Mathematica
Progress Together

Early Childhood Literature Scan Brief

Nikki Aikens, Tutrang Nguyen, Jessica F. Harding

How Much Does the Pre-K CLASS Relate to Children's Readiness for School Skills?

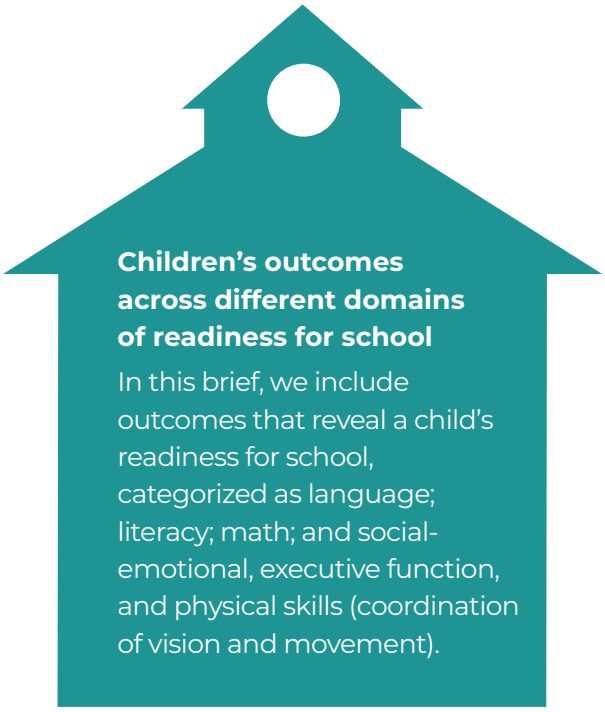
Key findings

- Classroom scores on the Pre-K CLASS sometimes have a relationship with children's school readiness outcomes in different domains. When they do, the size of the relationship is small.
- The Pre-K CLASS assesses teacher-child interactions in a variety of areas, known as domains. Instructional Support is the domain whose scores have the greatest relationship to children's outcomes. Technical assistance to teachers and professional development providers focused on this domain could have the most impact for improving children's outcomes.
- There is some limited evidence that Pre-K CLASS scores need to reach a certain level to be related to children's outcomes, so more research is needed to determine the appropriateness of benchmarks for determining quality.
- A few studies found that Pre-K CLASS scores matter more for some children than others. More research is needed to examine the relationships of Pre-K CLASS scores with outcomes for children from different backgrounds, and the reasons why findings might differ for different groups.

Introduction

In early care and education (ECE) settings, the quality of a classroom is related to how well children learn and develop (Phillips et al. 2017). In a classroom, quality has two dimensions: process quality and structural quality. Process quality is especially important. This type of quality generally focuses on sensitive caregiving, responsiveness to children's emotional needs, and cognitive and language stimulation. These features predict a child's readiness for school better than structural quality measures like teacher-child ratios, class size, operating hours, classroom materials, and teachers' credentials (Howes et al. 2008; Mashburn et al. 2008; Sabol et al. 2013).

Research has revealed that classroom process quality, in particular, is related to children's outcomes, especially for children whose families have low incomes or primarily speak a language other than English in the home (Yoshikawa et al. 2013). In the past two decades, however, studies have generally found that these relationships are small to modest in strength (see Burchinal 2018 and Perlman et al. 2016 for reviews). This raises the question of whether there is a level, or threshold, of quality, and above that threshold, quality is more strongly related to children's outcomes. If there is a threshold that classrooms need to meet or exceed for the children in those classrooms to be well prepared for school, then the best way to use limited resources might be to raise classrooms above that threshold.



One widely used tool that captures the process quality of preschool classrooms, including interactions between teachers and children, is the Classroom Assessment Scoring System-Preschool (Pre-K CLASS; Pianta et al. 2008). The Bill & Melinda Gates Foundation funded Mathematica to conduct a literature scan to search for recent studies analyzing how well widely used classroom quality measures—including the Pre-K CLASS—perform (see box at the end of the brief for more details about methods). This brief focuses on what we know about how the Pre-K CLASS relates to children's outcomes in general, and whether its relationships with outcomes differs for key subgroups of children.

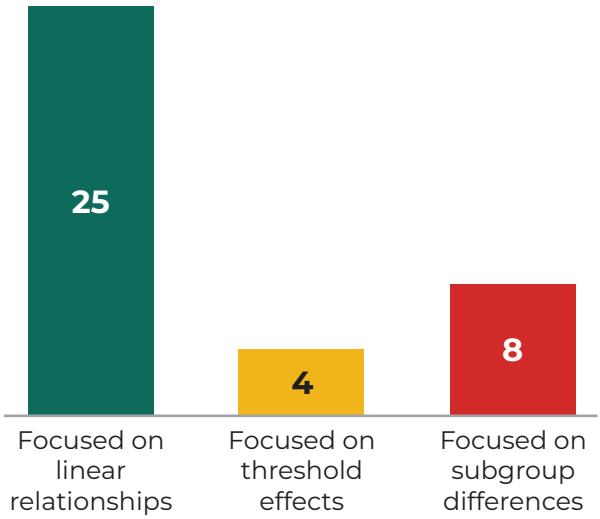
By summarizing findings of the most recent studies published in the field, we can learn more about how and when quality measures relate to children's outcomes, the reasons why the strength of those relationships might be modest, and if there is the need to expand existing measures of quality. We conclude with some implications these findings have for practice and future research.

Description of Pre-K CLASS domains

The Pre-K CLASS focuses on classrooms serving children ages 3 to 5. It assesses classroom quality in three broad domains of teacher-child interactions: Instructional Support, Emotional Support, and Classroom Organization. The interactions are scored on a 7-point scale, with scores of 1 or 2 for low quality interactions, scores of 3, 4, or 5 for midrange quality, and scores of 6 or 7 for high quality. Each domain is designed to assess a particular aspect of process quality:

Domain	Aspect of process quality assessed by domain
Instructional Support	Quality of instructional practices used in the classroom
Emotional Support	Social and emotional functioning in the classroom
Classroom Organization	Teacher's ability to organize the classroom to make efficient use of class time

Figure 1. Number of studies reviewed (n=27), by type of relationship



Key Findings

Figure 1 shows the number of studies we reviewed for this brief.[1] Specifically, out of 27 studies, 25 focused on whether there were linear relationships (see key terms box) between the Pre-K CLASS and children's outcomes. Four studies also examined whether there were threshold effects above which scores have a relationship to better outcomes for children. Eight studies highlighted differences in classroom quality and in whether children's characteristics (for example, being a dual language learner) played a role in the strength or direction of the relationship between classroom quality and children's outcomes.

