Title: Estimating the Cost-Effectiveness of a Comprehensive Kindergarten Literacy and Science Curriculum that Strengthens Reading at Home.

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Background/Context: Lags in early reading skills continue to be a major issue for many students across the country. The curriculum evaluated here, *Zoology One,* aims to address this issue by providing a comprehensive approach to teaching and supporting literacy, providing engaging materials, increasing the volume of reading – which includes leveraging parents and caregivers through daily reading at home, empowering students to be independent learners, and scaffolding teaching on a leveled system that integrates books, formative assessment, and teaching strategies. The program integrates literacy instruction with science, which is theorized to facilitate learning by increasing motivation and improving students' background knowledge and vocabulary. Critically, the mission of the program is to have all students on grade level at the completion of kindergarten, regardless of where they started the year. This paper provides methods and results from the cost-effectiveness component of an efficacy trial of the curriculum.

Purpose/Objective/Research Question: This paper focuses on estimating the total costs of *Zoology One*, as they correspond to the production of effects. This estimation strategy, also called a cost-effectiveness framework, is now required by IES as a component of efficacy trials. We estimate the distribution of costs that were borne by the school and those contributed by students' households. We also examine variation in resources – such as teaching time, home reading assigned, supplemental curricular materials, supplemental support for struggling students – within and across experimental conditions and cohorts.

Setting: This multi-site randomized field trial was conducted in the School District of Philadelphia. The sample was split into two cohorts based on year of entry into kindergarten. The sample includes 35 treatment classrooms and 33 control classrooms that were randomized to receive the program of interest or to continue with business as usual.

Population/Participants/Subjects: The participants in this study are kindergarten students, teachers, principals, and program staff.

Intervention/Program/Practice: *Zoology One* a is an integration literacy and science curriculum for kindergarteners. The program is guided by the theory that children learn better when they are motivated and engaged, when they read frequently and with different individuals, when materials are targeted at their reading level, and when reading occurs in the classroom and at home. This theory hinges on the availability of materials and books to read, highly trained and prepared teachers, and a curriculum that comprehensively addresses literacy development. An additional component to this process is the incorporation of authentic assessment and data driven instruction.

The program was delivered in two cohorts where approximately half the sample was served in year one and the other half was served in year two. Implementation for the evaluation was completed in June 2018.

Research Design: We examined the resources ("ingredients") used during implementation in order to understand the contrast between the treatment and control groups in the production of the outcome (Levin, McEwan, Belfield, Bowden, & Shand, 2018; Century & Cassata, 2016; Hulleman & Cordray, 2009). Following the ingredients method, we estimated the costs to replicate effects by: 1) identifying ingredients of *Zoology One*, 2) collecting data to describe and quantify ingredients, and to understand how resource use contrasts between treatment and control classrooms, 3) pricing ingredients and estimating costs, 4) estimating variation in costs and the distribution of cost financing, and 5) examining costs relative to effects. Data collection on resource use was done simultaneously with data collection on implementation. Thus, we have cost estimates for each classroom in each school. These data allow us to examine the contrast in resources used by treatment and control classrooms and the variation within those groups.

This cost-effectiveness efficacy trial is exemplary as one of the first rigorous trials funded by IES to produce results.

Data Collection and Analysis: The cost component of the evaluation used data from the program's management information system, school district records, classroom observations, interviews with teachers and principals, teacher surveys, teacher time logs, teacher reported needs for supplemental supports for students who were behind, and coach surveys and interviews.

Findings/Results: Students in the treatment group received more literacy instruction in school and at home than the control group. The teachers allocated 30 minutes more to literacy instruction in the treatment classrooms. However, when science instruction is added to the control teachers' instructional time, there appears to be no difference across groups in the amount of instruction on literacy and science by the students' primary kindergarten teacher.

We saw small differences in teacher time for preparation to teach, with treatment teachers allocating more time to prep. This finding is logical as any new curriculum would take time to prepare new lessons. The critical component to this finding though is the invisible nature of teacher time, which is largely ignored in evaluations of curricula.

Treatment teachers assigned more home reading. However, there was large variation across and among experimental groups in the assignment of reading and the completion of home reading. While this finding supports the theory of change on average, the variation in implementation suggests areas for further research and opportunities to strengthen the home reading component.

The treatment also had obvious costs, such one set of books and class materials (including a formative assessment system, read aloud books, practice guides, etc.) per classroom, literacy coaches, and professional development. Interestingly, in year one this package of resources was largely incremental to the standard practice amongst the control classrooms – meaning that the total cost of these aspects of the program are equivalent to the cost above and beyond business as usual. In year two, this contrast was less clear and, in some cases, equivalent to only the books and materials.

Conclusions: This paper highlights potential efficiencies through employing one comprehensive curriculum rather than many layered curricular materials to teach early literacy. Overall, the costs of Zoology One are largely driven by the coaching component, which was not as large of a contrast in the second year of the study. The observed differences in levels of resources available to and used by teachers provide contextual and replication information regarding the generalizability of these findings and point to future work to explore mechanisms in the production of effects.