SEPTEMBER 2020

MICHELLE F. MAIER
JOANN HSUEH
MEGHAN MCCORMICK

RETHINKING CLASSROOM QUALITY

What We Know and What We Are Learning

Public support for and government investments in early childhood education (ECE) are at an all-time high. Research has identified early childhood as a critical period for brain development,[1] work that has spurred interest in expanding ECE programs across the United States. But not all programs produce positive effects at the end of the preschool year. For those that do improve children's outcomes, impacts tend to diminish as children enter kindergarten and elementary school.[2] To maximize these significant investments in ECE, programming must be high quality, brought to scale, and generate substantial impacts on children's early learning that can be sustained through elementary school and into adulthood.

Experts in the ECE field agree that the quality of classroom learning experiences is critical to promoting children's development.[3] However, there is a lack of consensus both on the aspects of quality that matter most for advancing children's developmental gains and how to define and measure the quality of ECE programs.[4] Unfortunately, current conceptions and measurement approaches demonstrate small and inconsistent associations between quality and children's outcomes.[5] Identifying and measuring the dimensions of quality that are most strongly linked to children's outcomes can provide needed information on how to target interventions to ensure that children, particularly those from low-income minority families, receive and benefit from high-quality ECE programming at scale.

As the federal and state governments increasingly invest in ECE programs to improve their quality, MDRC is leading several studies that conceive and measure the quality of ECE classrooms in new and innovative ways. In particular, MDRC is focusing on *instructional quality* by examining promising instructional practices, such as the use of rich content and individualized activity settings and the promotion of higher-order skills within a broad range of learning domains. In doing so, MDRC aims to improve the understanding of the critical aspects of instructional quality that promote school readiness among low-income children and their sustained academic success as they move through elementary school and beyond.

HOW CLASSROOM QUALITY IS CURRENTLY CONCEIVED

Although researchers agree that ECE quality is important,[6] they have not established what "high quality" means in a definitive and accurate way.[7] Current conceptions identify the following two broad dimensions of quality that are thought to influence children's learning and development:

1 **STRUCTURAL QUALITY** refers to the *structural or physical* aspects of how ECE classrooms are designed and configured. This dimension includes aspects of the physical

mdrc
BUILDING KNOWLEDGE TO IMPROVE SOCIAL POLICY

classroom, such as the arrangement of furniture, the available materials and toys, and cleanliness and safety; structural features that may be determined by policy, such as teacher-child ratios, class size, age composition (for instance, mixed age or 4-year-olds only), and full-day or part-day hours; and teacher qualifications.

2 **PROCESS QUALITY** refers to the *relational* aspects of classrooms and includes the social, emotional, and instructional interactions that occur among teachers and children.

HOW CLASSROOM QUALITY IN PRESCHOOL RELATES TO CHILDREN'S OUTCOMES

Strong structural features are thought to provide a critical foundation that supports other components of quality.[8] Aspects of process quality are typically hypothesized to be more closely linked with children's gains than structural quality given their focus on interactions, which are more proximal to children's learning experiences than structural factors.[9] Yet, most studies have found small and inconsistent links between measures of process quality and children's outcomes in preschool.[10] Notably, instructional aspects of process quality — such as teacher practices that facilitate rich conversations and open-ended questioning — hold the most promise, demonstrating somewhat stronger links to positive child outcomes than other aspects of quality.[11]

Researchers find clearer associations between quality features and child outcomes when they are more closely aligned. For example, emotionally responsive teacher-child interactions have been shown to predict children's teacher-reported social skills, whereas instructional interactions such as promoting children's high-order thinking skills and providing a rich language environment have been linked with better academic and language skills.[12] This body of work suggests that it is important to distinguish specific aspects of quality when considering what matters most for each child outcome.

Taken together, the literature suggests that (1) structural quality may be necessary but is insufficient for promoting children's learning and development, and (2) a greater focus on the instructional aspects of quality is critical to moving the needle on child outcomes, especially because instructional quality in ECE classrooms tends to be low.[13] Even so, associations between higher instructional quality and gains in child outcomes are still modest. This raises a fundamental question: What is missing in existing definitions and measures of classroom quality, given that the ultimate goal is to produce sustained gains in children's learning and development?

