectiveness or benefit-cost analysis, in that it does not imply a decision rule. Therefore, we cannot test, for instance, whether changes would alter the efficiency ranking of programs according to cost-effectiveness, or the break-even point under which a program's benefits would no longer exceed its costs. Rather, we follow Boardman, Greenberg, Vining, and Weimer (2011) and perform a series of parameter variation tests, by which we select the assumptions about which we are most uncertain or which are most likely to significantly impact our results, and test a range of plausible values. We then combine these sensitivity tests into "best case" (lowest cost) and "worst case" (highest cost) scenarios to estimate upper and lower bounds.

Missing Data Strategies

Even with our extensive data collection efforts as described above, two important pieces of information critical to perform cost analysis were still missing. These were information related to: (i) whether each Community and Educator Corps member was new or returning, and (ii) classroom-level information on members, Internal Coaches and lead teachers. This section describes the rationale behind the importance of this information and the strategies we used to generate the missing information with the information already in hand.

Member experience

Program documents and interview data from key MRC program personnel indicate that personnel time allocation across the program is directly linked to whether the AmeriCorps member assigned to each site is returning (and therefore experienced) or new. A returning member's experience within the program greatly alleviates Internal and Master Coach supervision time as well as implementation time allocation from key school staff. More specifically, during Fall and Spring semesters, Internal Coaches would spend 6 hours per returning member per month to conduct two classroom observations and provide follow-up support. In contrast, they spent 12 hours per month in the Fall and 8 hours in the Spring for a new member. These interactions

between ingredients is an important aspect to estimating idiosyncratic site level costs. Nevertheless, our data were unable to identify whether a specific member was returning or newly assigned, or which exact member or personnel was assigned to which classroom within a site. Therefore, we utilized the data available to conduct a simulation procedure to fill in these missing data for our analysis. This section provides a description of the methods used in this procedure.

Within a specific classroom, each member's experience level (i.e., returning or new) was varied through Monte Carlo simulations, a statistical method often used to account for uncertainty and missing data. Monte Carlos methods rely on repeated random sampling to obtain numerical results to problems that are unfeasible to resolve through other statistical approaches (Greene, 2000). For this study, we used Monte Carlo simulation to draw from a probability distribution that would allow us to determine the experience of each member of the data at hand. We approximated the way returning or new members were distributed across sites to a "binominal" probability distribution—a distribution that can be drawn from a repeated random experiment of two possible outcomes, such as flipping a coin (i.e., "head" and "tail"). Each of these draws is called a "Bernoulli" trial. In our case, we conducted one Bernoulli trial of our two outcomes — "returning" and "new"— for each member at each site 50 times and averaged their time commitments across each simulation trial to obtain their time allocation across sites.

One strength of this simulation strategy is its capacity to incorporate data from actual practice, for example the share of returning and new members. We conducted a survey of all current Master Coaches (i.e, from the 2017-2018 school year) who were working closely with site level personnel, and asked questions about the experience of AmeriCorps members that they supervise. The survey results showed that, on average, 58.37% of AmeriCorps members were new, implying that more than half of the sites in our sample would receive a greater amount of time allocated for supervision and support of its members. Assuming that current practice reflected the practice in the 2013-2014 school year, we used this percentage as an input to our Bernoulli trial. This assumption about the percentage of new members is varied and tested in the sensitivity analyses provided in Section 6.

Personnel structure

Another piece of information that was missing in our data was the classroom-level personnel structure; that is, which AmeriCorps member or Internal Coach was assigned to which

classroom within the site. In other words, we had member and Internal Coach assignment information at the site-level, but the information was not further broken down by classrooms even when a site had multiple classrooms. Different personnel structures could potentially generate variation, both in student outcomes and in costs per site.

For example, each classroom has a lead teacher and he or she can also be an Educator Corps member. Lead teachers that are *not* Educator Corps would spend extra preparation time for MRC activities in addition to the preparation for their ‘business-as-usual’ activities in order to incorporate the MRC requirements. However, if the lead teacher is also an Educator Corps member, such additional preparation time would not be considered “incremental” and would be accounted for fully with the Educator Corps time commitment. An interview with a Master Coach indicated that, in another instance, classrooms in which Educator Corps members were also the lead teachers and were not paired with a Community Corps member for additional support faced particular challenges in maintaining implementation fidelity. Such implementation difficulty may serve to impede the program’s ability to help develop children’s literacy skills.

