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Widely Used Measures of Classroom Quality Are Largely Unrelated to Preschool Skill Development

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Widely Used Measures of Classroom Quality Are Largely Unrelated to Preschool Skill Development

Early childhood education programs (ECE) invest in assessments of classroom quality to enable accountability and to enact efforts towards quality improvement. The *Early Childhood Environment Rating System – Revised* (ECERS-R) and *Classroom Assessment Scoring System* (CLASS) are two widely used classroom quality assessments that have inconsistently been linked to longitudinal change in preschoolers' school-readiness skills. The current study examined how the ECERS-R and CLASS scores relate to changes in preschoolers' skills and whether associations are stronger in the second half of the school year than across the whole school year. We used data from classrooms in a San Francisco Bay Area preschool program primarily serving low-income families; 164 classrooms were observed using the CLASS (N = 2,327) and 131 classrooms were observed using ECERS-R (N = 1,792). School readiness was assessed using teacher reports of cognitive, physical, self-regulation, social-emotional, verbal language, and written language development measured in the fall, winter, and spring and a direct assessment of children's letter awareness and pre-literacy skills measured in the fall and spring. Results showed that measures of classroom quality did not relate to children's skills in spring controlling for fall skills, while the ECERS-R *Interactions* was the only quality domain associated with all teacher-reported skills in spring controlling for winter scores. We provide recommendations to incorporate professional development, coaching, and assessment to improve classroom interactions and support child skills throughout the preschool year.

Keywords: Classroom quality; Preschool skills; Early Childhood Environment Rating Scale; Classroom Assessment Scoring System; Quality Resource and Improvement System

To improve preschool quality across early childhood education, the field has enacted quality standards and developed systems to measure and track quality improvements (Bassok & Galdo, 2016; Friedman-Krauss et al., 2020; National Center on Early Childhood Quality Assurance, 2016). Two measures of classroom quality, the *Early Childhood Environmental Rating Scale - Revised* (ECERS-R) and *Classroom Assessment Scoring System* (CLASS) have been widely adopted to provide a rating score for programs and provide information to families, practitioners, and program or school administrators about the quality of their local programs (Friedman-Krauss et al., 2020). Across the 41 statewide Quality Rating Improvement Systems (QRIS) employed to measure the quality of preschool programs in the United States, 76% use Environment Rating System scales such as ECERS-R and 44% use the CLASS, with some programs using both quality rating systems (National Center on Early Childhood Quality Assurance, 2016). Despite widespread use of these classroom quality measures, it remains unclear whether the quality domains measured by ECERS-R and CLASS are associated with improvements in child outcomes during their preschool year (Gordon et al., 2013; Guerrero-Rosada et al., 2021; Howes et al., 2008; Mashburn et al., 2008; Sylva et al., 2006; Weiland et al., 2013). Because so many states use these measures as an index of quality control, it is important to know whether these measures relate to children's development during preschool.

Leveraging administrative data from five cohorts of preschool children from a district-wide preschool program primarily serving children from low-income families in the San Francisco Bay Area, we test whether classroom quality domains from ECERS-R and CLASS are associated with gains in school-readiness skills across the preschool year. Specifically, we test whether the domains of classroom quality measured by ECERS-R and CLASS relate to change in: (1) teacher-reported language, cognitive, social-emotional, and physical skill development

between the fall and spring and between the winter and spring; and (2) direct assessments of pre-literacy skills between the fall and spring.

Preschool Program Quality and Pre-Academic Skills

Studies of early preschool programs (Perry Preschool, Carolina Abecedarian) with high-quality structures, educational activities, high teacher qualifications, and wrap-around services for families demonstrated positive effects on early academic skills such as language, literacy, and math, as well as longitudinal improvements in social-emotional skills for children from low-income families (Barnett, 1985; Ramey et al., 1975). Encouraged by the promising effects investing in high-quality early childhood programs has on equitable outcomes for children from lower-income families and a continued need for early care and education to support the growing number of women in the labor force, early childhood education proponents have sought to increase access to preschool for children in low-income families with federal, state, and local funding (Barnett & Ackerman, 2006; Greenberg et al., 2019). There is also a continued need to improve program quality across the field as it is believed to be a key factor in sustained, positive effects of preschool impacts (Burchinal, 2018; Friedman-Krauss et al., 2020; Maier et al., 2020; Pianta et al., 2020),

The development of standardized observational measures of classroom quality has allowed the field of early childhood education to better set and track goals for improvement in preschool programs (Burchinal, 2018). According to Tseng and Seidman's (2007)systems framework for understanding social settings, the three components necessary for targeting and improving dynamic social settings are resources, organization of resources, and social processes. Within the quality measurement of early childhood programs, these boil down to two components of classroom quality that practitioners and researchers believe to be imperative for

safe and supportive preschool classrooms: structural quality and process quality (Burchinal, 2018). Structural quality refers to the developmentally appropriate space and resources present in the classroom, while process quality refers to classroom interactions, behavioral supports, learning approaches, and emotional climate.

Two observation scales that are commonly used in both research and practice to measure classroom quality are the Early Childhood Environmental Rating Scale (ECERS) and the Classroom Assessment Scoring System (CLASS). The ECERS-Revised (ECERS-R) was developed to capture a range of developmentally appropriate program structures (structural quality) and patterns of interactions between teachers and children (process quality) in preschool settings (Harms et al., 1998). The ECERS-R includes four scales measuring structural quality – *Space and Furnishing*, *Personal Care Routines*, *Activities*, and *Program Structure* – and two scales measuring process quality: *Language-Reasoning* and *Interactions*. The ECERS was designed for practitioners to evaluate the overall quality of classroom environments and was later adapted for research use. Although ECERS captured elements of process quality through *Interactions* and *Language-Reasoning*, there was a need to capture the elements of process quality in the classroom that directly impact child development and skills (Pianta & Hamre, 2009). This led to the development of the CLASS, which was designed to measure three distinct types of classroom interactions: *Classroom Organization, Instructional Support*, and *Emotional Support* (Pianta et al., 2007)

Although the ECERS-R and CLASS are designed to help early childhood education programs track and improve classroom quality, there is a disconnect between how the measures are used in practice (i.e., total score for ECERS-R and domain scores for CLASS) and how they have been validated in research. There are mixed findings as to how the domains measured by

these quality assessment tools relate to the development of preschool skills that educators believe to be important for school readiness. Further, much of the empirical work done on ECERS-R and CLASS has combined samples from preschool programs serving low-income populations (e.g., Head Start) and preschool programs serving more general populations within each individual study (Brunsek et al., 2017; Gordon et al., 2013; Hong, 2019; Howes et al., 2008; Mashburn et al., 2008; Perlman et al., 2016). As early childhood educators strive to improve the quality of preschool programs that serve low-income populations, it is important to know which components of program quality are most relevant for the development of children's skills.