Key terms

- **Linear relationships** indicate that as classroom quality increases or decreases, the children's scores on an outcome also increase or decrease.
- **Threshold effects** suggest that classroom quality scores need to reach a certain level before we see scores rise on children's outcomes.

Next, we highlight key findings from the studies we examined (see Tables A.1 through A.4 in the appendix for more details). It is important to keep in mind that studies can be done in different ECE settings; use different control variables, sample sizes, or sample compositions; and use different Pre-K CLASS scores. We might therefore find a different pattern in the findings from one study to the next, even for the same outcome.

How do the Pre-K CLASS domain scores relate to children's readiness for school skills?

Pre-K CLASS scores were related to children's outcomes in preschool,[2] kindergarten, and beyond. Those relationships were generally modest, and sometimes they were counterintuitive. Some studies did not find that scores related to outcomes at all. Table 1 shows the number of studies in our scan that found a relationship between higher Pre-K CLASS scores and better outcomes for children.

Instructional Support was the Pre-K CLASS domain that was most commonly related to children's outcomes. It was related to children's outcomes in the literacy; language; and social-emotional, executive function, and physical domains (Table 1). Looking at different outcomes for children, this domain was most often related to better literacy (for example, Carr et al. 2019; Han et al. 2017; Soliday Hong et al. 2019) and language skills (for example, Goble and Pianta 2017; Hamre et al. 2014). It was also positively related to children's math skills (Carr et al. 2019; Gordon and Peng 2020; and Vitiello et al. 2018), social skills and self-efficacy (Hestenes et al. 2015), closeness with their teacher (Hamre et al. 2014), executive function (Early et al. 2018; Vitiello et al. 2018), inhibitory control (Goble et al. 2019; Gordon and Peng 2020), and visuomotor outcomes (coordination of vision and movement) (Byers et al. 2016). These findings from individual studies differ from a meta-analysis conducted by Perlman et al. (2016),[3] which found significant but small relationships between Instructional Support and social skills, but none between Instructional Support and any of the other reviewed outcomes (English receptive vocabulary, letter-word identification, or math).

Table 1. Number of studies in which Pre-K CLASS scores were related to more positive child outcomes[a]

Pre-K CLASS score	Language	Literacy	Math	Social-emotional, executive function, physical
Instructional Support	7 of 12	12 of 14	5 of 11	8 of 13
Emotional Support	1 of 10	3 of 12	1 of 9	5 of 12
Classroom Organization	2 of 9	4 of 11	2 of 8	6 of 10
Other[b]	3 of 4	4 of 6	2 of 5	7 of 8

[a]In individual studies, the patterns of findings were sometimes inconsistent (that is, some relationships were significant, whereas others were not; or some alternative scores were significantly related to child outcomes, whereas others were not). We only include studies in counts of significant findings when the patterns in those studies are in the expected directions.

[b]"Other" includes studies that examined a total Pre-K CLASS score (in other words, the average for all three domains) or constructed the score in alternative ways, such as combining Emotional Support and Classroom Organization domain scores into one score.

Emotional Support was most often related to children's social-emotional, executive function, and physical outcomes (Table 1). For example, in individual studies, it was positively related to approaches to learning (Limlingan et al. 2020), executive function (Early et al. 2018; Vitiello et al. 2018), inhibitory control skills (Hamre et al. 2014), and visuomotor outcomes (Byers et al. 2016). A handful of studies revealed a relationship between Emotional Support and early literacy skills (Soliday Hong et al. 2019; Goble and Pianta 2017; Carr et al. 2019; Gordon and Peng 2020). Only two studies found a relationship between Emotional Support scores and children's outcomes in other domains—specifically, with children's language outcomes (Soliday Hong et al. 2019) or math skills (Schmitt et al. 2020). These findings from individual studies differ from those in Perlman et al.'s (2016) meta-analysis, which reported no significant relationships between Emotional Support and any of the reviewed outcomes (executive function, social skills, English receptive vocabulary, letter-word identification, or math).

Classroom Organization was most often related to children's literacy and social-emotional, executive function, and physical outcomes (Table 1). In individual studies, it was positively related to prelit-eracy (Soliday Hong et al. 2019; Vitiello et al. 2018), knowledge of letters (Carr et al. 2019; Early et al. 2018; Gordon and Peng 2020) and letter sounds (Carr et al. 2019) skills. It was also related to inhibitory control skills (Hamre et al. 2014; Gordon and Peng 2020), executive function (Early et al. 2018; Vitiello et al. 2018), social skills (Early et al. 2018), working memory (Hamre et al. 2020), and visuomotor outcomes (Byers et al. 2016). In just a handful of studies, Classroom Organization was related to children's outcomes in other domains, including math skills (Gordon and Peng 2020; Vitiello et al. 2018) and receptive vocabu-lary (Carr et al. 2019; Soliday Hong et al. 2019). The meta-analysis conducted by Perlman et al. (2016) found significant but small relationships between Classroom Organization and executive function, but—unlike the individual studies we reviewed—there were no relationships with any of the other reviewed outcomes (social skills, English receptive vocabulary, letter-word identification, or math).

Do alternative Pre-K CLASS scores relate to children's readiness for school skills?

Some studies examined the total Pre-K CLASS score or constructed alternative Pre-K CLASS scores. These scores were most often related to outcomes in the literacy and social-emotional, executive function, and physical domains. A total Pre-K CLASS score (in other words, one that averaged the scores of the three domains) was positively related to children's preliteracy, applied problems, and executive function skills (Vitiello et al. 2018). Soliday Hong and colleagues (2019) also examined a total Pre-K CLASS score and found modest relationships with two of the four outcomes—language and literacy skills—but not with math or social skills. Broekhuizen and colleagues (2016) examined classroom quality scores in pre-K and kindergarten by combining Emotional Support and Classroom Organization scores. They found that children in higher quality classrooms in both years had better social skills in kindergarten and fewer behavior problems than children who were in a high quality classroom for only one year.

Alternative domain scores that included a general Responsive Teaching factor[4] in the Pre-K CLASS were related to children's outcomes across domains, including language, literacy, working memory, and teacher-reported conflict (Hamre et al. 2014). Gordon and Peng (2020) found relationships between alternative domain scores and children's outcomes. For example, a Cognitive Facilitation factor was positively related to math scores.

Are there threshold effects of the Pre-K CLASS on children's readiness for school skills?

There was some limited evidence that the relationship between Pre-K CLASS scores and children's outcomes was stronger in classrooms with higher levels of quality than in classrooms of lower quality (Table 2). Burchinal and colleagues (2016) found evidence of a threshold in the relationship between Instructional Support and children's language and literacy scores. Specifically, using a score of 2.75 as the threshold cut point, Instructional Support was a stronger predictor of language and literacy scores in higher quality classrooms than in lower quality classrooms.