In order to account for this missing information at the classroom-level, we performed two different analyses. First, using a similar Monte Carlo simulation approach, we simulated whether the lead teacher in each classroom in each site was also an Educator Corps member. That is, we made a random draw of two possible outcomes — “lead teacher is Educator Corps” and “lead teacher is not Educator Corps”— for each classroom in each site. To reflect actual practice in the simulation, we incorporated the Master Coach survey results about the percentage of lead teachers who are also Educator Corps members (i.e., 27.13%). This adjustment allows us to recover variation in lead teacher time arising from the way that the Educator Corps and lead teacher roles may overlap, which in turn can generate variation in cost across sites. The result of this approach is presented as part of our main analysis in Section 6.

There are other types of classroom-level personnel structures, such as lead teachers who also serve as Internal Coaches, that possibly lead to implementation difficulties. Our second approach to explore classroom-level personnel structure is intended to shed light on this phenomenon. These estimation exercises are not based on simulation, but rather on estimates of the average costs per classroom per ingredient. Drawing on these estimations allows us to estimate the costs of different personnel structures within the average classroom and provide insight on how

different personnel assignment to each classroom might vary these costs. Results for this analysis are presented below in Section 6.

Prices

After quantities and qualitative descriptions of all ingredients were obtained, the next step in the ingredients method is to apply an appropriate market or shadow price that represents the economic value of each ingredient. In this analysis, we utilize national average prices in 2014 US Dollars. Additional descriptions of the methods and assumptions used in this step are provided below.

We mainly utilized competitive market prices rather than idiosyncratic expenditure data. Average market prices represent the economic value for each ingredient based upon revealed preference of willingness to pay broadly, rather than reflecting specific prices that may not be available elsewhere nor reflect the true value of the resource. National prices were utilized here to ensure comparability across sites in different locations (rural, suburban, and urban) to inform replication efforts nationally, and to allow for comparison with other program alternatives for policy.

A majority of the national prices used in this analysis were obtained from the CBCSE Database of Educational Resource prices available through the cost tool, *CostOut* (Hollands *et al.*, 2015). Where appropriate, a corresponding fringe benefit cost was added for full-time personnel such as preschool principals or preschool teachers.

Ingredients in the personnel category include Internal and Master Coach time, as well as Educator Corps, Program Coordinator, lead teacher, and Principal time. As described above, the MRC program relies upon AmeriCorps, a nation-wide federally supported volunteer program for young adults, retirees, or anyone above the age of 18 willing to serve in the community. Given the scale and availability of this program, this analysis values all Community Corps positions with the market value of the actual 2013-14 hire packages provided to Community Corps members. If the program were replicated without the availability of the AmeriCorps program, the price value of these personnel may change. We explore this by conducting a sensitivity test that applies the national market rate of a minimum wage position to perform equivalent services.

Facilities and equipment costs were amortized to reflect the life value of these resources beyond the term of this evaluation to provide annualized measures. The prices were estimated

using new construction or purchase prices amortized over 30 years for facilities, and 3 years for printers and laptops (2 years for small printer) at a 3.5% discount rate.

Training was also an important category of ingredients for the MRC program. MRC provides a standardized training, in partnership with RMI, for AmeriCorps members as well as for coaches. The market price for this training was applied in our analyses. Data on training, and resources used for training related to these specific sites, were provided by RMI. In addition, we included the opportunity cost of members and coaches attending training sessions in the training category rather than in the personnel category. The pricing for these were matched with the corresponding prices in the personnel category.

Estimation of Average Cost Per Site and Cost Per Student

After we collected the quantity and price data for each ingredient, we produced cost estimates by multiplying each corresponding pair of quantity and price. Our quantity data were specific to each site, so the quantity-price multiplication generated a cost for each ingredient for each of the sampled sites. In our research questions, we had set out to estimate: (i) average cost per site and (ii) average cost per student. To yield average cost per site, we simply aggregated costs by site, and took the average among the 25 sites. For the average cost per student, we aggregated all costs regardless of the sites and divided by the total number of students served at the 25 sampled sites. Both of these estimates should be generalizable to other MRC program sites in Minnesota because our sample of 25 sites was a representative sample of Pre-K program sites in Minnesota with three or more years of experience in the program.