Early Childhood Environmental Rating System (ECERS) and Preschoolers' Outcomes

Research relating the ECERS-R Total Score – which captures a broad conceptualization of quality by combining both the structural and process quality domains – to child outcomes measured from the fall to spring of preschool have revealed mixed findings. After controlling for fall skills, the Total Score was linked to spring social-emotional skills, but was not linked to spring cognitive skills in a study of preschool programs in England (Sylva et al., 2006). Further, controlling for fall skills, the ECERS-R Total Score was associated with children's language skills in the spring, but not pre-literacy skills, applied problem solving, or social skills across multiple needs-based and community programs in the U.S. (Mashburn et al., 2008). A recent meta-analyses of the ECERS-R Total Score found small, positive associations with preschoolers' pre-literacy and social skills in the spring while accounting for fall skills, but no such association with math skills (Brunsek et al., 2017). However, others have found no associations of the ECERS-R Total Score to children's literacy, math, language, and social-emotional skills in needs-based and community programs (Hong, 2019; Sabol & Pianta, 2014). These inconsistencies could be due to combining measures of structural quality, which is not often

linked to child skills, with measures of process quality (Burchinal, 2018).

Other studies have used latent ECERS-R factors, most commonly capturing separate scores of structural quality and process quality. Structural quality scores have not been found to relate to preschoolers' skills (Brunsek et al., 2017; Gordon et al., 2013; Weiland et al., 2013), but results for process quality have been inconsistent across studies. Process quality was associated with emotional and behavioral regulation and children's physical health at the end of preschool in a nationally representative sample of preschoolers (Gordon et al., 2013). However, it was not associated with language or inhibitory control skills in Boston's universal preschool program (Weiland et al., 2013). A meta-analysis found no association between ECERS-R process quality and longitudinal change in language or math skills (Brunsek et al., 2017).

The few studies that have examined links between specific ECERS-R domains and child outcomes revealed some associations. *Personal Care Routines* was positively associated with children's emotional and behavioral regulation, attention, and concentration, but not reading or math skills (Gordon et al., 2013). *Interactions* was positively associated with children's general math, social-emotional and cognitive skills, but not language or pre-literacy skills (Sylva et al., 2006). *Language-Reasoning* was associated with better social-emotional skills and better literacy skills (Brunsek et al., 2017; Sylva et al., 2006). Given the mixed findings from the total score, factor scores, and single domains of the ECERS-R, more research on individual domains is needed to understand how the different domains of classroom quality relate to children's outcomes.

Classroom Assessment Scoring System (CLASS) and Preschoolers' Outcomes

The CLASS was designed to capture processes across three domains, including teacher feedback and modeling (*Instructional Support*), behavior management (*Classroom*

Organization), and classroom climate and teacher responsiveness (*Emotional Support*). According to the developers of this measure of classroom quality, *Instructional Support* was supposed to capture educational experiences provided for children that align with learning of academic skills and language comprehension while *Emotional Support* would capture teacher-child interactions and the emotional climate of the classroom that may support social-emotional skills. Finally, *Classroom Organization* would capture the procedures, management, and learning formats that would determine how well teachers maximize time spent on learning activities and thus, relate to children's outcomes overall (La Paro et al., 2004). However, the growing literature on the CLASS reveals mixed findings regarding whether the three broad domains of classroom quality are related to children's skills (Pianta et al., 2020).

In studies using data from national samples of both public and private preschool programs, *Instructional Support* has been associated with more skills in the spring relative to the fall in preschoolers' language, pre-literacy skills, reading skills, and applied problem solving across needs-based and community preschool programs (Hong, 2019; Howes et al., 2008; Mashburn et al., 2008). A meta-analysis found small associations between this domain and preschoolers' social skills and no associations with executive-functioning, math, or language skills by the end of preschool (Perlman et al., 2016). Other work has shown no associations between *Instructional Support* and literacy, executive functioning, or math skills in the spring controlling for fall skills (Guerrero-Rosada et al., 2021; Weiland et al., 2013).

Similarly, links between *Classroom Organization* and longitudinal gains in preschoolers' skills have been inconsistent. Two studies of a universal, district programs found null associations with *Classroom Organization* and changes in children's skills at the end of preschool, controlling for fall scores (Guerrero-Rosada et al., 2021; Weiland et al., 2013). A

study of Head Start programs found that *Classroom Organization* was related to gains in children's learning behaviors across preschool (Domínguez et al., 2010). Another study examining multiple needs-based and community of preschool found associations with preliteracy skills (Hong, 2019). A meta-analysis found *Classroom Organization* positively associated with early cognitive skills only when measured by a specific inhibitory control task (Perlman et al., 2016).

Researchers have tested, but failed to find associations between *Emotional Support* has and longitudinal changes in preschoolers' skills in individual studies (Guerrero-Rosada et al., 2021; Hong et al, 2019; Howes et al., 2008) and a recent meta-analysis (Perlman et al., 2016). The Emotional Support domain was related to teacher-reported social skills in spring controlling for fall skills in one study of the CLASS domains (Mashburn et al., 2008). One explanation for the mixed findings is that classroom quality may have a quadratic relation between classroom quality and child outcomes, such that as quality increases, the associations between quality domains and child outcomes increase. In one study, higher classroom quality was associated with a greater change in outcomes only among children in moderate and high-quality classrooms (Burchinal et al., 2010).