HOW CLASSROOM QUALITY IN PRESCHOOL IS TYPICALLY MEASURED

Measurement-related issues, however, overlay existing findings and limit what the field can currently learn. Current measures vary with respect to the aspects of quality on which they focus, the level of depth with which they assess quality dimensions, and the unit of observation (classroom versus

child). The most commonly used observational measures of ECE classroom quality are the Classroom Assessment Scoring System (CLASS) and the Early Childhood Environmental Rating Scale (ECERS).[14] These measures capture a mix of structural, process, and instructional quality. Other classroom observational measures focus on what is taught in terms of skill domains, such as math, literacy, and science, and the different activity settings where children spend time, such as whole group, small group, or centers.[15] Another set of measures captures the quality of instructional practices within specific skill domains.[16]

The most frequently used measures assess *global* quality — capturing what the average child experiences — but there are several measures that focus on the quality of an *individual* child's learning experiences.[17] Classroom measures of global quality are more common because they are less time- and resource-intensive to code. Yet, child-specific measures of quality may be more predictive of child outcomes because they account for variation in individuals' experiences within the classroom.[18]

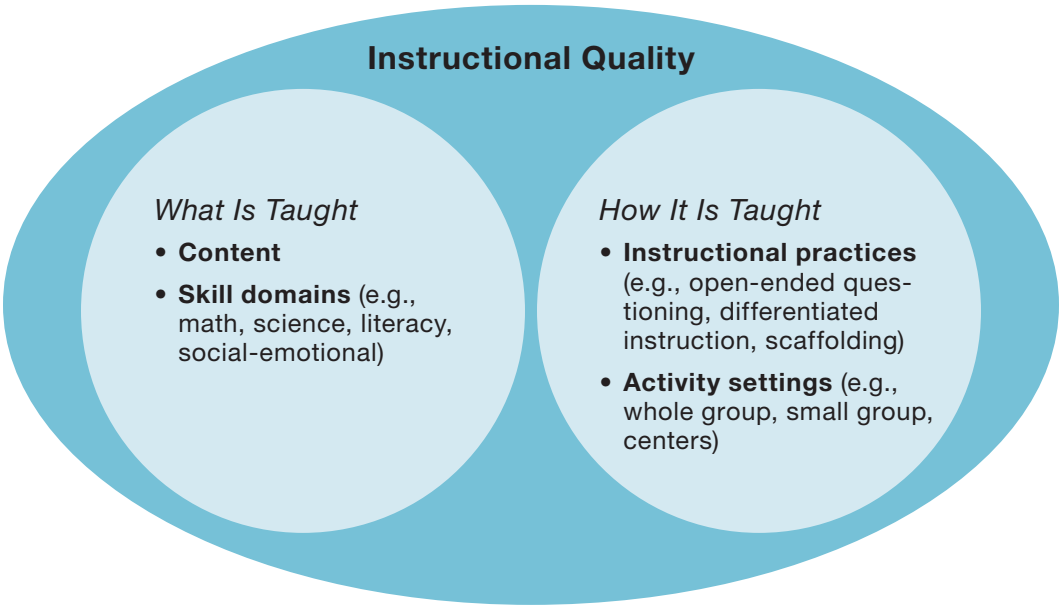
A GREATER FOCUS ON INSTRUCTIONAL QUALITY