Distribution of Costs

In a final step of the cost analysis performed in this study, the distribution of the cost burden is analyzed across categories of ingredients (i.e., personnel, facilities, materials and equipment, training, and other) and by perspective of who bears the burden of the costs (i.e., schools, the program, members, and students' families). Knowing the resources that feed into a program, their costs, and who pays for them is valuable information that allows a deeper understanding of how the impacts of the program are generated, the resources the program leverages, in addition to the program's financial resources and how replication of the program is viable elsewhere.

For this analysis, the primary cost perspective of interest is that of the program, Minnesota Reading Corps. However, for comparative purposes it is also important to document the total costs from a social perspective. This includes all ingredients regardless of who provides them, and whether there is a monetary cost or if they are provided in-kind by schools, such as personnel time and facilities space. From a school's perspective, however, the program may provide great value due to the resources provided by the program, by members and by families. In addition to analyzing costs according to perspective, and total costs from a social perspective, we also analyze how costs vary according to different bundling of resources, such as by different classroom personnel structures, and by school site.

6. RESULTS

In this section, we present estimates of the total incremental cost of the Minnesota Reading Corps Pre-K Program, or the estimated costs above and beyond “business-as-usual,” as well as the average per student cost and the ways costs vary by school site, and by bundling of various resources, such as personnel structures. We also examine the cost borne by various perspectives, such as by the program, by the school sites, by members, and by families.

Main Results

Table 1 presents the total and per student costs of the program. Note that for all reported findings, figures are presented in 2014 US dollars and rounded to the nearest \$10 to avoid false precision. The total cost of the MRC program as evaluated in 2013-14 in 25 sites, serving 1261 children, is \$2,124,480 per year. The average cost per site is \$84,980. Each site serves between 17 to 164 students. On average, the cost per student is \$1,690. This average is weighted for site size.

The average cost per site varies substantially, with a standard deviation of \$31,080. This variation is due to the fact that site size varies across the sample as some small sites serve 17 students while other larger sites serve 164. In addition, the assignment of Educator Corps and Community Corps varies across sites. Some sites have exclusively Community Corps members assigned to them while others have only Educator Corps. Since these two resources have different

opportunity costs and different incremental time allocation², these assignment variations are translated into variation in total personnel and training costs across sites.

Total Cost for 25 sites	\$2,124,480
Cost Per Student	\$1,690
Average Costs Per Site	\$84,980
	(\$31,080)

*Note: Dollars reported in 2014 US \$ and rounded to the nearest ten.
Standard errors of site-level statistics are in parenthesis.*

Table 2 shows the distribution of the costs across categories of ingredients. As is the case typically in education, most of the costs to deliver the program are in the categories of personnel and training. These two categories together account for 96% of the costs of the program. Once again there is great variation in costs across sites within each ingredient category. This variation is not driven by the size of each site, rather it reflects differences in the way the program is delivered across sites. Average personnel costs per site are \$51,680 but have a standard deviation of \$26,290, while average training costs per site are \$29,860 and have a standard deviation of \$16,030. This variation is driven by the number of members allocated to each site and by whether or not the members are new to the program.

While personnel and training costs of education programs tend to be larger than that of other categories, the share of training cost (35%) is higher than usual in the Pre-K MRC program. The program training costs include costs associated with delivering organized training sessions, such as the annual Summer Institute, the Make-Up Institute throughout the year (for those who missed the summer training), the Pre-K Fundamentals training provided throughout the year, and an annual week-long SEEDS training. Moreover, resources and materials used for these training sessions, such as a Literacy Handbook—the primary resource that provides theoretical foundation and practical guidance as to how to organize reading activities, are included. Finally, we included the time of Community and Educator Corps, as well as Internal Coaches, when attending relevant trainings. Altogether, these account for 35% of the total cost.

² A Community Corps hour is valued at \$10.94 while an Educator Corps hours is valued at \$24.30 which is the hourly rate of a Child Care Center Teacher at the national level.

Table 2. Distribution of Costs by Ingredient Category					
	Personnel	Facilities	Materials & Equipment	Training	Other
Average Costs Per Site	\$51,680 (\$26,290)	\$650 (\$220)	\$1,730 (\$1,090)	\$29,860 (\$16,030)	\$1,090 (\$460)
Average Site-level Cost Per Student	\$1,180 (\$500)	\$20 (\$10)	\$40 (\$20)	\$780 (\$560)	\$30 (\$20)
Percent	61%	1%	2%	35%	1%

*Note: Dollars reported in 2014 US \$ and rounded to the nearest ten.
Standard errors of site-level statistics are in parenthesis.*

Table 3 shows the distribution of costs across schools, the program, members, and students' families. Schools provide in-kind resources such as facilities and materials and key on-site personnel time that contribute to the implementation of the program. Members also contribute the time that they allocate to the training sessions in the summer and throughout the school year. Finally, families contribute to the program by assisting students at home with reading assignments that are part of the program's designed activities.