Classroom Quality and Preschool' Skills Across the School Year

Many preschool programs, such as Head Start, have incorporated the ECERS-R and CLASS into their efforts to measure and improve classroom quality (Peisner-Feinberg et al., 2001; Weiland et al., 2013). Further, states like California require classroom observations for preschool programs statewide as part of their QRIS (California Department of Education, 2017). Given the expansive investment in these measures and national reliance on them, it is crucial that early childhood education leaders understand how these measures of quality relate to children's

preschool outcomes. The mixed findings associating these measures with preschool skills make it unclear as to how these assessments should be used to inform preschool program assessment and improvement. More research is needed to understand what these assessments can tell us about the development of school-readiness skills in the preschool classroom.

Extant research has focused on understanding how classroom quality relates to spring skills, controlling for fall skills. However, no studies to date have examined whether classroom quality indicators are more highly associated with skill development in the second half of the preschool year (i.e., spring skills controlling for winter skills). It may take time for classroom structures and processes to start to have an impact on literacy, cognitive, and social-emotional skills. In fact, many preschool curricula suggest spending the first month or two setting up practices and routines, to lay the groundwork for successful functioning of the classroom (Dodge et al., 2010), which may not have immediate impact on children's literacy, cognitive, and social-emotional skills. Further, children's skills at the beginning of the year may reflect experiences prior to preschool and familiarity with formal learning environments and expectations. In the current study, we examine the timing of associations between classroom quality and school readiness skills by running two sets of models. First, we predicted school readiness scores in the spring controlling for fall scores, following the standard approach in the classroom quality literature. Second, we predicted school readiness scores in the spring controlling for winter scores to examine the associations in the second half of the school year and identify whether domains of classroom quality are more strongly associated with skill development after children and teachers have settled into their classroom routines.

Current Study

This study will address important research gaps by examining associations between

specific domains of classroom quality and growth in children's literacy, cognitive, social-emotional, and physical skills across multiple cohorts of preschool children enrolled in a district-wide program in the San Francisco Bay Area that primarily serves low-income families. We examined the associations between the ECERS-R or CLASS and six critical domains of preschool skills as assessed by the teacher-reported Desired Results Developmental Profile (DRDP; Kriener-Althen et al., 2020). We also used the direct assessment of early phonological awareness and pre-literacy skills evaluated with the Phonological Awareness Literacy Screening (PALS; Invernizzi, 2003). We report on gains from the fall to the spring for both the DRDP and PALS and from winter to spring for the DRDP.

We hypothesized that higher ratings of classroom process quality (i.e., ECERS-R *Language-Reasoning*; ECERS-R *Interactions*; CLASS *Instructional Support*; CLASS *Emotional Support*) would be related to gains in preschooler's preliteracy skills, cognitive skills, and social-emotional skills, but the effect sizes would be small (e.g., Howes et al., 2008; Sylva et al., 2006). Still, based on previous evidence that associations between classroom quality and children's skill development are more likely to be detectable among classrooms in the moderate- to high-quality range where most of the classrooms in this study fall, we hypothesized that we would capture any associations between quality measures and child skills (Burchinal et al., 2010). Specifically, based on theoretical conceptualizations of the ECERS-R and CLASS domains as well as trends within prior work, we expected to find *Instructional Support* and *Language-Reasoning* to be related to children's preliteracy skills, cognitive skills, and socioemotional skills (Brunsek et al., 2017; Mashburn et al., 2008; Perlman et al., 2016). We also expected that *Emotional Support* and *Interactions* would be more highly associated with socioemotional skills than any other domains, but not associated with other skills (e.g., Gordon et al., 2013; Mashburn et al., 2008). Because of

the lack of relations found in previous work, we did not expect to find associations between *Classroom Organization, Space and Furnishing, Personal Care Routines, Activities*, and *Program Structures* domains and child outcomes (Burchinal et al., 2008; Sylva et al., 2006). In regard to timing, we expect that the hypothesized associations stated above will be more strongly related to skill gains during the second half of the year after classroom routines and culture are established building on literature that has generally only examined associations between ECERS-R and CLASS skill levels across the entire preschool year.

Method

Participants

Participants were drawn from five preschool cohorts of children (2014–2015 through 2018–2019) who attended a preschool program in a large, urban school district serving primarily low-income families in the San Francisco Bay Area of California. The preschool classrooms were a mix of school-based and center-based programs with a maximum ratio of 8children to each teacher. The program is designed around five district-approved approaches: The Reggio Emilia approach, The Project Approach, The Creative Curriculum®, The Montessori Method, and the HighScope Curriculum. Teachers hold at least a Child Development Teacher Permit, which requires early childhood education or related coursework according to the State of California Commission on Teacher Credentialing (2016). Teachers select from a variety of professional learning opportunities to meet their and their classrooms' needs and are provided with instructional coaching to support their growth in the classroom throughout the year. Program spots are prioritized for four-year-olds, although approximately a quarter of children enroll at age three. Being enrolled in the preschool program is associated with higher literacy (Effect size = 0.25) and cognitive skills (Effect size = 0.21) upon kindergarten entrance (Sulik et

al., under review), with moderate effect sizes that are in line with recent preschool effect studies (Ansari et al., 2021; Lipsey et al., 2015).

Demographics of the two samples were reported by families upon enrollment in the preschool programs. The ECERS-R and CLASS and samples were similar in age, gender, home language status, and race/ethnicity (see Table 1 for sample descriptions). All children in the preschool programs were assessed with the DRDP, while only 4-year-olds were assessed with the PALS. To ensure independence of observations and because we were interested in children's outcomes at the end of their preschool experience, we removed the first year of data for children who attended a program for two years, which affected about one-fifth of the sample.

Procedures

The data used in the study were collected as part of Quality Counts California, the state QRIS. In accordance with the state guidelines, classrooms are observed annually and scores are provided to teachers and district leaders to determine areas of improvement. The observations are done independently by WestEd, a reputable nonprofit research, development, and service agency tasked with assessing all early learning programs that receive municipal funding. For ECERS-R, regional observers undergo a five-day certification process and must achieve a minimum average of 90% reliability with master anchors. These observers must renew their certification every 18 months, maintaining 90% reliability (California Department of Education, 2020). CLASS observers are certified through Teachstone. After completing the training, observers must pass the CLASS Reliability Test with 80% reliability with the master code. Within each dimension, at least two of five codes must be within one point of the master code. CLASS certification lasts for one year, after which observers must recertify (*Teachstone Testing and Certification*, 2021).

