



Identifying the essential ingredients to literacy and numeracy improvement: Teacher professional development and coaching, student textbooks, and structured teachers' guides



Benjamin Piper^{a,*}, Stephanie Simmons Zuilkowski^b, Margaret Dubeck^c, Evelyn Jepkemei^a, Simon J. King^d

^a RTI International, Misha Tower, 3rd Floor, 47 Westlands Road, P.O. Box 1181-00621, Village Market, Nairobi, Kenya

^b Learning Systems Institute, Florida State University, University Center C 4600, Tallahassee, FL 32306, USA

^c RTI International, 701 13th Street, NW, Suite 750, Washington, DC 20005-3967, USA

^d RTI International, 3040 Cornwallis Road, P.O. Box 12194, Research Triangle Park, NC 27709-2194, USA

ARTICLE INFO

Article history:

Accepted 24 January 2018

Keywords:

Literacy
Numeracy
Africa
Program evaluation
Randomized controlled trial
Reading

ABSTRACT

Several rigorously evaluated programs have recently shown positive effects on early literacy and numeracy outcomes in developing countries. However, these programs have not been designed to evaluate which ingredients of the interventions are most essential to improve literacy outcomes. Policy makers therefore lack evidence as to whether program ingredients such as teacher professional development (PD), instructional coaching, learner materials, teachers' guides, community support, or technology are required for program impact. The Kenya Primary Math and Reading Initiative was a randomized controlled trial that compared three treatment groups with specific ingredients and a control group. Using literacy and numeracy outcome measures for grades 1 and 2, we evaluated the benefits of the following ingredients: (1) teacher PD and teacher instructional support and coaching; (2) revised student books in literacy and numeracy, at a 1:1 ratio, added to PD and instructional support; and (3) structured teacher lesson plans added to student books, PD, and instructional support. We found that two of the three combinations of ingredients had statistically significant positive impacts on learning outcomes. The results showed that the third combination—PD, teacher instructional support and coaching, 1:1 student books, and structured teacher lesson plans—was most effective. A cost-effectiveness analysis on the ingredients showed that the option of PD and instructional support, 1:1 revised books, and teachers' guides was the most expensive, but that the additional impact on learning made this the most cost-effective intervention. This study rigorously analyzes which ingredients for literacy and numeracy improvement would be most effective for overall impact, and suggests to policy makers that careful decisions regarding program ingredients will lead to more effectively designed and implemented interventions to improve learning in developing countries.

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1. Introduction

In recent years, national and international education policy makers increasingly have focused on quality—what do children learn in school, and how valuable are those skills when they leave school? This emphasis is evident in the new Sustainable Development Goals, adopted in 2015. Goal 4 is “Ensure inclusive and equitable quality education and promote lifelong learning,” and more specifically, target 4.6 states: “by 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve

literacy and numeracy” (United Nations, 2015, p. 21). Improving learning outcomes is, therefore, now a critical interest of donors and national governments alike.

Although stating that educational quality is important is a necessary first step for national policy makers, they must now begin the difficult work of determining *how* to improve their systems in order to achieve the goals of literacy and numeracy for all. Educational policy making can be difficult in any country, but it is especially challenging in developing countries, where both resources and guiding evidence are particularly scarce. Regarding the evidence (or lack thereof), whereas ever more early grade literacy programs are being rigorously evaluated, such research typically has not shown the effects of specific elements of the programs' technical design. In other words, a researcher might group a literacy program into the broad category of “teacher

* Corresponding author.

E-mail addresses: bpiper@rti.org (B. Piper), szuilkowski@lsi.fsu.edu (S. Simmons Zuilkowski), dubeck@rti.org (M. Dubeck), ejepkemei@tusome.rti.org (E. Jepkemei), sjking@rti.org (S.J. King).

professional development” (PD), but then not comprehensively evaluate the impact of program components such as teacher in-service training, teacher pre-service training, a 1:1 pupil-to-textbook ratio, additional supplementary readers, or teacher lesson plans. Recent research in developing-country contexts has shown that effective programs can have a combination of possible intervention components—teacher professional development, student books, teachers’ guides with daily lesson plans, community interventions, information and communication technology (ICT) interventions, and teacher coaching. Given the wide range of program components that may exist within a single study, meta-analyses of these types of studies do not result in a proven set of ingredients that education planners can choose from. Although a larger body of research has examined specific components of literacy programs tightly focused on quality improvement, such as textbook provision and structured teachers’ guides, the literature is mixed and controversial. Given the few rigorous studies in Southern countries, there is even less evidence regarding the specific components required to improve numeracy outcomes.