Given that instructional aspects of process quality are more predictive of child outcomes than relational aspects of process quality, the MDRC research team has been studying instructional quality and what it entails and refining how it is conceived. Many current conceptions of instructional quality focus on *how teachers teach* by capturing general instructional practices and the quality of instruction within a skill domain.[19] Largely absent from these conceptions, however, is an emphasis on *what teachers teach*. When it is studied, it is commonly examined as the time spent on teaching different skill domains (for example, math, literacy, and so on). Yet, what teachers teach is broader and includes the provision of content-rich instruction, which the research team defines as the delivery of background and world knowledge as the medium through which teachers support the development of children's skills.[20] The literature suggests that what children are taught — including their exposure to rich content — is critical to the development of their higher-order skills, such as deep knowledge of vocabulary and problem solving, which are fundamental to children's overall development and are positively related to longer-term outcomes.[21] Since these skills can be fostered by an intervention such as a prekindergarten (Pre-K) program and in fact are less likely to develop in the absence of such a program,[22] exposure to rich content may be a key element that current preschool programs must include in their curriculum to sustain impacts on outcomes over time. Because more disadvantaged children may have less exposure to content-rich learning opportunities, such practices may also reduce achievement gaps before, during, and beyond kindergarten.[23]

With these considerations in mind, the research team proposes to conceptualize instructional quality as encompassing both *what* teachers teach and *how* teachers teach. (See Figure 1.) The hypothesis is that the interaction between the what and the how of teaching — the content being taught along with high-quality instructional practices that promote children's cognitive development — is what is most important for supporting short-term and lasting gains in children's outcomes.

FIGURE 1

A Refined Conceptualization of Instructional Quality



In this conceptualization, the working definition of "content" is the rich background and world knowledge that teachers deliver through multiple, repeated knowledge-building learning activities that are connected to one another via a theme or multidisciplinary project. In essence, content is the medium through which instruction can support children's skill development across multiple domains. Accordingly, content-rich instruction differs from instruction that teaches domain-specific skills in isolation. It also often falls outside present notions and measures of classroom quality, which tend to focus on how teachers teach but not what they teach. For example, in a Pre-K classroom where domain-specific skills are taught, a teacher might define vocabulary words about the ocean during a read-aloud but may not reinforce these concepts the rest of the week. In a classroom that takes a content-rich approach, by contrast, a teacher would intentionally build on the content discussed during the read-aloud through, for example, a hands-on, science-focused small group activity about the ocean as a habitat that also targets language, literacy, and math skills. The research team hypothesizes that the exposure to rich content as it takes place in the latter classroom — that is, as a medium through which domain-specific skills (such as vocabulary, print awareness, and counting) are developed — better supports children's learning of world knowledge and higher-order problem-solving skills than the singular focus on domain-specific skills in the former classroom.[24]

RETHINKING A CONCEPTUAL MODEL OF CLASSROOM QUALITY

In line with this revised understanding of instructional quality, the research team puts forth a conceptual model of classroom quality that hypothesizes that there are three distinct but interrelated dimensions of quality. The team draws a distinction between the interactional and instructional aspects of process quality and proposes examining these aspects according to the following working definitions:

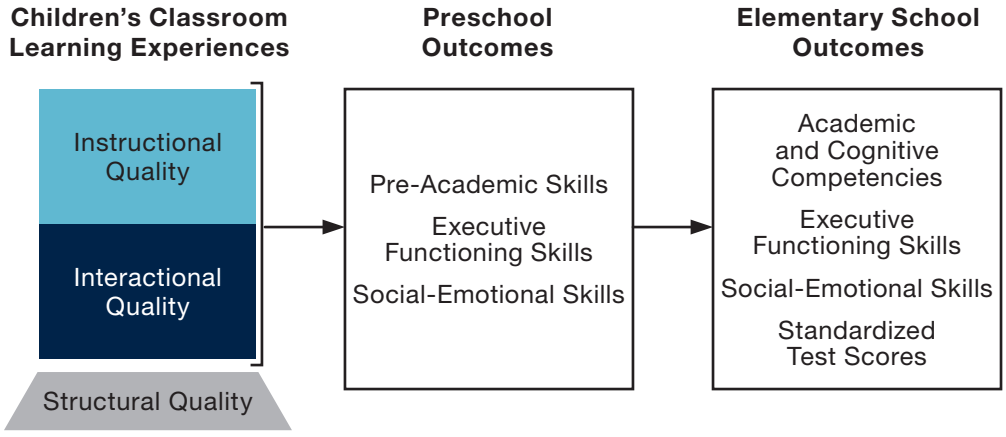
- **INTERACTIONAL QUALITY** refers to the quality of children's interactions with teachers and other children in the classroom and the ways in which the classroom climate is positive, responsive, and predictable. It includes teachers' warmth and sensitivity, as well as their overall classroom management and organizational skills.