During an ECERS-R observation, one assessor observed the classroom for at least two

hours. Preschool programs receive at least two days' notice of their upcoming classroom observation. For the classroom observation administered with CLASS, one assessor observed the classrooms in person during four independent 20-minute cycles over the course of two to four hours.

According to local guidelines, classrooms must be assessed by the ECERS-R and CLASS on a rotating basis every other year. Therefore, we conducted two sets of analyses, one using children in classrooms observed with the ECERS-R and the other using children in classrooms observed with the CLASS. The sample assessed with CLASS consisted of 2,286 unique children (36 schools; 162 classrooms) while the ECERS-R sample consisted of 1,768 unique children (34 schools; 123 classrooms). Twenty-nine classrooms in this study were randomly selected to receive both assessments in the same year (California Department of Education, 2017). Table S1 in the online supplement provides a description the two samples on fall DRDP and PALS skills showing that there were no discernable differences in children's skills between the two samples. Table S2 in the online supplement provides correlations between ECERS-R and CLASS domains based on the 29 classrooms where both measures were used.

Measures

ECERS-R

The ECERS-R (Harms et al., 1998) assesses six domains of classroom quality: 8-item *Space and Furnishings* (e.g., "Room arrangement for play"), 6-item *Personal Care Routines* (e.g., "Safety practices"), 10-item *Activities* (e.g., "Fine Motor"), 4-item *Program Structures* (e.g., "Free play"), 4-item *Language-Reasoning* (e.g., "Encouraging children to communicate"), and 5-item *Interactions* (e.g., "Staff-child interactions") (see Table S2 for descriptive statistics). Each item was scored on a 7-point Likert scale, with responses ranging from 1 (*low quality*) to 7

(*high quality*). The ECERS-R items load on the six domains with adequate model fit (Gordon et al., 2013). The rating for each domain was determined by averaging item scores. The means of the ECERS-R domains are moderate-to-high (M = 5.72–6.53) in all except Personal Care Routines (M = 3.70, SD = .72), which fell in the low-to-moderate range (Harms et al., 1998).

CLASS

The CLASS (La Paro et al., 2004) assesses three domains of the classroom environment and teacher-child interactions: *Classroom Organization* (e.g., "Clear behavior expectations"), *Emotional Support* (e.g., "Positive communication"), and *Instructional Support* (e.g., "Prompting thought processes") (see Table S2 for descriptive statistics). Each domain was measured with three items on a 7-point Likert scale ranging from 1 (*low quality*) to 7 (*high quality*). Item scores were averaged to calculate an overall score for each domain. In previous research, CLASS items loaded on the three domains with adequate model fit (La Paro et al., 2004). Average CLASS domain scores in this study were slightly higher than the national average for Head Start, but had similar distributions (Early Childhood Learning & Knowledge, 2020). Overall, classrooms in the current study had moderate to high levels of *Classroom Organization* (M = 5.88, SD = 0.71) and *Emotional Support* (M = 6.41, SD = 0.54) and low to moderate levels of *Instructional Support* (M = 3.26, SD = 1.06).

DRDP

School readiness was measured using teacher-reported Desired Results Developmental Profile (DRDP) administered in the fall, winter, and spring. The DRDP is an instrument designed by the California Department of Education used to assess children's progress on multiple domains of school readiness using a developmental continuum: *Approaches to Learning – Self-Regulation, Social and Emotional Development, Cognition, Physical Development/Health,* and

Language and Literacy Development (Kriener-Althen et al., 2020). Teachers were trained to use the DRDP through professional development offered by a local organization funded to provide professional development across the Bay Area. Teachers use the instrument annually to track the development of their preschoolers' skills on a 5- to 9-point scale with dozens of items , based on their observations of each child. Developers report high inter-rater reliability on each domain (> 90%; Desired Results Access Project, 2015). Exploratory factor analysis (EFA) for each DRDP domain indicated that all items were in alignment with the conceptualized domain structure except *Language and Literacy,* which was best characterized by two factors (RMSEA < .10; CFI ≥ .95, SRMR < .06): *Verbal Language* and *Written Language*. All items were rescaled to a nine-point scale and a mean composite was created for each factor in the model, with a threshold of 70% non-missing items for each composite. The DRDP scales had good variability at all timepoints and few children end up at the low-end of the scores by the spring.

Approaches to Learning/Self-Regulation was assessed using seven items (e.g., "Child increasingly develops strategies for regulating feelings and behavior, becoming less reliant on adult guidance over time"; αs = .94–.95). *Social and Emotional Development* was assessed using five items (e.g., "Child shows increasing awareness of self as distinct from and also related to others"; αs = .96–.97). *Cognition* was assessed using eleven items (e.g., "Child shows developing understanding of number and quantity"; αs = .97–.98). *Physical Development/Health* consisted of 10 items measuring children's motor skills and personal care routines (e.g., "Child shows increasing proficiency in gross motor manipulative skills (e.g., reaching, kicking, grasping, throwing, and catching)"; αs = .97–.98). *Verbal Language Development* consisted of four items measuring children's oral language expression and comprehension (e.g., "Child's communication develops from nonverbal communication to using language with increasingly

complex words and sentences"; αs = .96–.97). *Written Language Development* consisted of six items measuring children's written language comprehension and pre-literacy skills (e.g., "Child shows increasing awareness of letters in the environment and their relationship to sound, including understanding that letters make up words"; αs = .95–.96).

PALS

In the fall and spring of preschool, college student interns were trained to conduct the 8-item Phonological Awareness and Literacy Screening (PALS) – Pre-K, a direct assessment of phonological awareness and pre-literacy skills (Invernizzi, 2003). EFA estimated with Mplus 7.4 (Muthén & Muthén, 2015) revealed a two-factor model corresponding to phonological awareness and pre-literacy skills had adequate fit for the fall assessment, ($\chi^2(df = 13) = 315.52$, $p < .001$, RMSEA = .08, CFI = .98, SRMR = .02) and the spring assessment, ($\chi^2(df = 13) = 184.48$, $p < .001$, RMSEA = .06, CFI = .99, SRMR = .02).