On average, approximately two-thirds of the costs of the implementation of the program are borne by MRC (73%). The other third of the program's costs are borne mostly by the school (18%). Members and families contribute to the remaining 9% of the economic costs of the program. Cross-site variation of the distribution of who bears the costs is consistent with earlier patterns as there is substantial variation across sites in how costs are distributed. The majority of the costs borne by the schools are personnel costs, which include principal time, lead teacher time and Internal Coach time.

Table 3. Distribution of Costs by Perspectives				
	School	Program	Members	Families
Personnel	\$10,190 (\$5,610)	\$34,920 (\$17,880)		\$6,590 (\$4,590)
Facilities	\$560 (\$210)	\$90 (\$60)	- -	- -
Materials and Equipment	\$1,050 (\$670)	\$680 (\$440)	- -	- -
Training	\$3,900	\$24,960	\$1,010	-

	(\$1,650)	(\$15,700)	(\$950)	-
Other	-	\$1,090	-	-
	-	(\$460)	-	-
Total	\$15,690	\$61,710	\$1,010	\$6,590
	(\$6,450)	(\$22,690)	(\$950)	(\$4,590)
Percent	18%	73%	1%	8%

*Note: Dollars reported in 2014 US \$ and rounded to the nearest ten.
Standard errors of site-level statistics are in parenthesis.*

Personnel Structures

This section presents estimates of the costs associated with different types of classroom-level personnel structures. Information on the perceived efficiency of each classroom personnel structure was obtained from a survey completed by Master Coaches in the 2017-2018 school year in which they were asked to rate each classroom structure efficiency from 1 to 5, where 5 indicated the most efficient structure. Estimates of perceived efficiency are thus 2017-18 measures and must be taken with caution as they might not reflect the actual efficiency of each personnel structure as implemented in the 2013-14 school year.

Table 4 presents the costs estimates of the most common personnel structures as reported by Master Coaches. Some personnel structures, for example those that involve the presence of both a Community and an Educator Corps member in the classroom, have a great deal of variation in costs that depend on whether each member is full-time or part-time and whether they are returning or not. For these personnel structures, standard errors are presented that reflect the variation of the costs generated by different ingredient combinations.

		Classroom Cost	Cost Per Student	Efficiency
1	Community Corps + Lead Teacher + Internal Coach	\$36,900	\$1,845	4.07
2	Community Corps + Educator Corps + Lead Teacher + Internal Coach	\$43,620 (\$4,500)	\$2,181 -	4.16
3	Educator Corps who is also Lead Teacher + Internal Coach	\$29,640	\$1,482	3.3
4	Community Corps + Lead Teacher who is also an Internal Coach	\$36,170	\$1,809	4
5		\$45,780	\$2,289	4*

	Community Corps + Educator Corps who is also Lead Teacher + Internal Coach	(\$3,800)	-	
6	Community Corps + Educator Corps + Lead Teacher who is also an Internal Coach	\$42,890 (\$4,500)	\$2,145 -	5*

*Note: Dollars reported in 2014 US \$ and rounded to the nearest ten. Standard errors of site-level statistics are in parenthesis. * indicates that efficiency estimates were recovered from 5 or less observations*

The estimates show an important variation of costs per student across different classroom personnel structures. A classroom structure where there is only an Educator Corps who is also a lead teacher in the classroom (#3) is the least costly personnel structure with an average cost per student of \$1,482. However, its perceived efficiency is the lowest of all the personnel structures analyzed. The costliest personnel structure is one where a Community Corps member and an Educator Corps member who is also a lead teacher are present in the classroom (#5). This personnel structure generates an average cost per student of approximately \$2,289, but is not associated with the highest perceived efficiency.

In general, there appears to be more cost-efficient options than allocating resources to the costliest personnel structure. For example, personnel structures where both a Community and an Educator Corps member are present (#2 and #6) are perceived by Master Coaches as the most efficient personnel structures in implementing the program, but are not the costliest to provide.