- **INSTRUCTIONAL QUALITY** refers to *what* is being taught in the classroom and *how*. This dimension is described in more detail below.

Figure 2 illustrates how these three dimensions of classroom quality — structural, interactional, and instructional — make up children's classroom learning experiences and their relation to outcomes in preschool and elementary school.

FIGURE 2

Conceptual Framework Linking Classroom Quality to Child Outcomes



WHAT IS MDRC LEARNING ABOUT THIS MODEL OF CLASSROOM QUALITY?

Given the small and inconsistent associations between extant measures of quality and child outcomes, there is a great need in the ECE field to create or adapt quality measures that capture a fuller range of activities, practices, and interactions in classrooms that are more strongly and directly

linked to children's growth and development. The hope is that a more encompassing conception of quality and corresponding measures can help to identify which dimensions of quality may be most beneficial for promoting children's learning and development.

Two current MDRC studies are gathering new sets of observational measures for ECE settings that detail the extent to which teachers promote the development of children's vocabulary, use cognitively demanding teaching practices, and expose children to rich content to dive deeper into their classroom learning experiences. Both are a part of the MDRC-led Expanding Children's Early Learning (ExCEL) Network and will provide evidence for this new conception of quality.[25]

The first study, ExCEL Quality, examines the effectiveness of two different curricular and professional development approaches to improving quality, one focusing on promoting structural and interactional quality and the other on promoting the conception of instructional quality described above. The latter approach aims to change *what* preschool teachers teach and *how* by (1) providing a content-rich curriculum in which learning activities follow a developmental sequence and (2) offering training and coaching that support teachers' fidelity to the curriculum and their use of intentional instructional practices that promote children's higher-order thinking, domain-specific skill development, and content knowledge. ExCEL Quality is poised to provide evidence for the malleability of these different dimensions of quality.

The second study, ExCEL P3, is a collaboration among MDRC, the Boston Public Schools Department of Early Childhood, the University of Michigan, and the Harvard Graduate School of Education. It evaluates a district-wide curriculum and professional development model that aims to align instruction from preschool to second grade in the Boston Public Schools. The project dives deeper into different aspects of instructional quality by collecting a new set of observational items that captures rich information on the extent to which teachers improve children's vocabulary, use cognitively demanding teaching practices, and expose children to rich content. ExCEL P3 is set to elucidate which aspects of instructional quality persist through early grades when schools deliver content-rich and instructionally aligned curricular models.

IMPLICATIONS OF MDRC'S WORK

Most of the current research on classroom quality is nonexperimental, which means it does not rigorously establish which specific quality dimensions — and associated teaching practices or instructional moves — consistently yield better child outcomes. These two studies will build on rigorous evidence about the effectiveness of interventions aimed at improving dimensions of quality, as well as shed light on the particular quality dimensions and teacher practices in ECE programming that should be targeted on a large scale to optimize child outcomes. To do so, the studies use a broader conception of classroom quality to assess instructional quality in a deeper and unparalleled way. Ultimately, this work can help identify ways to structure and package professional development for teachers that helps build an ECE workforce that can create high-quality learning environments and meet the needs of all children.[26]

NOTES

1 Harvard Center on the Developing Child (2007).

2 For example, Barnett (1995); Ludwig and Phillips (2008); McCormick, Hsueh, Weiland, and Bangser (2017); Puma et al. (2012).