However, Hatfield and colleagues (2016) did not find evidence of threshold effects for Instructional Support on children's language skills, print knowledge, phonological skills, or inhibitory control. Yet they find thresholds in the relationship between Emotional Support and Classroom Organization and children's phonological skills and inhibitory control. Children demonstrated higher skills in both areas in classrooms where Emotional Support scores were higher than 6, but these relationships were weak or non-existent when they were below that threshold. They found similar patterns with Classroom Organization scores higher than 6 and phonological skills and print knowledge. Anderson and Phillips (2017) found evidence of thresholds above which Emotional Support had positive relationships with kindergarten reading and math skills. The relationships, however, were counterintuitive, with higher skills related to lower levels of Emotional Support (in the moderate quality—or scores of 5.0 to 5.9—range) rather than higher levels. There is inconclusive evidence about threshold effects, which may be because of small sample sizes when splitting the classrooms up by the different cut points, limited range of scores, and overall low scores in the sample.

Does the Pre-K CLASS have different relationships with children's readiness for school skills depending on children's background characteristics?

Classroom quality matters more for some children than others. Relationships between Pre-K CLASS scores and children's outcomes were stronger for native English-speaking children, children without individualized education programs (IEPs), non-immigrant children, and children in families with higher incomes.[5] Others found relationships between Pre-K CLASS scores and children's outcomes—not found with their peers—for boys, children in rural and small urban communities, and children with stronger self-regulation skills.

Specific subgroup findings on the relationship between Instructional Support and Emotional Support scores and outcomes include:

- When Instructional Support scores were in the low end of the moderate range (that is, scores of 3 to 4), kindergarten letter-word skills of children from higher-income families were not as strong as they were when Instructional Support scores were higher (Anderson and Phillips 2017).

Table 2. Number of studies with significant threshold findings for Pre-K CLASS scores and child outcomes

Pre-K CLASS score	Language	Literacy	Math	Social-emotional, executive function, physical
Instructional Support	1 of 2	1 of 3	0 of 2	0 of 2
Emotional Support	1 of 1	0 of 2	0 of 1	1 of 3
Classroom Organization	1 of 1	1 of 1	n.a.	0 of 1
Other[b]	n.a.	0 of 1	0 of 1	0 of 1

[a]In individual studies, the patterns of findings were sometimes inconsistent (that is, some relationships were significant, whereas others were not). We only include studies in counts of significant findings when the patterns in those studies are in the expected directions.

[b]"Other" includes a study that examined a total Pre-K CLASS score (in other words, the average for all three domains).

n.a. = not applicable. No studies examined threshold effects for these child outcomes.

- When children were in classrooms with high Instructional Support scores, chronic absenteeism was related to fewer gains in executive function skills (Fuhs et al. 2018).
- Classrooms with high scores on Instructional Support and Emotional Support had greater benefits for native English-speaking children (Beecher et al. 2018).
- Classrooms with high scores on Emotional Support had greater benefits for children without Individualized Education Plans (IEPs) (Beecher et al. 2018).
- Higher levels of Emotional Support were negatively related to boys' kindergarten math skills (Anderson and Phillips 2017).

Specific subgroup findings related to the total Pre-K CLASS scores from our scan include:

- Pre-K CLASS scores mattered more for non-immigrant children; in lower quality classrooms these children had lower scores on achievement tests than immigrant children did (Calzada et al. 2015).
- The relationship between Pre-K CLASS scores and children's behavioral outcomes differed by urbanicity, with one study finding relationships between the two for children in rural or small urban communities (and less often for those in large urban communities) (Schmitt et al. 2018).

What implications do the findings have for practice and research?

As many of the reviewed studies point out, users of the Pre-K CLASS can expect to find relationships between the scores and a range of children's outcomes, but these relationships are likely to be small or modest in strength. Users interested in detecting stronger relationships could consider other observation measures, such as domain-specific tools (Burchinal 2018; Clements and Sarama 2008), although less research has examined these.

Users of the Pre-K CLASS seeking the most effective way to predict child outcomes should carefully consider which domains to observe. Although domain scores on the Pre-K CLASS link to outcomes across the child domains assessed, Instructional Support is most consistently related to child outcomes across studies. Given this finding, states using the Pre-K CLASS may want to focus technical assistance and feedback for teachers and professional development providers on Instructional Support in particular. In addition, Emotional Support and Classroom Organization are most consistently associated with children's social-emotional, executive function, and physical outcomes compared with other outcome domains. Executive function and social-emotional skills have been shown to be important for eventual adult well-being and future success (Carneiro et al. 2007; Heckman 2006), so technical assistance could also focus on how classroom quality can develop and improve these skills. Few studies have examined threshold effects with the Pre-K CLASS, so more research is needed to determine the appropriateness of benchmarks for determining quality.

Pre-K CLASS scores and their relationship to children's outcomes can vary depending on the characteristics of the children in the classroom. In other words, the likelihood that quality scores are related to children's outcomes could be stronger for

children with different background characteristics and skills. Researchers should continue to examine the factors that could help explain why there are differential relationships between Pre-K CLASS scores and child outcomes. For states, it is important to understand the nature and extent of the relationships between classroom quality and outcomes for children of different backgrounds. As states' early learning systems continue to evolve, this understanding could help shape decisions with large financial and programmatic consequences—for example, where to target resources to improve the quality of classroom instruction and teacher-child interactions for children who stand to benefit from it the most.

Literature scan on classroom quality measures

This brief is one in a series of reporting products examining how scores on different classroom quality measures relate to children's readiness for school. The larger literature scan this is based on focused on studies that examined how well classroom quality measures capture what they are designed to capture, how they relate to children's outcomes, and issues of equity including differences in findings for subgroups of children. The goal was to inform the use of these classroom quality measures by the ECE field. We describe a subset of findings from the larger literature scan in this research brief.

Methods

We reviewed 27 studies published in the past five years. All 27 examined relationships between the Pre-K CLASS and child outcomes. We focused on research from the past five years because one study from Perlman and colleagues (2016) summarized findings about the Pre-K CLASS and children's outcomes through 2015. We compiled the studies by conducting (1) a database search of empirical studies and (2) a scan of key websites for recent and ongoing research and unpublished literature. Trained staff screened the studies and reports found in both the database search and website review for their relevance to the subject. We eliminated studies that were off topic, conducted outside of the United States, published in a language other than English, did not appear in a substantive publication (for example, we did not include press releases, newspaper articles, and opinion pieces), or focused on a different population or measure (such as use of the CLASS in elementary school classrooms). The reviewed studies were conducted in a range of ECE settings, primarily Head Start and state pre-K classrooms.