Uncertainty and Sensitivity Analyses

In estimating our main results, we made a number of assumptions. In this sub-section, we perform sensitivity analysis to examine four major assumptions that we made: (i) the proportion of new versus returning members, (ii) the pricing of Community Corps time, (iii) training costs, and (iv) families' time. Our sensitivity analyses show that, while varying or relaxing certain assumptions generates some variation in costs, the change in the estimations is not very substantial. Hence, our main results are generally robust.

Proportion of new vs returning members

Our analyses utilized missing data simulations to estimate the site-level cost of MRC. By imputing the years of experience for AmeriCorps members, there are potential implications for the value of personnel and training based upon a new or returning AmeriCorps member in each classroom. We test the sensitivity of the assumptions underpinning this simulation by providing

an upper bound estimate wherein all members are new (rather than nearly 60%). In addition to providing an upper bound on costs, these estimates can be informative for start-up costs in new locations. In this scenario, personnel costs increase as Internal Coach time allocation increases when guiding new members through the program throughout the school year. If all members are new, there are also cost implications for training as all new members must attend the Pre-K Fundamentals training sessions. Table 5 presents this sensitivity analysis. According to these estimates, if all members are new, implementation costs would be 3% higher, representing on average, an increase of \$2,590 on the average cost per site. These changes would account for an increase of 4.7% on total personnel costs per site and an increase of 0.6% on total training costs per site.

Table 5. Changes of the Average Cost Per Site with Variation of Members' Experience Assumptions				
	Main Cost Estimates	New Cost Estimate	Changes in Costs	Percent Change
Total Costs	\$84,980	\$87,570	\$2,590	3.0%
Personnel	\$51,680	\$54,090	\$2,410	4.7%
Training	\$29,860	\$30,040	\$180	0.6%

Note: Dollars reported in 2014 US \$ and rounded to the nearest ten.

Pricing of Community Corps time

In addition to varying the experience of the pool of members of the MRC program, we also perform a sensitivity analysis that varies the pricing of Community Corps time. If Community Corps members were not available, these positions would need to be replaced by the available local workforce. We assume the position would be filled as a minimum wage position based upon the open requirements and extensive training and support provided. Table 6 presents the average cost of the program per site under this sensitivity test. In general, these assumptions do not appear to affect cost estimates as changes in Community Corps pricing would lead to a decrease of 0.7% of the costs, approximately a decrease of \$560 on the average site costs. This in turn would generate a decrease in 1.1% of the average costs per site allocated to personnel ingredients.

Table 6. Changes of the Average Cost Per Site with Variation of Community Corps Pricing Assumptions				
	Main Cost Estimates	New Cost Estimate	Changes in Costs	Percent Change

Total Costs	\$84,980	\$84,420	-\$560	-0.7%
Personnel	\$51,680	\$51,120	-\$560	-1.1%

Note: Dollars reported in 2014 US \$ and rounded to the nearest ten.

Training costs

We also performed sensitivity analysis on training costs as presented in Table 7. Training costs represents the second largest category after personnel and hence it is important to examine some of the major assumptions made in its estimation. We assumed in the main analysis that about 80% of members and coaches attend the Summer Institute while the remaining 20% attend Make-Up Institute sessions. Our sensitivity analysis changed this distribution to 70% for the Summer Institute and 30% for the Make-Up Institute. This change in assumptions yields a negligible increase (\$10) in the training cost per site. Note that this estimate does not include some of the training costs that involved assumptions as to whether the member was new or returning (i.e., attendance to Pre-K Fundamentals training sessions). It is included in the analysis presented in Table 5.

	Main Cost Estimates	New Cost Estimate	Changes in Costs	Percent Change
Total Costs	\$84,980	\$84,990	\$10	0.0%
Training	\$29,860	\$29,870	\$10	0.0%

*Note: Dollars reported in 2014 US \$ and rounded to the nearest ten.
Standard errors of site-level statistics are in parenthesis.*

Families' time

Finally, a pricing assumption we used to recover the value of family time dedicated to home reading was to price this time at the national minimum wage (\$7.25 per hour). We decided to use this price because we assumed the skills needed to perform this task at home could be performed by someone with minimal qualifications. However, if the impact found in the outcome evaluation can be thought to be driven by higher skills and their effect on student outcomes through home reading activities, then the use of the minimum wage would underestimate the costs of the program. Thus, Table 8 presents sensitivity analysis estimations of the increase in the program costs if family time were to be valued at a higher price (\$22.5 per hour). Estimates indicate that

valuing family time at a higher rate would generate an increase of 16% of the total estimated average costs which would account for a 27% increase in total average personnel costs.