Phonological awareness was assessed using up to three items, *Upper-case Letter Recognition, Lower-case Letter Recognition,* and *Letter Sounds Recognition*, which each assessed correct identification of letters using 26 items on a dichotomous scale (0 = *incorrect*, 1 = *correct*). Children who correctly identified at least 16 upper-case letters received the lower-case assessment. Children who identified at least nine lower-case letters received the letter sound assessment. Children received zero points for items on which they were not assessed. Given that these items are measured on the same scale (1–26), we created an overall mean composite for the three domains. We included children who had data for any item from this scale due to the high correlations between the items in the fall and the spring (see Table S2 for descriptive statistics).

Pre-literacy skills were assessed using *Name Writing, Beginning Sound Awareness, Print and Word Awareness, Rhyme Awareness,* and *Knowledge of Nursery Rhymes*. *Name Writing* was

assessed using a 7-point Likert scale that ranged from 0 (*scribbles name and picture*) to 7 (*clearly prints name and separates picture*). The remaining skills were assessed using 10 items on a dichotomous scale (0 = *incorrect*, 1 = *correct*). To show *Beginning Sound Awareness,* children produced the beginning sounds of an object in a picture (e.g., a ball). For *Print and Word Awareness,* children identified components of text in a book (e.g., "points to the words in the title"). For *Rhyme Awareness,* children chose one picture out of three (e.g., a hat, a whale, and a ring) that rhymed with a fourth (e.g., a cat). To show *Nursery Rhyme Awareness,* children provided the final words to unfinished nursery rhymes (e.g., "Twinkle twinkle little star, how I wonder what you ____"). We standardized and averaged the scores from each pre-literacy domain to create a composite for children who had at least two items on this scale (see Table S2 for descriptive statistics).

Covariates

In all models, we controlled for child level covariates of age, race and ethnicity, home language status, special education status, and gender, as these variables are associated with academic and social-emotional skills in preschool (see Table 1 for the two sample demographics). Age was measured in months at the beginning of the school year. gender, race and ethnicity, and home language status were reported by parents upon enrollment in the preschool program. Race and ethnicity were added to the models as binary indicators with White children as the reference group. Home language status was made into a dichotomous variable (1 = *any English in the home,* 0 = *no English spoken in the home*). Special education status was a dichotomous variable with children who did not receive special education services at the reference group. Gender was coded as a dichotomous variable with males as the reference group. In accordance with previous work, we also controlled for classroom covariates of class size and

teacher education (Guerrero-Rosada et al., 2021; Weiland et al., 2013). Following previous studies (Guerrero-Rosada et al., 2021; Weiland et al., 2013), class size was made into a dichotomous variable with classes with fewer than 20 children as the reference group and teacher education was added as a dichotomous variable with Master's degree or higher set to one and any other education set to zero. We also examined the influence of preschool attendance on our outcomes as a sensitivity check by removing children who attended fewer than 120 days, or a total of four months, of preschool to ensure that our findings were not driven by children who received less exposure to quality classroom experiences.

Analysis Plan

Main analyses consisted of multilevel path analyses carried out in Mplus 7.4 (Muthén & Muthén, 2015). We explored associations between classroom quality and changes in skills over time using two sets of parallel models examining skills in the spring controlling for fall skills and skills in the spring controlling for winter skills. Children (level 1) were nested in classrooms (level 2). We considered using linear models to model the change in DRDP skills across the year, but found the linear model fit was inadequate and would produce biased results (CFI = .716; TLI = .533 RMSEA = .160; SRMR = .212). Missing data was handled using Full Information Maximum Likelihood. We report standardized coefficients.

We conducted a power analysis to determine whether our sample sizes were large enough to detect effect sizes between $r = .15$ to $r = .20$ (Fritz et al., 2012). To simulate the CLASS sample, we included 164 classrooms with 16 children per classroom and an $ICC = .33$ (the highest *ICC* for any outcome). Power analysis simulation showed we have a 90% chance of finding a small effect size and 99% chance to find a moderate effect size. To simulate the ECERS sample, we included 131 classrooms with 16 children per classroom and an $ICC = .33$.

This simulation showed we have an 84% chance of finding a small effect size and 96% chance of finding a moderate effect size. To account for the large number of statistical tests, we used the Benjamini-Hochberg procedure (1995; Yekutieli & Benjamini, 1999) to maintain a false discovery rate of .05 for each of the 128 models. All significant statistics reported in the results remained significant after adjusting for multiple testing.

We examined the associations of the ECERS-R and CLASS domains of classroom quality with teacher-rated skills from the DRDP in the spring controlling for skill-level in the fall in line with previous literature on classroom quality and child outcomes. We then ran parallel models examining associations between classroom quality and DRDP scores in the spring controlling for skill-level in the winter. These winter to spring models allowed us to examine the role of classroom quality during the second half of the preschool year, after which differences in children's skills may be more related to their experiences in the classroom and less affected by their familiarity with the preschool environment. We then examined the associations between the ECERS-R and CLASS domains and the PALS phonological awareness and pre-literacy scales by the spring controlling for skill-level in the fall. Finally, we ran two sensitivity analyses to check the robustness of our results. First, we retested all the models only with children who attended preschool at least 120 days to account for attendance. Next, we ran a sensitivity analysis using a total score composite of the DRDP scales to account for the multiple testing.

Results

Descriptive Statistics

The DRDP domains were all highly, positively correlated with each other (*r*s ranged from .62–.91, *p*s < .001), with the highest correlations between *Self-Regulation* and *Social-Emotional Development* ($r = .91$, $p < .001$). Despite the high bivariate correlations, we did not combine the scores across the DRDP domains in order to preserve the structure of the measure as it is used by teachers and school administrators. The PALS domains were also highly correlated (*r*s ranged from .50–.77, *p*s < .001) but captured unique sets of skills (see Measures). The DRDP domains were moderately correlated with the PALS domains (*r*s ranged from .20–.51, *p*s < .001). On average, DRDP scores increased between fall and winter, and between winter and spring, and PALS scores increased between fall and spring (See Table S2 for correlations).

Preschool Classroom Quality and Change in Skills

ECERS-R and DRDP

We found few associations between any ECERS-R domain and changes in DRDP outcomes (see Table 2). There were null findings for all models examining spring skills controlling for fall (*ß*s ranged from -.10 to .32, *p*s ranged from .10 to .96) and most spring skills controlling for winter (*ß*s ranged from .001 to .23, *p*s ranged from .07 to .99), except for positive associations between *Interactions* and every DRDP domain (*ß*s ranged from .31 to .43, *p*s ranged from < .001 to .01), *Activities* and social-emotional and written language domains (*ß*s = .19, *p*s ranged from .03 to .04), and *Language-Reasoning* and physical development, social-emotional, and verbal language domains (*ß*s ranged from .23 to .26, *p*s ranged from .03 to .04).