The reviewed studies used a range of analytic approaches to determine whether the Pre-K CLASS was related to children's outcomes. For example, some studies examined the relationship between the two variables without accounting for other variables, and others did include more variables in their analyses (for example, by using regressions) to account for children's characteristics such as gender and race or ethnicity. The most rigorous studies accounted for children's skills at the beginning of the school year, which allowed the researchers to see changes in skills after the year began and made it more likely that those changes could be attributed to the relationships they found.

Endnotes

[1] We consider a study to include all the relevant findings presented in a single manuscript, even if some manuscripts report findings from multiple samples.

[2] Unless otherwise specified, outcomes include those measured in the preschool year.

[3] Authors included 19 studies—all published through July 2015—in their meta-analyses. The findings of the meta-analysis of Perlman et al. (2016) may not bear out the findings of individual studies, some of which are included in this literature scan. Two reasons for this are that (1) the overall relationships between classroom quality and child outcomes might be eliminated when aggregating results across samples and (2) there is a conservative approach to including studies by only summarizing those that were very similar to each other in terms of operationalizing the CLASS and the various child outcome domains.

[4] Factor analysis groups together variables that focus on a similar concept or construct. These factors were derived from the data, not from theory.

[5] Findings are contrary to what has typically been found (i.e., Yoshikawa et al. 2013). These studies speculate some reasons for their findings in the individual articles. In general, they acknowledge that these findings are difficult to interpret.

References cited and studies offocus in this brief

Anderson, S., and D. Phillips. "Is Pre-K Classroom Quality Associated with Kindergarten and Middle-School Academic Skills?" Developmental Psychology, vol. 53, no. 6, 2017, pp. 1063–1078.

Beecher, C.C., P. Strand, and B.F. French. "Investigation of the Development of Pre-Academic Skills for Preschoolers in Head Start." Journal of Education for Students Placed at Risk, vol. 23, no. 3, 2018, pp. 230–249.

Broekhuizen, M.L., I.L. Mokrova, M.R. Burchinal, and P.T. Garrett-Peters. "Classroom Quality at Pre-Kindergarten and Kindergarten and Children's Social Skills and Behavior Problems." Early Childhood Research Quarterly, vol. 36, 2016, pp. 212–222.

Burchinal, M. "Measuring Early Care and Education Quality." Child Development Perspectives, vol. 12, no. 1, 2018, pp. 3–9.

Burchinal, M., Y. Xue, A. Auger, H.C. Tien, A. Mashburn, E. Peisner-Feinberg, E.W. Cavadel, M. Zaslow, and L. Tarullo. "Quality Thresholds, Features, and Dosage in Early Care and Education: Secondary Data Analyses of Child Outcomes: III. Testing for Quality Thresholds and Features in Early Care and Education." Monographs of the Society for Research in Child Development, vol. 81, no. 2, 2016, pp. 46–63.

Bustamante, A.S., and A.H. Hindman. "Classroom Quality and Academic School Readiness Outcomes in Head Start: The Indirect Effect of Approaches to Learning." Early Education & Development, vol. 30, no. 1, 2019, pp. 19–35.

Byers, A. I., C. E. Cameron, M. Ko, J. LoCasale-Crouch, and D. W. Grissmer. "What Preschool Classroom Experiences Are Associated with Whether Children Improve in Visuomotor Integration?" Early Education and Development, vol. 27, no. 7, 2016, pp. 976–1003.

Calzada, E., R. Barajas-Gonzalez, S. Dawson-McClure, K.Y. Huang, J. Palamar, D. Kamboukos, and L.M. Brotman. "Early Academic Achievement Among American Low-Income Black Students from Immigrant and Non-Immigrant Families." Prevention Science, vol. 16, no. 8, 2015, pp. 1159–1168.

Carneiro P., Crawford. C., and Goodman A. "The Impact of Early Cognitive and Non-Cognitive Skills on Later Outcomes." London, UK: Centre for the Economics of Education, London School of Economics, 2007.

Carr, R.C., I.L. Mokrova, L. Vernon-Feagans, and M.R. Burchinal. "Cumulative Classroom Quality During Pre-Kindergarten and Kindergarten and Children's Language, Literacy, and Mathematics Skills." Early Childhood Research Quarterly, vol. 47, 2019, pp. 218–228.

Clements, D. H., and J. Sarama. "Experimental Evaluation of the Effects of a Research-Based Preschool Mathematics Curriculum." American Educational Research Journal, vol. 45, no. 2, 2008, pp. 443–494.

Early, D.M., J. Sideris, J. Neitzel, D.R. LaForett, and C.G. Nehler. "Factor Structure and Validity of the Early Childhood Environment Rating Scale – Third Edition (ECERS-3)." Early Childhood Research Quarterly, vol. 44, 2018, pp. 242–256.

Fuhs, M.W., K.T. Nesbitt, and H. Jackson. "Chronic Absenteeism and Preschool Children's Executive Functioning Skills Development." Journal of Education for Students Placed at Risk, vol. 23, no. 1, 2018, pp. 39–52.

Goble, P., and R.C. Pianta. "Teacher–Child Interactions in Free Choice and Teacher-Directed Activity Settings: Prediction to School Readiness." Early Education & Development, vol. 28, no. 8, 2017, pp. 1035–1051.

Goble, P., L.E. Sandilos, and R.C. Pianta. "Gains in Teacher-Child Interaction Quality and Children's School Readiness Skills: Does It Matter Where Teachers Start?" Journal of School Psychology, vol. 73, 2019, pp. 101–113.

Gordon, R.A., and F. Peng. "Evidence Regarding the Domains of the CLASS Pre-K in Head Start Classrooms." Early Childhood Research Quarterly, vol. 53, 2020, pp. 23–39.

Hamre, B., B. Hatfield, R. Pianta, and F. Jamil. "Evidence for General and Domain-Specific Elements of Teacher–Child Interactions: Associations with Preschool Children's Development." Child Development, vol. 85, no. 3, 2014, pp. 1257–1274.

Han, J., M. Schleiber, and B. Gregory. "Associations of Home and Classroom Environments with Head Start Children's Code-Related and Oral Language Skills." Journal of Education for Students Placed at Risk, vol. 22, no. 4, 2017, pp. 200–219.

Harms, T., R. Clifford, and D. Cryer. Early Childhood Environment Rating Scale (3rd Ed.). New York, NY: Teachers College Press, 2015.

Hatfield, B.E., M.R. Burchinal, R.C. Pianta, and J. Sideris. "Thresholds in the Association Between Quality of Teacher–Child Interactions and Preschool Children's School Readiness Skills." Early Childhood Research Quarterly, vol. 36, 2016, pp. 561–571.