3 For example, Auger et al. (2014); Burchinal, Zaslow and Tarullo, (2016).

4 Burchinal (2018); Pianta, Downer, and Hamre (2016).

5 For example, Burchinal, Kainz, and Cai (2011); Weiland, Ulvestad, Sachs, and Yoshikawa (2013).

6 For example, Auger et al. (2014); Burchinal, Zaslow, and Tarullo (2016); Burchinal et al. (2008); Early et al. (2007); Zaslow et al. (2010).

7 Pianta, Downer, and Hamre (2016).

8 Connors (2016); Tseng and Seidman (2007).

9 Connors (2016); Tseng and Seidman (2007).

10 Burchinal (2018); Burchinal, Zaslow, and Tarullo (2016); Burchinal, Kainz and Cai (2011); Weiland, Ulvestad, Sachs, and Yoshikawa (2013).

11 Burchinal, Kainz, and Cai (2011); Burchinal, Vernon-Feagans, Vitiello, and Greenberg (2014); Burchinal et al. (2018); Howes et al. (2008); Mashburn et al. (2008).

12 Burchinal, Kainz, and Cai (2011); Burchinal, Vernon-Feagans, Vitiello, and Greenberg (2014); Burchinal, Zaslow, and Tarullo (2016); Howes et al. (2008); Mashburn et al. (2008).

13 For example, Burchinal, Vandergrift, Pianta, and Mashburn (2010); Denny, Hallam, and Homer (2012); Justice, Mashburn, Hamre, and Pianta (2008); Yoshikawa et al. (2013).

14 Pianta, La Paro, and Hamre (2008); Harms, Clifford, and Cryer (2005).

15 For example, Farran and Bilbrey (2004); Ritchie, Howes, Kraft-Sayre, and Weiser (2001).

16 For example, Goodson, Layzer, Smith, and Rimdzius (2006); Landry, Crawford, Gunnewig, and Swank (2001); Sarama and Clements (2009).

17 For example, Atkins-Burnett, Sprachman, and Caspe (2010); Downer et al. (2010); Ritchie, Howes, Kraft-Sayre, and Weiser (2001).

18 Connor et al. (2009).

19 For example, Pianta, La Paro, and Hamre (2008); Harms, Clifford, and Cryer (2005); Sarama and Clements (2007); Smith and Dickinson (2002).

20 Hirsch (2006); Neuman (2006); Neuman (2014).

21 Cervetti and Hiebert (2018); Dochy, Segers, and Buehl (1999); Kostons and van der Werf (2015); Recht and Leslie (1988).

22 Bailey, Duncan, Odgers, and Yu (2017).

23 Bassok and Galdo (2016); Snow and Matthews (2016).

24 Dochy, Segers, and Buehl (1999); Kostons and van der Werf (2015); McNamara and Kintsch (1996).

25 The ExCEL Network is a collaboration led by MDRC that engages local officials, preschool providers, and researchers as active partners in evidence building, while also benefiting from ongoing contributions from other experts in the field. It is a group of studies supported by Arnold Ventures and the Institute of Education Sciences, U.S. Department of Education, through Grant R305N160018 to MDRC.

26 Zaslow et al. (2010).

REFERENCES

Atkins-Burnett, Sally, Susan Sprachman, and Margaret Caspe. 2010. *Language Interaction Snapshot (LISn)*. Princeton: Mathematica Policy Research.

Auger, Anamarie, George Farkas, Margaret R. Burchinal, Greg J. Duncan, and Deborah Low Vandell. 2014. "Preschool Center Care Quality Effects on Academic Achievement: An Instrumental Variables Analysis." *Developmental Psychology* 50, 12: 2,559-2,571.

Bailey, Drew, Greg J. Duncan, Candice L. Odgers, and Winnie Yu. 2017. "Persistence and Fadeout in the Impacts of Child and Adolescent Interventions." *Journal of Research on Educational Effectiveness* 10, 1: 7-39.

Barnett, W. Steven. 1995. "Long-Term Effects of Early Childhood Programs on Cognitive and School Outcomes." *The Future of Children* 5, 3: 25-50.

Bassok, Daphna, and Eva Galdo. 2016. "Inequality in Preschool Quality? Community-Level Disparities in Access to High-Quality Learning Environments." *Early Education and Development* 27, 1: 128-144.