ECERS-R and PALS

We found no associations between ECERS-R domains phonological awareness or pre-

literacy skill levels in spring controlling for fall (Table 3; *β*s ranged from -.19 to .26, *p*s ranged from .05 to .72).

CLASS and DRDP

We found almost no associations between any CLASS domain and any DRDP outcome (see Table 2). There were null findings for all models examining spring skills controlling for fall (*β*s ranged from -.02 to .08; *p*s ranged from .32 to .99) and spring skills controlling for winter (*β*s ranged from -.002 to .09; *p*s ranged from .32 to .98), except for a positive association between *Instructional Support* and changes in physical development ($\beta = .18$, $p = .04$).

CLASS and PALS

We found no associations between any CLASS domain and spring skills controlling for fall skills for either phonological awareness or pre-literacy skills (Table 3; *β*s ranged from -.07 to 0.29; *p*s ranged from .15–.71).

Sensitivity Analyses

There were no changes in the patterns of associations between measures of classroom quality and children's changes in skills after taking into account children's attendance. Further, after analyzing a composite measure of total DRDP skills (Table S4), the pattern of null findings across both ECERS-R and CLASS domains remained and we found the same statistically significant association between ECERS-R Interactions and DRDP total skills in the spring controlling for winter skills.

Discussion

This study confirmed that domains of classroom quality measured by widely used ECERS-R and CLASS assessments largely do not relate to changes in children's school readiness skills from fall to spring in the preschool year. Our findings corroborate extant

literature showing null associations between these observational measures of classroom quality and changes in both teacher-reported and directly-assessed preschool skills (Guerrero-Rosada et al., 2021; Sabol & Pianta, 2014; Weiland et al., 2013). We extended this literature by showing that there were also few associations between the broad measures of classroom quality when measured in the spring relative to winter skills. Only the quality of classroom interactions measured by the ECERS-R – indexed by positive teacher-child interactions and child-peer interactions, appropriate discipline strategies, and attention to children's needs and safety – were consistently related to improvements in spring relative to winter skills across six domains of preschoolers' teacher-reported skills. Two other ECERS-R domains were weakly associated with social-emotional and written language skills (*Activities*) and physical development, social-emotional, and verbal language skills (*Language-Reasoning*).

Early childhood educators and policy makers have adopted ECERS-R and CLASS to measure and improve the quality of preschool programs for children's development. There is a need to revisit how classroom quality measures can capture experiences that are most relevant to children's outcomes and to more closely examine when classroom quality may be most relevant for growth of school-readiness skills. Our findings suggest that the quality of preschool interactions may be more important for skill-building in the later part of the preschool year once classroom routines have been established and children are familiar with the classroom environment. This work has implications for the timing of professional development, coaching, and assessment.

Null Findings of Relations Between Quality Measures and Changes in Skills

We found that three CLASS domains of classroom quality were unrelated to teacher-reported or directly assessed preschoolers' skills, with exception of a significant link of CLASS

Instructional Support to physical development skills measured in the spring controlling for winter skills. This finding corroborates more recent research that showed no associations of CLASS domains with direct assessments of vocabulary, executive functioning, or math from fall to spring, among children attending universal preschool programs in Boston (Guerrero-Rosada et al., 2021; Weiland et al., 2013). Our study extends this work by showing similar results in a preschool program that primarily serves low-income families in a different urban school district, documenting a lack of associations between CLASS domains and either teacher-reported or directly assessed literacy skills. Further, in line with previous work on ECERS quality domains, three out of the six ECERS-R scales were unrelated to preschoolers' skills (Brunsek et al., 2017; Mashburn et al., 2008). In sum, we found that most of the domains used to measure classroom quality are not related to changes in child outcomes by the end of preschool, despite high power to detect relatively small associations.

The results from the current study demonstrate the importance for preschool program leaders to understand whether the measures they depend on to determine classroom quality actually relate to desired child skills and outcomes by the end of the preschool year. There are also important implications for researchers and measure developers to continue to evaluate and improve measures of classroom quality, with the goal of measuring elements of classroom quality that relate to important outcomes. The lack of associations suggests there is a need to move away from merely capturing the average child's classroom experience, which these global measures do, and instead measure aspects of quality that more directly relate to individual children's experiences. This will also allow the field to better understand inclusivity and equity in the classroom.

Positive Interactions, Language Support, and Appropriate Activities Are Important for

Children

The positive relations between the ECERS-R *Interactions* domain and teacher-reported literacy, cognitive, and socioemotional skills may make this an especially important classroom indicator for children's growth in preschool. This finding is in line with the extensive literature on teacher-student relationships, which shows that positive, supportive relationships between teachers and children in the classroom play an important role in children's social and academic gains in school (Hamre, 2014; Nguyen et al., 2020; O'Connor et al., 2011; Pianta & Stuhlman, 2004). This strong association with ECERS-R *Interactions* remained when analyzing the DRDP scales as a total score, suggesting the associations are not a function on multiple testing.

Our study builds on this literature by providing evidence that classroom processes captured by the ECERS-R *Interactions* domain – including positive interactions between teachers and children, children and their peers, as well as appropriate discipline strategies and attention to children's needs and safety – are important for preschool skills, particularly in the second half of the school year. Although the ECERS-R *Interactions* measures similar classroom processes as the CLASS *Emotional Support* domain, there are important differences that might explain why it alone was associated broadly with children's skill development. The ECERS-R *Interactions* captures specific interactions between teachers, children, and peers that more directly affect children in the classroom, and which would also make up a positive and supportive climate. The CLASS *Emotional Support*, on the other hand, measures the general climate and overall responsiveness of the teacher, which are broader aspects of the classroom environment and perhaps do not capture variability in classrooms that is most meaningful for individual children's experiences and outcomes.