Heckman, J. J. "Skill Formation and the Economics of Investing in Disadvantaged Children." Science, vol. 312, no. 5782, 2006, pp. 1900-1902.

Hestenes, L.L., V. Kintner-Duffy, Y.C. Wang, K. La Paro, S.U. Mims, D. Crosby, C. Scott-Little, and D.J. Cassidy. "Comparisons Among Quality Measures in Child Care Settings: Understanding the Use of Multiple Measures in North Carolina's QRIS and Their Links to Social-Emotional Development in Preschool Children." Early Childhood Research Quarterly, vol. 30, 2015, pp. 199–214.

Hindman, A.H., and B.A. Wasik. "Building Vocabulary in Two Languages: An Examination of Spanish-Speaking Dual Language Learners in Head Start." Early Childhood Research Quarterly, vol. 31, 2015, pp. 19–33.

Howes, C., M. Burchinal, R. Pianta, D. Bryant, D. Early, R. Clifford, and O. Barbarin. "Ready to Learn? Children's Pre-Academic Achievement in Pre-Kindergarten Programs." Early Childhood Research Quarterly, vol. 23, no. 1, 2008, pp. 27–50.

Limlingan, M.C., C.M. McWayne, E. A. Sanders, and M.L. López. "Classroom Language Contexts as Predictors of Latinx Preschool Dual Language Learners' School Readiness." American Educational Research Journal, vol. 57, no. 1, 2020, pp. 339–370.

Mashburn, A., L.M. Justice, A. McGinty, and L. Slocum. "The Impacts of a Scalable Intervention on the Language and Literacy Development of Rural Pre-Kindergartners." Applied Developmental Science, vol. 20, no. 1, 2016, pp. 61–78.

Mashburn, A. J., R. C. Pianta, B. K. Hamre, J. T. Downer, O. A. Barbarin, D. Bryant, M. Burchinal, D. M. Early, and C. Howes. "Measures of Classroom Quality in Prekindergarten and Children's Development of Academic, Language, and Social Skills." Child Development, vol. 79, no. 3, 2008, pp. 732–749.

Perlman, M., O. Falenchuk, B. Fletcher, E. McMullen, J. Beyene, and P.S. Shah. "A Systematic Review and Meta-Analysis of a Measure of Staff/Child Interaction Quality (the Classroom Assessment Scoring System) in Early Childhood Education and Care Settings and Child Outcomes." Plos One, vol. 11, no. 12, 2016, pp. 1–33.

Phillips, D. A., M. W. Lipsey, K. A. Dodge, R. Haskins, D. Bassok, M. R. Burchinal, G. J. Duncan, M. Dynarski, K. A. Magnuson, and C. Weiland. "Puzzling it Out: The Current State of Scientific Knowledge on Pre-Kindergarten Effects – A Consensus Statement." Washington, DC: Brookings Institution, 2017.

Pianta, R. C., K. M. La Paro, and B. K. Hamre. Classroom Assessment Scoring System™: Pre-K Manual. Baltimore, MD: Paul H Brookes Publishing, 2008.

Purtell, K.M., and A. Ansari. "Classroom Age Composition and Preschoolers' School Readiness: The Implications of Classroom Quality and Teacher Qualifications." AERA Open, vol. 4, no. 1, 2018,

Schmitt, S.A., R.J. Duncan, A. Budrevich, and I. Korucu. "Benefits of Behavioral Self-Regulation in the Context of High Classroom Quality for Preschoolers' Mathematics." Early Education & Development, vol. 31, no. 3, 2020, pp. 323–334.

Schmitt, S.A., M.E. Pratt, I. Korucu, A.R. Napoli, and K.L. Schmerold. "Preschool Classroom Quality and Social-Emotional Functioning: Findings Across Geographic Regions." Early Childhood Research Quarterly, vol. 43, 2018, pp. 11–22.

Soliday Hong, S.L., T.J. Sabol, M.R. Burchinal, L. Tarullo, M. Zaslow, and E. Peisner-Feinberg. "ECE Quality Indicators and Child Outcomes: Analyses of Six Large Child Care Studies." Early Childhood Research Quarterly, vol. 49, 2019, pp. 202–217.

Vitiello, V.E., D. Bassok, B.K. Hamre, D. Player, and A.P. Williford. "Measuring the Quality of Teacher–Child Interactions at Scale: Comparing Research-Based and State Observation Approaches." Early Childhood Research Quarterly, vol. 44, 2018, pp. 161–169.

Yoshikawa, H., C. Weiland, J. Brooks-Gunn, M. R. Burchinal, L. M. Espinosa, W. T. Gormley, J. Ludwig, K. A. Magnuson, D. Phillips, and M. J. Zaslow. "Investing in Our Future: The Evidence Base on Preschool Education." Washington, DC: Society for Research in Child Development, 2013.

Appendix A

Detailed findings from studies examining the relationship between the Pre-K CLASS and child outcomes

Table A.1. Key findings on the relationship between the Pre-K CLASS Instructional Support and child outcomes

Citation	Gain or cross-sectional outcome?	Linear or threshold analysis?	Relationships by domain[a]			
			Language	Literacy[b]	Math	Social-emotional, executive function, physical
Anderson and Phillips 2017	Gain	Linear		+ (kindergarten letter-word → middle school reading)[c]	n.s. (kindergarten applied problems)	n.s. (kindergarten attentiveness)
Anderson and Phillips 2017	Gain	Threshold		n.s. (kindergarten spelling)	n.s. (kindergarten applied problems)	n.s. (kindergarten attentiveness)
Beecher et al. 2018	Gain*	Linear		n.s. (letter sounds) + (letter naming)	+ (object counting) n.s. (rote counting)	
Broekhuizen et al. 2016	Cross-sectional	Linear				n.s. (kindergarten social skills) n.s. (kindergarten behavior problems) n.s. (grade 1 social skills) n.s. (grade 1 behavior problems)
Burchinal et al. 2016	Gain	Threshold	+ (receptive vocabulary)	+ (letter word)	n.s. (applied problems)	
Bustamante and Hindman 2019	Gain	Linear	+ (approaches to learning → receptive vocabulary)[c]	+ (approaches to learning → letter word)[c] + (approaches to learning → spelling skills)[c]	+ (approaches to learning → applied problems)[c]	
Byers et al. 2016	Gain	Linear				+ (visuomotor)
Carr et al. 2019	Gain	Linear	+ (receptive vocabulary, oral expression)	+ (letter word, phonemic awareness)	+ (applied problems)	
Early et al. 2018	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word)	n.s. (applied problems)	+ (executive functioning) n.s. (behavior problems) n.s. (social skills)
Fuhs et al. 2018	Gain	Linear				n.s. (executive functioning)