Table 8. Changes in Family Pricing Assumptions				
	Main Cost Estimates	New Cost Estimate	Changes in Costs	Percent Change
Total Costs	\$84,980	\$98,870	\$13,890	16%
Personnel	\$51,680	\$65,570	\$13,890	27%

*Note: Dollars reported in 2014 US \$ and rounded to the nearest ten.
Standard errors of site-level statistics are in parenthesis.*

Limitations

While this study represents a thorough and comprehensive study of the resources required to implement the MRC program, and the results of the study are robust to assumptions according to sensitivity analyses, there are several possible limitations of this study that should be taken into account when interpreting the results. First, these estimations were performed retrospectively and are subject to measurement error issues insofar as we were not able to account for observed and detailed implementation practices. By performing several sensitivity analyses, presented above, we address this issue by generating possible bounds of how our costs estimates might vary.

Second, although the cost estimates provided imply information on the potential to replicate or scale the program in other areas of the country, a generalizability problem still persists. Programs in more densely populated areas may exhibit economies of scale: fixed costs may be divided over a larger number of participants, sites may become more efficient by learning from others nearby, and the program may become large enough to have market power to drive down prices for its ingredients. These two competing factors offset one another, but the extent to which they do so is unclear *a priori*. These general equilibrium effects are not accounted for in the estimates provided above. Hence, the results presented in the sensitivity analysis must be interpreted cautiously, taking these considerations into account.

Third, the pricing assumptions used in the estimation assume that a national market exists for each ingredient considered. However, specific local price contexts may vary due to a number of circumstances that are not accounted for in the cost estimates. For example, a program that requires personnel with specific and rare skills for its implementation might not be able to find

local workers with such skills in rural areas, because the local market does not attract the kind of human capital needed. Therefore, implementation would require these professionals to move to the areas of implementation, which may generate higher recruitment costs than it would if implementation were carried out in an otherwise costlier area of the country.

Finally, this analysis does not address other relevant questions that might be useful to understand about the MRC Pre-K program. For example, differences in personnel structure is one of the areas crucial for implementation quality and efficiency indicated by the prior evaluation of the MRC program (i.e., process assessment), as well as by our interviews and survey data. However, we are unable to know if the variation in costs across sites or across personnel structures is associated with commensurate differences in impact since the impact evaluation did not measure impacts by site or by personnel structure.

Despite these limitations, the cost estimates obtained from this analysis can offer useful information about the return on investment in the program, and specifically the costs borne by schools in a context in which Pre-K programs are underfunded and where improving early literacy skills remains an important policy objective.

7. CONCLUSION

This cost study examined the resources utilized in providing the MRC Pre-K program during the 2013-14 school year for a sample of schools that was evaluated for impacts on emergent literacy outcomes for 3-, 4-, and 5-year-olds. The impact evaluation found positive significant impacts that did not vary significantly by program personnel demographic or by type of site, indicating potential for replication. Our study compliments this evaluation to measure the costs associated with the impacts measured. Overall, the costs of MRC are \$2.1 million per year to serve 1,261 students across twenty-five schools, or \$1,690 per pupil on average. Costs were found to vary substantially by site, by ingredient category and by who bears the burden of the costs across the 25 sites evaluated. This variation is primarily driven by the assignment of Educator Corps and Community Corps across sites.

Our survey data also suggest that different bundles of resources, or personnel structures, may have different relative efficiencies that are perhaps not commensurate to the cost savings. Although the impact evaluation and this accompanying cost analysis cannot directly measure the

relative cost-effectiveness of different personnel structures, this analysis does indicate that costs vary between sites based on the number of assigned members, and by classroom personnel structure. The survey data also indicate that the costliest structures are not necessarily associated with the highest perceived efficiency. For example, classrooms with one Educator Corps member alone are perceived by current Master Coaches to have much lower relative efficiency than providing that Educator Corps member with additional support through either a Community Corps member or an Internal Coach.

These different classroom configurations may have implications for impact. While there are some variations in cost with these different personnel structures, it is possible that the associated impacts may vary disproportionately. This suggests that focusing program design on ensuring Community Corps and Educator Corps members are optimally supported in the classroom may have significant implications for impact. However, it should be noted that our survey data only capture perceived efficiency from a small sample, and are not rigorous data on impact; therefore, this hypothesis has not been tested yet. To continue improving on program design, MRC might consider conducting future evaluations of the impact of different personnel structures or resource bundles within sites and classrooms to understand which personnel structures and combination of resources optimize the quality of classroom instruction.