Our study also showed some positive associations between ECERS-R *Language-*

Reasoning and verbal language as well as physical development and social-emotional skills. *Language-Reasoning* measures teacher's strategies for building language and reasoning skills. Of all the measures of classroom quality, this measure that is specific to teaching strategies related to building language and reasoning has positive associations with changes in the target skills. This implies that in order to capture classroom processes that are important for learning, future classroom quality assessments should focus more specifically on teacher strategies that are salient for developing particular skills, expanding beyond language and reasoning to math to social-emotional skills. Measures that examine practices focused on skill building, rather than overall climate, may emerge as more robust predictors of skill development. For example, Zinnser, Curby, and Gordon (2021) have developed EMOTERs to understand the strategies teachers use to support social-emotional learning in the classroom. Bardack and Obradović (2019) developed a new observation measure to help study how teachers scaffold development of children's executive function skills.

Finally, our study showed positive associations between ECERS-R *Activities* and social-emotional and written language skills. This finding suggests that children's skills develop when they have access to developmentally appropriate activities and materials. Although *Activities* is often grouped in with structural quality, it captures how long children spend with activities and materials and how well activities promote acceptance of diversity. This finding strengthens the call to ensure that measures of classroom quality include the activities and experiences in the classroom that are child-driven and inclusive of diverse experiences.

Strengths, Limitations and Future Directions

The current study builds on previous work by examining the associations between widely adopted measures of classroom quality and preschool outcomes across multiple cohorts of

children from a public preschool program serving low-income families. We used teacher-reported and direct assessments to examine associations between classroom quality and child outcomes. Finally, we examined whether associations between classroom quality and child outcomes were stronger in the second half of the school year after classroom routines have been in place and child skills are less associated with experiences prior to the preschool year.

One limitation of the study is that the scales on the DRDP were highly correlated. Although this limits our ability to make claims about the relation between ECERS-R *Interactions* and each specific skill, we are able to show that independently observed quality interactions in the classroom are associated with teachers' own reports of skill development across the second half of the preschool year. Additionally, our sensitivity analyses using the DRDP total score demonstrates that the findings with ECERS-R Interactions are not due to multiple modelling. PALS, the direct assessment of preliteracy skills, was only measured in the fall and the spring, so we could not test associations with the ECERS-R and CLASS and PALS in the second half of the year. Future work should measure teacher-reported and direct assessment measures in the fall, winter, and spring to validate the current findings.

CLASS scores across all three domains in our study were higher relative to some previous studies, and comparable to scores from the Boston Pre-K studies (Guerrero-Rosada et al., 2021; Weiland et al., 2013). Similarly, ECERS-R scores in our study were higher compared to previous work (Schaack et al., 2013; Sylva et al., 2006). Threshold analyses have shown that in some samples, measures of classroom quality are associated with child skills only in the context of high quality classrooms (Burchinal et al., 2010; Weiland et al., 2013). However, recent work has shown no difference between low- and high-quality classrooms in the associations of classroom quality and child outcomes (Guerrero-Rosada et al., 2021). Because

the classrooms in our study were mostly moderate- to high-quality, it could be assumed that we might more easily capture any associations between quality measures and child skills, however we did not capture such associations. Although beyond the scope of this study, threshold are important to examine, particularly in contexts where classroom quality is largely moderate- to high-quality.

Finally, our study relies on observations conducted only once a year by one observer and could not undergo double-coding for reliability or validity. Still, the observers used in this locale come from a reputable national research firm and are highly trained, undergoing frequent recertification to ensure their reliability as classroom quality observers. Further, the frequency and pattern of quality observations is standard in practice for quality rating systems. Future measurement studies should systematically examine how the number of observations affects reliability, particularly because classroom observations developed by researchers are often developed and validated using multiple observations of teachers, but this may not always be feasible in practice (Cohen & Goldhaber, 2016).

There are a number of other avenues of study that will be important to investigate going forward. Future studies should examine more closely the timing of when preschool skills are measured and whether the associations with gains from winter to spring are replicated in other samples. Further, more recent research on quality measures have suggested that classroom quality is associated with skills for children who come from more disadvantaged backgrounds or who start with lower reading skills (Vernon-Feagans et al., 2019; Watts et al., 2021). Future work should continue to consider for whom or in what contexts classroom quality makes a difference.

The field of early childhood education should move to testing potential causal links

between positive classroom interactions and improvements in preschool skills by implementing professional development, training, or specific curricula targeting positive interactions and appropriate discipline and supervision. Similar work in literacy and language instruction has been shown to impact classroom quality, while targeted curricula have been found to improve child skills across preschool (Chambers et al., 2016; Nguyen et al., 2020).

Conclusion

Our results have important implications in both early childhood education research and practice about the utilization and interpretation of classroom quality measures. Overall, the largely null findings underline the importance of examining associations between quality measures and associations with preschool outcomes as they are used and measured in practice. For researchers, the results support the calls to improve classroom quality measurement to more meaningfully reflect structures and processes that impact the learning of specific skills (Rojas et al., 2021). For example, for literacy and numeracy skill development, it would be important to measure teaching strategies academic learning. The associations we found in preschoolers' longitudinal changes in skills were only found between winter and spring. We suggest that researchers carefully consider when certain aspects of classroom quality might have the strongest effect on children's skill development.

For early childhood education practitioners and policymakers, our findings suggest focusing on teacher interactions rather than broad measures of the classroom environment may be more meaningful for children's development of school-readiness skills. Education leaders could also provide the ECERS-R and CLASS as formative assessments, given to teachers for continual feedback across the year, and future research should test if self-evaluation as well as ongoing coaching or feedback practices impact the associations between domains of classroom quality

and growth in children's skills across the school year. More broadly, education leaders should carefully consider the associations between their measures of quality and changes in children's skills when making decisions on the use and timing of state or district-wide classroom assessments, designing teacher coaching, and providing professional development. By understanding how their classroom quality assessment results relate to preschoolers' school-readiness, education leaders can make more effective, evidence-based choices for their programs.

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Table 1

Demographic statistics for the CLASS and ECERS-R samples

Demographic Variable	CLASS Sample		ECERS-R Sample	
	M (SD)	%	*M* (SD)	%
Age	4.03 (0.56)		4.01 (0.56)	
Female		48%		48%
Asian/PI		32%		32%
Black		15%		15%
Latinx		31%		30%
White		13%		15%
Other		9%		8%
No English		32%		30%

Note. *M* = mean; SD = standard deviation; CLASS = Classroom Assessment Scoring System; ECERS-R = Early Childhood Environment Rating Scale – Revised

Table 2

Standardized associations of ECERS-R and CLASS domains with DRDP skills in spring controlling for fall skills and winter skills.