Citation	Gain or cross-sectional outcome?	Linear or threshold analysis?	Relationships by domain[a]			
			Language	Literacy[b]	Math	Social-emotional, executive function, physical
Goble and Pianta 2017	Gain	Linear	+ (expressive vocabulary) n.s. (receptive vocabulary)	+ (phonological awareness) n.s. (print knowledge)		n.s. (inhibitory control)
Goble et al. 2019	Gain	Linear	n.s. (receptive vocabulary)	+ (print knowledge)	n.s. (applied problems)	+ (inhibitory control)
Gordon and Peng 2020 (using FACES 2009 data)	Gain	Linear	n.s. (receptive vocabulary)	+ (letter word) n.s. (spelling)	n.s. (applied problems)	+ (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
Gordon and Peng 2020 (using FACES 2014 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	+ (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
Hamre et al. 2014	Gain	Linear	+ (receptive vocabulary, expressive vocabulary)	+ (phonological awareness, print knowledge)		n.s. (teacher-child conflict) + (teacher-child closeness) n.s. (working memory) n.s. (inhibitory control)
Han et al. 2017	Cross-sectional	Linear	n.s. (receptive vocabulary) n.s. (expressive vocabulary)	n.s. (letter word) + (letter sounds)		
Hatfield et al. 2016	Gain	Threshold	n.s. (receptive vocabulary) n.s. (expressive vocabulary) n.s. (phonological awareness)	n.s. (print knowledge)		n.s. (inhibitory control)
Hestenes et al. 2015	Cross-sectional	Linear				+ (social skills) + (learning self-efficacy) n.s. (externalizing problems) n.s. (internalizing problems)
Hindman and Wasik 2015	Gain	Linear	+ (English receptive vocabulary) + (Spanish receptive vocabulary)			

Citation	Gain or cross-sectional outcome?	Linear or threshold analysis?	Relationships by domain[a]			
			Language	Literacy[b]	Math	Social-emotional, executive function, physical
Mashburn et al. 2016[d]	Gain	Linear	n.s. (narrative language) + (definitional vocabulary) + (phonological awareness)	n.s. (print knowledge) n.s. (alphabet knowledge) n.s. (print concepts)		
Mashburn et al. 2016[e]	Gain	Linear	n.s. (narrative language) n.s. (definitional vocabulary) n.s. (phonological awareness)	+ (print knowledge) + (alphabet knowledge) + (print concepts)		
Perlman et al. 2016	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word)	n.s. (applied problems)	+ (social skills)
Schmitt et al. 2020	Cross-sectional	Linear			n.s. (applied problems)	
Soliday Hong et al. 2019	Gain	Linear	+ (receptive vocabulary)	+ (preliteracy)	n.s. (applied problems, quantitative concepts)	n.s. (social skills, behavior problems)
Vitiello et al. 2018 (local staff observations)	Gain	Linear		+ (preliteracy)	+ (applied problems, quantitative concepts)	+ (executive functioning)
Vitiello et al. 2018 (research staff observations)	Gain	Linear		n.s. (preliteracy)	n.s. (applied problems, quantitative concepts)	n.s. (executive functioning)

Note: Outcomes/domains that were not examined are represented by blank cells. Unless otherwise noted, the outcomes examined were measured in preschool.

For studies that conducted a linear analysis, + indicates that classroom quality had a positive relationship with the respective child outcome(s); – indicates that classroom quality had a negative relationship with the respective child outcome(s); n.s. = indicates no evidence of a significant relationship between classroom quality and the respective child outcome(s).

For studies that conducted a threshold analysis, + indicates that higher levels of classroom quality had a stronger, positive relationship with the respective child outcome(s); – indicates that lower levels of classroom quality had a stronger, positive relationship with the respective child outcome(s); n.s. = indicates no evidence of a threshold of quality above or below which the respective child outcome(s) were related to classroom quality.

* Denotes that the study examined gains by using change scores. Otherwise, gains were examined by controlling for a previous score.

[a] Measures listed together in the same set of parentheses were examined together as a composite.

[b] Preliteracy refers to a composite of skills, including expressive vocabulary, receptive vocabulary, phonological awareness, print knowledge, and/or letter-word identification. Studies included either a subset or all of these skills in their composite.

[c] Finding is based on an indirect relationship.

[d] These analyses focused on the Language Modeling dimension of Instructional Support.

[e] These analyses focused on the Literacy Focus dimension of Instructional Support.

FACES = Head Start Family and Child Experiences Survey.

Table A.2. Key findings on the relationship between the Pre-K CLASS Emotional Support and child outcomes

Citation	Gain or cross-sectional outcome?	Linear or threshold analysis?	Relationships by domain[a]			
			Language	Literacy[b]	Math	Social-emotional, executive function, physical
Anderson and Phillips 2017	Gain	Linear		n.s. (kindergarten letter word) n.s. (kindergarten spelling)	n.s. (kindergarten applied problems)	n.s. (kindergarten attentiveness)
Anderson and Phillips 2017	Gain	Threshold		- (kindergarten letter word) n.s. (kindergarten spelling)	- (kindergarten applied problems)	n.s. (kindergarten attentiveness)
Beecher et al. 2018	Gain*	Linear		n.s. (letter sounds) n.s. (letter naming)	n.s. (object counting) n.s. (rote counting)	
Burchinal et al. 2016	Gain	Threshold				n.s. (behavior problems) n.s. (social skills)
Byers et al. 2016	Gain	Linear				+ (visuomotor)
Carr et al. 2019	Gain	Linear	n.s (receptive vocabulary, oral expression)	+ (letter word, phonemic awareness)	n.s. (applied problems)	
Early et al. 2018	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word)	n.s. (applied problems)	+ (executive functioning) n.s. (behavior problems) n.s. (social skills)
Goble and Pianta 2017	Gain	Linear	n.s. (expressive vocabulary) n.s. (receptive vocabulary)	+ (phonological awareness) n.s. (print knowledge)		n.s. (inhibitory control)
Goble et al. 2019	Gain	Linear	n.s. (receptive vocabulary)	n.s. (print knowledge)		n.s. (inhibitory control)
Gordon and Peng 2020 (using FACES 2009 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
Gordon and Peng 2020 (using FACES 2014 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)

