

Linking instructional aspects of children's early classroom learning experiences to student outcomes in PreK and Kindergarten

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Background. Rigorous studies point to the potential for high-quality early education to reduce income-, race-, and language-based gaps in school readiness skills (Magnuson & Duncan, 2016; Waldfogel, 2015). However, there is no conclusive evidence about the specific aspects of early learning experiences that matter most for generating sustained gains for learners as they move from PreK to elementary school. Adding to this challenge is a growing sense that current observational measures of quality do not capture the full range of practices critical for promoting students' skills (Burchinal, 2018). A vast body of empirical work has focused on the structural, process, and instructional quality features of classroom experiences, showing these dimensions to have small or inconsistent links with gains in child outcomes (Burchinal et al., 2011; Weiland et al., 2013). Indicators of instructional quality like the promotion of children's vocabulary and higher-order thinking have shown stronger associations with gains in students' skills. Yet, the magnitude of these associations remains modest (Burchinal et al., 2016). As localities aim to scale high-quality programs that improve student outcomes and reduce early achievement gaps, the field needs new measures to capture the breadth of practices that may be critical for promoting students' outcomes (Weiland et al., 2018). Many conceptualizations of instructional quality focus on *how teachers teach* in terms of instructional practices. Largely absent is a focus on *what teachers teach*, specifically the delivery of rich, complex content presented in a *cognitively demanding way*.

Objective. The current study examines the extent to which a new set of observational items validly and reliably captures information about aspects of instructional quality—vocabulary promotion, cognitively demanding teaching practices, and content-rich instruction—in PreK and kindergarten. We consider whether these practices vary by grade, teacher experience, and classroom composition; and whether they predict gains in language, math, and executive functioning skills beyond extant measures of process and instructional quality. We also examine whether associations between practices and gains vary by children's skills at school entry.

Setting, Participants, and Research Design. This study was conducted in partnership with the Boston Public Schools (BPS) Department of Early Childhood. The sample includes 41 public-school PreK classrooms and 10 community-based organizations (CBOs) and 114 kindergarten classrooms. Most teachers reported using BPS's *Focus* curriculum, which is based on the language and literacy-focused curriculum, *Opening the World of Learning* (Schickedanz & Dickinson, 2004) and the *Building Blocks* math curriculum (Clements & Sarama, 2008). Data on

child skills were collected in the Fall and Spring of PreK and kindergarten, and information on curricular implementation and classroom quality was collected during the Winter of each year.

Data. The team collected assessments of children's language (PPVT; Dunn & Dunn, 2007), math (REMA; [Clements et al., 2008]; WJ Applied Problems [Woodcock et al., 2001]), and executive functioning (Digit Span [Wechsler, 1974]; Hearts & Flowers [Diamond et al., 2011]). Data on classroom quality (CLASS; Pianta et al., 2008) and quality of curricular implementation (team-developed observational tool) were collected by observing each classroom for two hours each on two separate days. At the end of each fidelity observation, the observer rated 13 items assessing the quality of implementation across the observation. Global items used a 5-point scale ranging from low quality/little evidence (1) to high quality/substantial evidence (5).

Analysis. Exploratory factor analysis was used to examine the factor structure of the 13 items using the PreK and kindergarten samples. Measures were created by averaging the items loading onto each factor. Comparison of measures by auspice (CBO vs. public school), grade (PreK vs. K), classroom composition (50% or more students are DLLs vs. less than 50%, 50% or more students are Black or Hispanic vs. less than 50%, 50% or more students eligible for free/reduced price lunch [FRPL] vs. less than 50%), and teacher experience was examined using t-tests. Multilevel models were conducted in a step-wise manner to examine whether the practices predicted child gains controlling for baseline assessment of the outcome, child characteristics (eligibility for FRPL, sex, DLL status, ethnicity, age at start of school year), auspice, the CLASS domain scores, and the new quality measures. We then tested for moderation by interacting each quality measure with the baseline score on the outcome.

Findings. A 3-factor solution was the best fit for the data: Vocabulary, Cognitive Demand, and Instructional Content. Table 1 shows the psychometrics for each factor, indicating good internal consistency. Correlations among factors were moderately high (.62 to .68) but not so high to suggest they were redundant. Means for the measures were around a 3, showing that teachers implemented these practices at a moderate level of quality or somewhat consistently, but with wide variation. Moderate correlations were found between Cognitive Demand and two CLASS domains (Classroom Organization and Instructional Support; $r_s = .30-.32$). Instructional Content varied by grade (higher in PreK in comparison to K) and by one aspect of classroom composition (higher in K classrooms where more than 50% of the students were DLL), but the other quality measures did not vary by auspice, grade, classroom composition, or teacher experience.

Multilevel models showed that Cognitive Demand negatively predicted PreK gains in math whereas Instructional Content positively predicted PreK gains in math (Applied Problems). The interaction between Cognitive Demand and baseline skills was significant when predicting math skills (Applied Problems) and executive function (Hearts & Flowers). The interaction between Vocabulary and baseline skills was significant when predicting math skills (REMA) (See Figure 1).