Faced with this lack of clear evidence, it is important to compare various distinct program ingredients against different ingredient combinations, rather than solely comparing each treatment with a control group. In this paper, we aim to provide evidence on the effectiveness of three components of a literacy and numeracy intervention in the Kenyan context. This is important in Kenya, as in other countries focused on instructional improvement, due to the explicit attention paid to improved learning outcomes (the National Education Sector Plan: Ministry of Education [MoE], 2014) and the existence of ongoing, large-scale interventions that aim to rapidly improve learning outcomes. Given scarce resources in the Kenyan context, policy makers need to have evidence not only about the effect of programs, but also about the cost-effectiveness of the options available. This area of research is remarkably nascent, with few large-scale initiatives providing policy makers with cost-effectiveness comparisons (Piper, Zuilkowski, & Mugenda, 2014). Below, we examine how the different components of one intervention worked together to improve primary students’ literacy and numeracy outcomes. This evidence may assist policy makers in deciding how to most effectively allocate educational funding in resource-scarce settings.

2. Background and context

2.1. Improving literacy and numeracy in developing countries—what works?

Several recent meta-analyses and systematic reviews have attempted to assess the effects of a range of educational intervention types that have been used in developing countries (Conn, 2014; Ganimian & Murnane, 2016; Glewwe, Hanushek, Humpage, & Ravina, 2013; Kremer, Brannen, & Glennerster, 2013; Kremer & Holla, 2009; Krishnaratne, White, & Carpenter, 2013; McEwan, 2015). As noted by Evans and Popova (2015), these reviews have little overlap in the studies included, and they sometimes categorize studies differently, possibly explaining their divergent findings. Additionally, such approaches compress wide categories of interventions—those using ICT, for example—into one averaged effect size. While this is a useful first step from a policy-making perspective, it does not go far enough in giving education policy makers the specific information they need. Early grade literacy and numeracy programs in developing countries may include a wide range of component parts. In some cases, all of these parts may be complementary and necessary in order to produce positive student results. In other cases, the effect may be driven by one or two of those components, with other parts of

the program increasing the cost but not producing additional benefits. In this section, we briefly review the evidence for three components that are typically part of such programs—teacher professional development, student textbooks, and teachers’ guides that include daily lesson plans.

The most basic version of the intervention discussed in this study (described further below) involved teacher professional development. Given that student–teacher interactions are at the core of learning to read, and that much of the teaching pedagogy used in Kenya is a didactic type not supported by current research (Dubeck, Jukes, & Okello, 2012), with limited teacher and student interactions (Ackers & Hardman, 2001), it is critical that teachers already in the classroom be retrained in literacy and numeracy pedagogical techniques. Piper and Spratt (2017) reviewed potential options for teacher professional development for Cambodia, describing a range of options that could be effective in the current educational context, many of which could be applicable in Kenya.

While not all teacher professional development programs are successful, studies in Kenya have found that teacher professional development programs can improve teachers’ literacy knowledge (Dubeck, Jukes, Brooker, Drake, & Inyega, 2015). In a meta-analysis of 17 rigorous studies of primary-level teacher professional development programs in developing countries, McEwan (2015) found a mean effect size on student outcomes of 0.12 standard deviations (SD). Conn (2014), examining studies in sub-Saharan Africa in her meta-analysis, found far larger effects for pedagogical interventions, a broader category that includes teacher coaching: 0.918 SD for all studies, and 0.228 SD for those she categorized as “high quality.”

In addition to teacher professional development, all three variations of the program studied here included teacher coaching as a base element. In the United States, studies in a variety of contexts have shown that coaching approaches can impact teacher pedagogy and student outcomes (Biancarosa, Bryk, & Dexter, 2010; Carlisle, Cortina, & Katz, 2011; Matsumura, Garnier, Correnti, Junker, & Bickel, 2010; Teemant, 2014). While evidence on coaching-based professional development is limited in sub-Saharan Africa, our work in Kenya found that this approach was also effective in this context (Piper & Zuilkowski, 2015; Piper et al., 2014; Zuilkowski & Piper, 2017). Given that Kenyan teachers generally have two or three years of postsecondary education, compared to four or more in wealthier countries, such one-on-one support is critical in developing teacher skills.

The role of text access in learning to read is central: While students can learn letters and words from a blackboard or slate, children cannot truly become fluent readers without exposure to a variety of reading material (Kim, Boyle, Zuilkowski, & Nakamura, 2017). Teachers in resource-poor contexts greatly value textbooks as pedagogic tools (Lee & Zuilkowski, 2015). The empirical evidence on the relationship between textbooks and student achievement is mixed, however. A number of studies, many conducted in the 1980s and 1990s, have found positive associations between textbook availability and outcomes in developing countries (Fehrler, Michaelowa, & Wechtler, 2009; Fuller, 1987; Harbison & Hanushek, 1992; Heyneman & Jamison, 1980; Heyneman, Jamison, & Montenegro, 1984; Lockheed, Vail, & Fuller, 1986; Riddell & Nyagura, 1991; Yara & Otieno, 2010). Many of these studies used multiple regression analytic methods that were unable to isolate the causal effect of the textbooks. More recently, other studies have shown that the mere presence of books is not enough to ensure improved student performance; other factors interact with the availability of textbooks to produce effects (Mohammed & Kumari, 2007; Read, 2011; Sabarwal, Evans, & Marshak, 2013; Somers, 2011). A recent meta-analysis found that the mean effect size for interventions that included instructional materials was just 0.08 standard deviations (SD) (McEwan, 2015). As noted above,

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