Citation	Gain or cross-sectional outcome?	Linear or threshold analysis?	Relationships by domain[a]			
			Language	Literacy[b]	Math	Social-emotional, executive function, physical
Hamre et al. 2014	Gain	Linear	n.s. (receptive vocabulary, expressive vocabulary)	n.s. (phonological awareness, print knowledge)		n.s. (teacher-child conflict) n.s. (teacher-child closeness) n.s. (working memory) - (inhibitory control)
Han et al. 2017	Cross-sectional	Linear	n.s. (receptive vocabulary) n.s. (expressive vocabulary)	n.s. (letter word) n.s. (letter sounds)		
Hatfield et al. 2016	Gain	Threshold	n.s. (receptive vocabulary) n.s. (expressive vocabulary) + (phonological awareness)	n.s. (print knowledge)		+ (inhibitory control)
Hestenes et al. 2015	Cross-sectional	Linear				n.s. (social skills) n.s. (learning self-efficacy) n.s. (externalizing problems) + (internalizing problems)
Limlingan et al. 2020	Gain	Linear	n.s. (receptive vocabulary) n.s. (Spanish receptive vocabulary)			+ (approaches to learning) n.s. (cooperative behavior)
Perlman et al. 2016	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word)	n.s. (applied problems)	n.s. (social skills) n.s. (executive functioning)
Schmitt et al. 2020	Cross-sectional	Linear			+ (applied problems)	
Soliday Hong et al. 2019	Gain	Linear	+ (receptive vocabulary)	+ (preliteracy)	n.s. (applied problems, quantitative concepts)	n.s. (social skills, behavior problems)
Vitiello et al. 2018 (local staff observations)	Gain	Linear		n.s. (preliteracy)	n.s. (applied problems, quantitative concepts)	n.s. (executive functioning)
Vitiello et al. 2018 (research staff observations)	Gain	Linear		n.s. (preliteracy)	n.s. (applied problems, quantitative concepts)	+ (executive functioning)

Note: Outcomes/domains that were not examined are represented by blank cells. Unless otherwise noted, the outcomes examined were measured in preschool.

For studies that conducted a linear analysis, + indicates that classroom quality had a positive relationship with the respective child outcome(s); – indicates that classroom quality had a negative relationship with the respective child outcome(s); n.s.= indicates no evidence of a significant relationship between classroom quality and the respective child outcome(s). For

studies that conducted a threshold analysis, + indicates that higher levels of classroom quality had a stronger, positive relationship with the respective child outcome(s); – indicates that lower levels of classroom quality had a stronger, positive relationship with the respective child outcome(s); n.s. = indicates no evidence of a threshold of quality above or below which the respective child outcome(s) were related to classroom quality.

* denotes that the study examined gains by using change scores. Otherwise, gains were examined by controlling for a previous score.

[a] Measures listed together in the same set of parentheses were examined together as a composite.

[b] Preliteracy refers to a composite of skills, including expressive vocabulary, receptive vocabulary, phonological awareness, print knowledge, and/or letter-word identification. Studies included either a subset or all of these skills in their composite.

FACES = Head Start Family and Child Experiences Survey.

Table A.3. Key findings on the relationship between the Pre-K CLASS Classroom Organization and child outcomes

Citation	Gain or cross-sectional outcome?	Linear or threshold analysis?	Relationships by domain[a]			
			Language	Literacy[b]	Math	Social-emotional, executive function, physical
Beecher et al. 2018	Gain*	Linear		+ (letter sounds) + (letter naming)	+ (object counting) n.s. (rote counting)	
Byers et al. 2016	Gain	Linear				+ (visuomotor)
Carr et al. 2019	Gain	Linear	+ (receptive vocabulary, oral expression)	+ (letter word, phonemic awareness)	n.s. (applied problems)	
Early et al. 2018	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word)	n.s. (applied problems)	+ (executive functioning) n.s. (behavior problems) + (social skills)
Goble and Pianta 2017	Gain	Linear	n.s. (expressive vocabulary) n.s. (receptive vocabulary)	n.s. (phonological awareness) n.s. (print knowledge)		n.s. (inhibitory control)
Goble et al. 2019	Gain	Linear	n.s. (receptive vocabulary)	n.s. (print knowledge)		n.s. (inhibitory control)
Gordon and Peng 2020 (using FACES 2009 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) + (social skills) n.s. (behavior problems)
Gordon and Peng 2020 (using FACES 2014 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)

Citation	Gain or cross-sectional outcome?	Linear or threshold analysis?	Relationships by domain[a]			
			Language	Literacy[b]	Math	Social-emotional, executive function, physical
Hamre et al. 2014	Gain	Linear	n.s. (receptive vocabulary, expressive vocabulary)	n.s. (phonological awareness, print knowledge)		n.s. (teacher-child conflict) n.s. (teacher-child closeness) + (working memory) + (inhibitory control)
Han et al. 2017	Cross-sectional	Linear	n.s. (receptive vocabulary) n.s. (expressive vocabulary)	n.s. (letter word) n.s. (letter sounds)		
Hatfield et al. 2016	Gain	Threshold	n.s. (receptive vocabulary) n.s. (expressive vocabulary) + (phonological awareness)	+ (print knowledge)		n.s. (inhibitory control)
Hestenes et al. 2015	Cross-sectional	Linear				n.s. (social skills) n.s. (learning self-efficacy) n.s. (externalizing problems) n.s. (internalizing problems)
Perlman et al. 2016	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word)	n.s. (applied problems)	n.s. (social skills) + (executive functioning)
Schmitt et al. 2020	Cross-sectional	Linear			n.s. (applied problems)	
Soliday Hong et al. 2019	Gain	Linear	+ (receptive vocabulary)	+ (preliteracy)	n.s. (applied problems, quantitative concepts)	n.s. (social skills, behavior problems)
Vitiello et al. 2018 (local staff observations)	Gain	Linear		+ (preliteracy)	+ (applied problems, quantitative concepts)	n.s. (executive functioning)
Vitiello et al. 2018 (research staff observations)	Gain	Linear		+ (preliteracy)	n.s. (applied problems, quantitative concepts)	+ (executive functioning)

Note: Outcomes/domains that were not examined are represented by blank cells. Unless otherwise noted, the outcomes examined were measured in preschool.

For studies that conducted a linear analysis, + indicates that classroom quality had a positive relationship with the respective child outcome(s); – indicates that classroom quality had a negative relationship with the respective child outcome(s); n.s. = indicates no evidence of a significant relationship between classroom quality and the respective child outcome(s).

For studies that conducted a threshold analysis, + indicates that higher levels of classroom quality had a stronger, positive relationship with the respective child outcome(s); – indicates that lower levels of classroom quality had a stronger, positive relationship with the respective child outcome(s); n.s. = indicates no evidence of a threshold of quality above or below which the respective child outcome(s) were related to classroom quality.

* denotes that the study examined gains by using change scores. Otherwise, gains were examined by controlling for a previous score.