The costs measured in this study represent investments made by MRC, schools, members, and families. The portion of the costs borne by the schools was about 18% of the total. Thus, schools are able to receive additional personnel, who are trained and supported, to supplement standard classroom practices without financing 100% of the costs of the intervention. In dollars, the average cost per site for resources provided or financed by the school ranged from \$8,570 to \$33,300. Depending on the alternatives available, the MRC Pre-K program may provide a low-cost option for Pre-K schools to enhance reading support for young students. This is particularly valuable given a setting where Pre-K education is systematically budget-constrained.

Minnesota faces budget limitations in Pre-K funding, and as they increase investments toward a targeted approach, policymakers need information to understand which programs provide the greatest return on investment. Thus, it is important to interpret these findings within the context of traditional Pre-K funding in Minnesota. In 2016, student expenditure in Pre-K programs in

Minnesota was \$7,924 per student (NIEER, 2016).³ The average cost per student of \$1,690 indicates that the program is relatively resource intensive, which largely reflects a program model that includes intensive training and continued support. However, from the perspective of the school, MRC is adding about \$370 per student rather than the full amount. Thus, the program offers a low-cost approach for schools even though the program provides about a 25% increase in the investment on schooling received in public Pre-K.

Given previous literature on the effectiveness of various early literacy interventions, under-resourced schools within Minnesota face an important decision of how to address resource constraints to provide the individualized attention that struggling readers might need. This gap can either be filled by additional certified teachers, who are costly and may be in low supply, or volunteers, who likely require intensive support to ensure quality of instruction and scalability. To be effective, volunteer based-programs likely need to be relatively resource-intensive. The results of this study indicate that the MRC Pre-K program provides the resources and a support structure with the necessary intensity to ensure the instructional quality of AmeriCorps members, and delivers impacts on emergent literacy with little required additional investment from under-resourced schools. Identifying such a design that delivers impact and at a relatively small cost to schools is important for decision makers aiming to address the challenges of early literacy faced not only by Minnesota, but by the entire nation.

³ http://nieer.org/wp-content/uploads/2017/05/Minnesota_YB16.pdf

REFERENCES

- Baydar, N., Brooks-Gunn, J., & Furstenberg, F. F. (1993). Early warning signs of functional illiteracy: Predictors in childhood and adolescence. *Child Development, 64*(3), 815-829.
- Boardman, A. E., Greenberg, D. H., Vining, A. R., & Weimer, D. L. (2011). *Cost-benefit analysis: Concepts and practice* (4th ed.). New York, NY: Cambridge University Press.
- Bridges, K. K. (2015). KIDS COUNT Data Center. Retrieved from:
<http://datacenter.kidscount.org/>
- Bruck, M. (1998). Outcomes of adults with childhood histories of dyslexia. In C. Hulme & R. M. Joshi (Eds.), *Reading and spelling: Development and disorders* (179- 200). Mahwah, NJ: Lawrence Erlbaum Associates, Inc., Publishers.
- Chall, J. S., Jacobs, V. A., & Baldwin, L. E. (1990). *The reading crisis: Why poor children fall behind*. Cambridge, MA: Harvard University Press.
- Diaconis, A., Estrera, E., Hafford, C., Hernandez, M., Markovitz, C., Muyskens, P. (2015). *Process assessment of the Minnesota Reading Corps PreK program*. Chicago, IL: NORC at the University of Chicago.
- Felton, R. H. (1998). The development of reading skills in poor readers: Educational implications. In C. Hulme & R. M. Joshi (Eds.), *Reading and spelling: Development and disorders* (219-233). Mahwah, NJ: Lawrence Erlbaum Associates, Inc., Publishers.
- Greene, W. H. (2000). *Econometric Analysis*. Upper Saddle River, NJ: Prentice Hall.
- Grossman, J. B., & Furano, K. (1999). Making the most of volunteers. *Law and Contemporary Problems, 62*(4), 199-218.
- Hafford, C., Markovitz, C., Hernandez, M., Hedberg, E., Silberglitt, B., Langerman, H.,... Kiss, M. (2013). *Process assessment of the Minnesota Reading Corps*. Chicago, IL: NORC at the University of Chicago.
- Hager, M. A., & Brudney, J. L. (2004). *Balancing act: The challenges and benefits of volunteers*. Washington, DC: The Urban Institute.
- Hollands, F. M., Pan, Y., Shand, R., Cheng, H., Levin, H. M., Belfield, C. R., ... Hanisch-Cerda, B. (2013). *Improving early literacy: Cost-effectiveness analysis of effective reading programs*. New York, NY: Center for Benefit-Cost Studies of Education, Teachers College, Columbia University.
- Horst, K., & Passe, A. (2004). *Creating Literacy Rich Classrooms for Preschool Children (Ages*