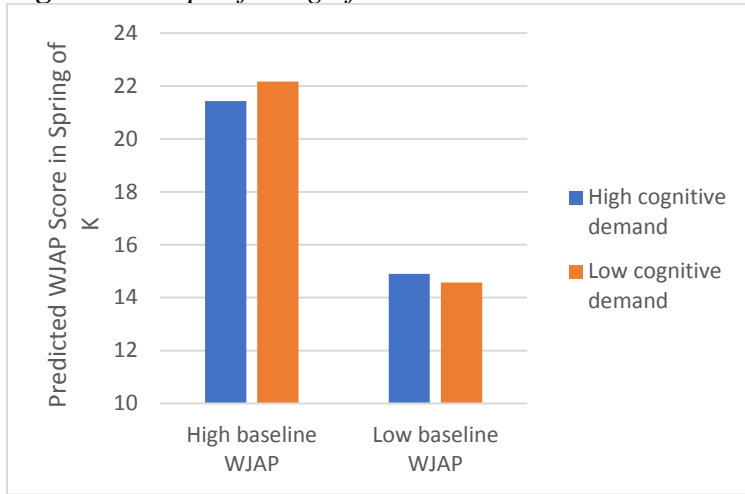
Conclusions. Findings provide evidence for reliability, face validity, and predictive validity for these different aspects of instructional quality. Some associations between Cognitive Demand, as well as Vocabulary, and student gains varied for students were entered school with higher versus

lower skill levels. High cognitive demand may be important for students beginning the year with lower math and executive function skills. Less focus on vocabulary was associated with more math gains for students beginning the year with lower math skills. Findings provide preliminary evidence that a new set of measures—diving further into instructional quality—has promise in predicting outcomes in PreK and kindergarten.

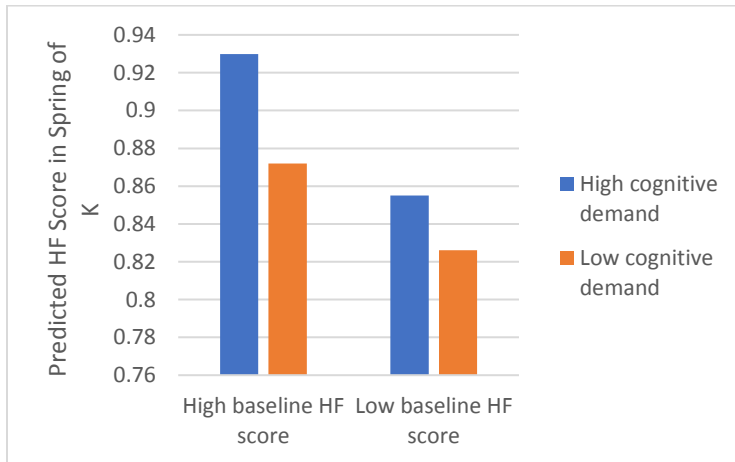
Table 1. *Items loading onto each of the three quality measures*

Vocabulary $\alpha = .78$	How often are relevant vocabulary and rich academic language used and clearly defined throughout the observation?"
	How many theme-specific vocabulary words did the teacher define?
Cognitive Demand $\alpha = .87$	Teacher talks to children in ways that encourage them to expand on or think more deeply about ideas.
	To what degree does this teacher use differentiated learning strategies to make the curriculum accessible to and address the range of children in the classroom
	To what degree does this classroom capitalize on learning opportunities for children?
	To what degree is it the classroom culture to discuss and explicitly demonstrate diversity?
	To what degree are the learning opportunities in this classroom cognitively demanding?
Instructional Content $\alpha = .90$	Teacher connects or links activities to the curriculum unit or book in explicit and intentional ways.
	How rich is the content delivered on the theme/focal question?
	How much evidence of the theme/focal question did you see in this classroom instructional time?
	To what degree did the teacher make connections between activities to deepen children's understanding of the theme/focal question?
	To what degree is there evidence of the theme in classroom materials, including materials within centers and students' work on the walls?

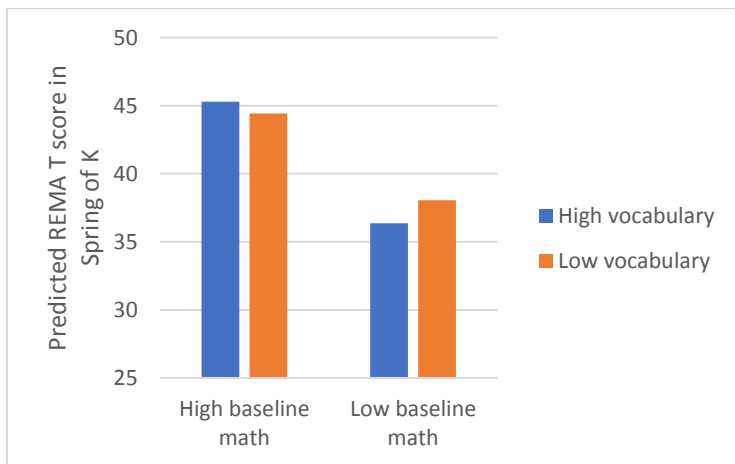
Figure 1. Graphs for significant interactions between instructional practices and student gains.



(a) Graph of interaction between cognitive demand and baseline math scores (WJ Applied Problems)



(b) Graph of interaction between cognitive demand and baseline executive function scores (Hearts & Flowers)



(c) Graph of interaction between vocabulary and baseline math scores (REMA)