[a] Measures listed together in the same set of parentheses were examined together as a composite.

[b] Preliteracy refers to a composite of skills, including expressive vocabulary, receptive vocabulary, phonological awareness, print knowledge, and/or letter-word identification. Studies included either a subset or all of these skills in their composite.

FACES = Head Start Family and Child Experiences Survey.

Table A.4. Key findings on the relationship between the Pre-K CLASS alternative factors and child outcomes

Alternative factor	Citation	Gain or cross-sectional outcome?	Linear or threshold analysis?	Relationships by domain[a]			
				Language	Literacy[b]	Math	Social-emotional, executive function, physical
Combined Emotional Support and Class-room Organization	**Broekhuizen et al. 2016**	Cross-sectional	Linear				+ (kindergarten social skills) - (kindergarten behavior problems) + (grade 1 social skills) - (grade 1 behavior problems)
	Gordon and Peng 2020 (using FACES 2009 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
	Gordon and Peng 2020 (using FACES 2014 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
Total	**Bustamante et al. 2018**	Cross-sectional	Linear	+ (percentage of child-to-teacher talk)			+ (child engagement)
	Calzada et al. 2015	Gain*	Linear		+ (kindergarten reading) n.s. (grade 2 reading)	n.s. (kindergarten math) n.s. (grade 2 math)	
	Gordon and Peng 2020 (using FACES 2009 data)	Gain	Linear	n.s. (receptive vocabulary)	+ (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
	Gordon and Peng 2020 (using FACES 2014 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)

Alternative factor	Citation	Gain or cross-sectional outcome?	Linear or threshold analysis?	Relationships by domain[a]			
				Language	Literacy[b]	Math	Social-emotional, executive function, physical
	Purtell and Ansari 2018 (using a sample of 3-year-old children only)	Gain	Linear		n.s. (preliteracy)	n.s. (applied problems, quantitative concepts)	+ (social skills) n.s. (behavior problems)
	Purtell and Ansari 2018 (using a sample of 3-year-old children only)	Gain	Threshold		n.s. (preliteracy)	n.s. (applied problems, quantitative concepts)	n.s. (social skills) n.s. (behavior problems)
	Purtell and Ansari 2018 (using a sample of 4-year-old children only)	Gain	Linear		n.s. (preliteracy)	n.s. (applied problems, quantitative concepts)	n.s. (social skills) n.s. (behavior problems)
	Purtell and Ansari 2018 (using a sample of 4-year-old children only)	Gain	Threshold		n.s. (preliteracy)	n.s. (applied problems, quantitative concepts)	n.s. (social skills) n.s. (behavior problems)
	Schmitt et al. 2018	Cross-sectional	Linear				+ (social competence) n.s. (externalizing behavior, internalizing behavior)
	Soliday Hong et al. 2019	Gain	Linear	+ (receptive vocabulary)	+ (preliteracy)	n.s. (applied problems, quantitative concepts)	n.s. (social skills, behavior problems)
	Vitiello et al. 2018 (research staff observations)	Gain	Linear		n.s. (preliteracy)	+ (applied problems, quantitative concepts)	+ (executive functioning)
General Responsive Teaching	**Gordon and Peng 2020 (using FACES 2009 data)**	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
	Gordon and Peng 2020 (using FACES 2014 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)

Alternative factor	Citation	Gain or cross-sectional outcome?	Linear or threshold analysis?	Relationships by domain[a]			
				Language	Literacy[b]	Math	Social-emotional, executive function, physical
	Hamre et al. 2014	Gain	Linear	+ (receptive vocabulary, expressive vocabulary)	+ (phonological awareness, print knowledge)		- (teacher-child conflict) n.s. (teacher-child closeness) + (working memory) n.s. (inhibitory control)
Cognitive Facilitation	**Gordon and Peng 2020 (using FACES 2009 data)**	Gain	Linear	- (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	+ (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
	Gordon and Peng 2020 (using FACES 2014 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	+ (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
	Hamre et al. 2014	Gain	Linear	+ (receptive vocabulary, expressive vocabulary)	+ (phonological awareness, print knowledge)		n.s. (teacher- child conflict) n.s. (teacher- child closeness) n.s. (working memory) n.s. (inhibitory control)
Proactive Management and Routines	**Gordon and Peng 2020 (using FACES 2009 data)**	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	- (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
	Gordon and Peng 2020 (using FACES 2014 data)	Gain	Linear	n.s. (receptive vocabulary)	- (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) + (attention) n.s. (social skills) n.s. (behavior problems)
	Hamre et al. 2014	Gain	Linear	n.s. (receptive vocabulary, expressive vocabulary)	n.s. (phonological awareness, print knowledge)		n.s. (teacher-child conflict) n.s. (teacher-child closeness) n.s. (working memory) + (inhibitory control)
Climate and Management	**Gordon and Peng 2020 (using FACES 2009 data)**	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
	Gordon and Peng 2020 (using FACES 2014 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)

Alternative factor	Citation	Gain or cross-sectional outcome?	Linear or threshold analysis?	Relationships by domain[a]			
				Language	Literacy[b]	Math	Social-emotional, executive function, physical
Sensitivity and Regard	**Gordon and Peng 2020 (using FACES 2009 data)**	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) n.s. (behavior problems)
	Gordon and Peng 2020 (using FACES 2014 data)	Gain	Linear	n.s. (receptive vocabulary)	n.s. (letter word) n.s. (spelling)	n.s. (applied problems)	n.s. (inhibitory control) n.s. (attention) n.s. (social skills) - (behavior problems)

Note: Outcomes/domains that were not examined are represented by blank cells. Unless otherwise noted, the outcomes examined were measured in preschool.

For studies that conducted a linear analysis, + indicates that classroom quality had a positive relationship with the respective child outcome(s); – indicates that classroom quality had a negative relationship with the respective child outcome(s); n.s. = indicates no evidence of a significant relationship between classroom quality and the respective child outcome(s).

For studies that conducted a threshold analysis, + indicates that higher levels of classroom quality had a stronger, positive relationship with the respective child outcome(s); – indicates that lower levels of classroom quality had a stronger, positive relationship with the respective child outcome(s); n.s. = indicates no evidence of a threshold of quality above or below which the respective child outcome(s) were related to classroom quality.

* denotes that the study examined gains by using change scores. Otherwise, gains were examined by controlling for a previous score.

[a] Measures listed together in the same set of parentheses were examined together as a composite.

[b] Preliteracy refers to a composite of skills, including expressive vocabulary, receptive vocabulary, phonological awareness, print knowledge, and/or letter word identification. Studies included either a subset or all of these skills in their composite.

FACES = Head Start Family and Child Experiences Survey.