Using Design-Based Implementation Research and a Randomized Controlled Trial to Replicate, Refine, and Study the Effectiveness of a Model of Reading Engagement (MORE) on First-Graders' Science Domain Knowledge, Reading Motivation and Engagement, and Reading Comprehension

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Background/Context: Too many U.S. school children and adolescents struggle to read and understand complex expository texts. According to descriptive findings from the Early Children Longitudinal Survey (Reardon, Valentino, & Shores 2011), fewer than 5% of US first-graders can understand complex texts requiring prior knowledge of science and social studies content, and, as eighth-graders, only 37% of these students are proficient in evaluating complex nonfiction. On literacy tasks that require background knowledge of school subjects, low-income children enter high school with literacy skills that are, on average, five years below their high-income classmates. Why do so many young children, particularly from low-income families, struggle to read complex expository texts with understanding?

Children's opportunity to acquire science (and social studies) content in school may play a critical role. For example, descriptive studies of instructional practices in first- and third-grade classrooms suggest that schools are reducing time devote to content area instruction and instructional practices that allow students to extend their understanding of science and social studies content (Connor, Ingebrand, Dombek, 2013; National Institute of Child Health and Human Development and Early Child Care Research Network, 2002, 2005; Shanahan, 2017). In response to this challenge, researchers have developed and tested interventions that ground elementary grades literacy instruction in social studies and science content (Cervetti, Pearson, Barvo, & Barber, 2006; Goldschmidt, 2009; Mantzicopoulos, Patrick, & Samarapungavan, 2013; Pearson, Moje, & Greenleaf, 2010; Connor et al., 2017).

Purpose/Research Question: To improve first-graders' science domain knowledge and literacy skills, we used Design Based Implementation Research to co-develop the components of a Model of Reading Engagement (MORE) intervention with teachers in an urban school district and then used a randomized controlled trial design to test its effectiveness at scale in a representative sample of 36 classrooms in 10 K-5 elementary schools. In the two-week MORE lesson unit, teachers ground literacy instruction in science content (Connor et al., 2017; Pearson, Moje, & Greenleaf, 2010; Romance & Vitale, 2001; Williams, Stafford, Lauer, Hall, & Pollini, 2009), use conceptually-related trade books (Cervetti, Wright, & Hwang, 2016; Guthrie, McRae, & Klauda, 2007), and teach children to read and write about science content and vocabulary (Graham & Hebert, 2010). In this study, we report findings from the RCT study to address the following question:

1. Compared to typical instruction, what is the impact of MORE on near transfer measures of first-graders' (a) task specific motivation, and (b) domain specific science vocabulary and content knowledge, and argumentative writing?

2. Compared to typical instruction, what is the impact of MORE on far transfer measures of first-graders' (a) reading comprehension and basic literacy skills, and (b) motivational and behavioral engagement?

Population/Participants/Subjects: A total of 674 first-graders (89%) received parental consent. Students were nested in 36 grade 1 classrooms. Table 1 displays demographic characteristics of the children at the beginning of the study. The first-graders in this study included mostly African-American and Hispanic children and one-fifth were classified as having limited English proficiency. Although the district does not provide family income data (i.e., eligibility for free and reduced lunch), the majority of children (63%) attended Title I schools that receive federal funding to serve the educational needs of economically disadvantaged children. We pre-registered this study prior to implementation activities.

Intervention/Program/Practice: The MORE intervention is a content area literacy program for the early elementary grades (K-3). This RCT focuses on the first-grade MORE curriculum. First-grade classroom teachers implemented a 10-day unit on the theme of animal survival. The intervention aims to: (a) embed science content into English language arts instruction to build domain-specific knowledge; (b) select interesting and conceptually-connected books in content area instruction to facilitate domain specific vocabulary knowledge and argumentative writing skills; (c) increase the time students read and write about related science concepts, and (d) increase opportunities for children to read conceptually related books at home.

Research Design: This study is a cluster (classroom) randomized controlled trial design. A total of 36 first-grade classroom teachers in 10 K-5 elementary schools were randomly assigned to typical instruction or treatment conditions during the two-week implementation period. There was no statistically significant difference on any pretest reading or demographic measure.

Data Collection: We collected administrative data to address questions about far transfer effects (NWEA MAP; Measure of Academic Progress, Primary Grade Reading Comprehension) and researcher-administered data to address questions about near transfer effects.

Findings: On the near transfer measure, there was no statistically significant effect on task specific motivation measures (i.e., children's perceived competence and valuing of the MORE lesson books). There was a statistically significant positive impact of MORE on a measure of domain-specific vocabulary and comprehension (impact estimate = 2.074, s.e. = .463, $p < .001$) and argumentative writing (impact estimate = .35, s.e. = .139, $p < .05$), and a far transfer measure of reading comprehension (impact estimate = 1.64, s.e. = .81, $p < .05$). There was no negative effect on far transfer basic literacy skills and behavioral and motivational engagement.

Conclusions: The results indicate that a brief content area literacy intervention can work in first grade to improve both student's domain knowledge and reading comprehension. In addition, the results indicate that there is no negative effect on basic literacy skills or student motivation. Additional analyses will shed light on the classroom levers of change including an analysis of the

texts used during literacy instruction and the time spent on content area instruction and expository writing.

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Tables.

Table 1 *Demographic characteristics of students in the baseline sample by group*

	TI	MS	MSH	Total
Gender				
Female	118	99	122	339
Male	100	110	113	323
Race/Ethnicity				
African American	70	69	78	217
Asian	16	19	25	60
Hispanic/Latino	75	65	81	221
White	53	47	41	141
Other race/ethnicity	4	9	10	23
English Proficiency				
English Proficient	166	174	186	526
Limited English Proficiency	52	35	49	136
Special Education Status				
Not receiving services	205	191	221	617
Receiving special education services	13	18	14	45
Attend a Title I School?				
Yes	140	130	156	426
No	84	83	81	248
Have Demographic Data?				
Yes	218	209	235	662
No	6	4	2	12
Have MAP ELA MOY Data?				
Yes	165	146	173	484
No	59	67	64	190
Total	224	213	237	674