Variable	Fall-Spring		Winter-Spring	
	β (SE)	*p*	β (SE)	*p*
ECERS-R				
Space and Furnishings				
Cognition	-.01 (.08)	.92	.09 (.11)	.41
Physical Development	-.09 (.08)	.22	.05 (.10)	.59
Self-Regulation	-.04 (.08)	.60	.13 (.11)	.25
Social-Emotional	.01 (.09)	.95	.18 (.10)	.08
Verbal Language	.03 (.09)	.72	.12 (.10)	.24
Written Language	-.03 (.07)	.65	.12 (.09)	.22
Personal Care Routines				
Cognition	-.10 (.10)	.31	.16 (.11)	.17
Physical Development	-.08 (.11)	.44	.04 (.11)	.74
Self-Regulation	-.07 (.11)	.51	.08 (.12)	.52
Social-Emotional	-.02 (.12)	.89	.13 (.11)	.24
Verbal Language	-.05 (.12)	.66	.07 (.11)	.52
Written Language	-.13 (.09)	.13	.001 (.10)	.99
Activities				
Cognition	.06 (.07)	.44	.18 (.10)	.07
Physical Development	.02 (.10)	.85	.17 (.10)	.09
Self-Regulation	.07 (.08)	.41	.14 (.10)	.15
Social-Emotional	.07 (.09)	.46	**.19 (.10)***	**.04**
Verbal Language	.06 (.09)	.52	.13 (.10)	.18
Written Language	.06 (.07)	.39	**.19 (.09)***	**.03**
Program Structures				
Cognition	.17 (.12)	.16	.17 (.13)	.20
Physical Development	-.01 (.17)	.96	.10 (.16)	.55
Self-Regulation	.15 (.14)	.27	.13 (.14)	.36
Social-Emotional	.11 (.15)	.46	.16 (.15)	.28
Verbal Language	.06 (.17)	.71	.18 (.16)	.27
Written Language	.14 (.11)	.25	.18 (.13)	.15
Language-Reasoning				
Cognition	.02 (.12)	.89	.14 (.13)	.26
Physical Development	.03 (.11)	.77	**.23 (.11)***	**.04**
Self-Regulation	.07 (.13)	.58	.23 (.134	.09
Social-Emotional	.03 (.12)	.79	**.26 (.13)***	**.04**
Verbal Language	.08 (.11)	.48	**.24 (.11)***	**.03**
Written Language	.03 (.12)	.81	.18 (.13)	.16

Interactions				
Cognition	.28 (.20)	.17	**.43 (.12)*** **	**< .001**
Physical Development	.16 (.14)	.25	**.31 (.10)** **	**.001**
Self-Regulation	.32 (.20)	.10	**.40 (.15)** **	**.01**
Social-Emotional	.23 (.15)	.13	**.38 (.11)** **	**.001**
Verbal Language	.18 (.13)	.16	**.37 (.09)*** **	**< .001**
Written Language	.28 (.22)	.21	**.37 (.15)***	**.01**
CLASS				
Classroom Organization				
Cognition	-.01 (.09)	.91	-.002 (.09)	.98
Physical Development	-.01 (.09)	.89	.09 (.09)	.32
Self-Regulation	.07 (.10)	.47	.06 (.09)	.51
Social-Emotional	.01 (.09)	.89	.05 (.09)	.63
Verbal Language	-.01 (.09)	.88	.06 (.09)	.49
Written Language	.08 (.09)	.39	.05 (.10)	.61
Instructional Support				
Cognition	.01 (.08)	.92	.01 (.10)	.90
Physical Development	.05 (.08)	.53	**.18 (.09)***	**.04**
Self-Regulation	.05 (.09)	.56	.05 (.10)	.57
Social-Emotional	-.001 (.09)	.99	.05 (.09)	.55
Verbal Language	-.03 (.09)	.75	.05 (.10)	.65
Written Language	.08 (.09)	.35	.04 (.11)	.69
Emotional Support				
Cognition	.07 (.09)	.46	.05 (.09)	.59
Physical Development	-.02 (.09)	.80	.09 (.10)	.40
Self-Regulation	.08 (.10)	.41	.05 (.10)	.64
Social-Emotional	.04 (.09)	.67	.06 (.10)	.57
Verbal Language	-.02 (.09)	.87	.06 (.09)	.51
Written Language	.10 (.10)	.32	.07 (.10)	.50

Note: Models control for children's age, gender, race/ethnicity, and whether English is spoken in the home. * < .05, ** < .01, *** < .001

Table 3

Standardize associations of ECERS-R and CLASS domains with Letter Awareness and Preliteracy Skills in spring controlling for fall skills.

Variable	Fall-Spring	
	β (SE)	*p*
ECERS-R		
Space and Furnishings		
Letter Awareness	-.13 (.15)	.38
Preliteracy Skills	-.16 (.13)	.22
Personal Care Routines		
Letter Awareness	-.22 (.13)	.09
Preliteracy Skills	.02 (.12)	.85
Activities		
Letter Awareness	.06 (.18)	.74
Preliteracy Skills	.03 (.13)	.85
Program Structures		
Letter Awareness	-.26 (.13)	.05
Preliteracy Skills	-.19 (.12)	.11
Language-Reasoning		
Letter Awareness	.18 (.14)	.20
Preliteracy Skills	.19 (.12)	.13
Interactions		
Letter Awareness	.09 (.11)	.44
Preliteracy Skills	.14 (.10)	.17
CLASS		
Classroom Organization		
Letter Awareness	.17 (.14)	.22
Preliteracy Skills	.05 (.12)	.65
Instructional Support		
Letter Awareness	-.07 (.12)	.58
Preliteracy Skills	-.02 (.03)	.58
Emotional Support		
Letter Awareness	.04 (.14)	.80
Preliteracy Skills	.09 (.11)	.43

Note: Models control for children's age, gender, race/ethnicity, and whether English is spoken in the home. * < .05, ** < .01, *** < .001