-
- 0-5). Presented at the 2004 *CEED Symposium*. Minneapolis, MN.
- Jacob, R., Armstrong, C., & Willard, J. (2015). *Mobilizing volunteer tutors to improve student literacy: Implementation, impacts, and costs of the Reading Partners program*. New York, NY: MDRC.
- Jacob, R., Armstrong, C., Bowden, A. B., & Pan, Y. (2016). Leveraging volunteers: An experimental evaluation of a tutoring program for struggling readers. *Journal of Research on Educational Effectiveness*, 9(sup1), 67-92.
- Levin, H. M. (1975). Cost-effectiveness analysis in evaluation research. In M. Guttenbag & E. L. Struening (Eds.). *Handbook of evaluation research* (Vol. 2, Chap. 5). Beverly Hills, CA: Sage.
- Levin, H. M. (1983). *Cost-effectiveness analysis*. Beverly Hills, CA: Sage.
- Levin, H. M., & McEwan, P. J. (2001). *Cost-effectiveness analysis: Methods and applications* (Vol. 4). Beverly Hills, CA: Sage.
- Levin, H. M., McEwan, P. J., Belfield, C., Bowden, A. B., & Shand, R. (2018). *Economic evaluation in education: Cost-effectiveness and benefit-cost analysis*. Beverly Hills, CA: Sage.
- Lonigan, C. J., & Shanahan, T. (2009). Developing Early Literacy: Report of the National Early Literacy Panel. Executive Summary. A Scientific Synthesis of Early Literacy Development and Implications for Intervention. Washington, DC. *National Institute for Literacy*.
- Markovitz, C. E., Hernandez, M. W., Hedberg, E. C., & Silberglitt, B. (2014). *Impact evaluation of the Minnesota Reading Corps K-3 program*. Chicago, IL: NORC at the University of Chicago.
- Markovitz, C. E., Hernandez, M. W., Hedberg, E. C., & Silberglitt, B. (2015). *Outcome evaluation of the Minnesota Reading Corps PreK program*. Chicago, IL: NORC at the University of Chicago.
- May, H., Gray, A., Gillespie, J. N., Sirinides, P., Sam, C., Goldsworthy, ... Tognatta, N. (2013). *Evaluation of the i3 scale-up of Reading Recovery: Year one report, 2011-12*. Philadelphia, PA: Consortium for Policy Research in Education.
- Meier, J. D., & Invernizzi, M. (2001). Book Buddies in the Bronx: Testing a model for America Reads. *Journal of Education for Students Placed at Risk*, 6(4), 319-333.

-
- Morrow-Howell, N., Jonson-Reid, M., McCrary, S., Lee, Y., & Spitznagel, E. (2009). *Evaluation of Experience Corps: Student reading outcomes* (CSD Research Report 09-01). St. Louis, MO: Washington University, Center for Social Development.
- NAEP. (2015a). National Center for Education Statistics. The Nation's Report Card: National Results Overview for Reading. National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, Washington, D.C.
- NAEP. (2015b). *The Nation's Report Card – 2015 Reading State Snapshot Report, Minnesota, Grade 8, Public Schools*. U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), various years, 1998-2015 Reading Assessments.
- NIEER. (2016). National Institute for Early Education Research. Minnesota Report. Retrieved from: http://nieer.org/wp-content/uploads/2017/05/Minnesota_YB16.pdf
- Ramey, M. (1991). Compensatory Education Sustained Gains from Spring 1988 to Spring 1990. Report No. 91-1.
- Simon, J. (2011). *A cost-effectiveness analysis of early literacy interventions*. Columbia University.
- Slavin, R. E., Lake, C., Davis, S., and Madden, N.A. (2011). Effective programs for struggling readers: A best-evidence synthesis. *Educational Research Review*, 6(1), 1-26.