Burchinal, Margaret. 2018. "Measuring Early Care and Education Quality." *Child Development Perspectives* 12, 1: 3-9.

Burchinal, Margaret, R. C. Culling Carr, Lynne Vernon-Feagans, Clancy Blair, and Martha J. Cox. 2018. "Depth, Persistence, and Timing of Poverty and the Development of School Readiness Skills in Rural Low-Income Regions: Results from the Family Life Project." *Early Childhood Research Quarterly* 45: 115-130.

Burchinal, Margaret, Carollee Howes, Robert C. Pianta, Donna Bryant, Diane Early, Richard Clifford, and Oscar Barbarin. 2008. "Predicting Child Outcomes at the End of Kindergarten from the Quality of Pre-Kindergarten Teacher — Child Interactions and Instruction." *Applied Developmental Science* 12, 3: 140-153.

Burchinal, Margaret, Kirsten Kainz, and Yaping Cai. 2011. "How Well Do Our Measures of Quality Predict Child Outcomes? A Meta-Analysis and Coordinated Analysis of Data from Large-Scale Studies of Early Childhood Settings." Pages 11-31 in Martha Zaslow, Ivelisse Martinez-Beck, Kathryn Tout, and Tamara Halle (eds.), *Quality Measurement in Early Childhood Settings*. Baltimore, MD: Brookes Publishing Company.

Burchinal, Margaret, Nathan Vandergrift, Robert C. Pianta, and Andrew Mashburn. 2010. "Threshold Analysis of Association Between Childcare Quality and Child Outcomes for Low-Income Children in Pre-Kindergarten Programs." *Early Childhood Research Quarterly* 25, 2: 166-176.

Burchinal, Margaret, Lynne Vernon-Feagans, Virginia Vitiello, and Mark Greenberg. 2014. "Thresholds in the Association Between Childcare Quality and Child Outcomes in Rural Preschool Children." *Early Childhood Research Quarterly* 29, 1: 41–51.

Burchinal, Margaret, Martha Zaslow, and Louisa Tarullo. 2016. “Quality Thresholds, Features, and Dosage in Early Care and Education: Secondary Data Analyses of Child Outcomes.” *Monographs of the Society for Research in Child Development* 81, 2: 1-128.

Cervetti, Gina N., and Elfrieda H. Hiebert. 2018. “Knowledge at the Center of English/Language Arts Instruction.” *The Reading Teacher* 72, 4: 499-507.

Connor, Carol McDonald, Shayne B. Piasta, Barry Fishman, Stephanie Glasney, Christopher Schatschneider, Elizabeth Crowe, Phyllis Underwood, and Frederick J. Morrison. 2009. “Individualizing Student Instruction Precisely: Effects of Child X Instruction Interactions on First Graders’ Literacy Development.” *Child Development* 80, 1: 77-100.

Connors, Maia C. 2016. “Creating Cultures of Learning: A Theoretical Model of Effective Early Care and Education Policy.” *Early Childhood Research Quarterly* 36: 32-45.

Denny, Joanna H., Rena Hallam, and Karen Homer. 2012. “A Multi-Instrument Examination of Preschool Classroom Quality and the Relationship Between Program, Classroom, and Teacher Characteristics.” *Early Education and Development* 23, 5: 678-696.

Dochy, Filip, Mien Segers, and Michelle M. Buehl. 1999. “The Relation Between Assessment Practices and Outcomes of Studies: The Case of Research on Prior Knowledge.” *Review of Educational Research* 69, 2: 145-186.

Downer, Jason T., Leslie M. Booren, Olivia K. Lima, Amy E. Luckner, and Robert C. Pianta. 2010. “The Individualized Classroom Assessment Scoring System (inCLASS): Preliminary Reliability and Validity of a System for Observing Preschoolers’ Competence in Classroom Interactions.” *Early Childhood Research Quarterly* 25, 1: 1-16.

Early, Diane M., Kelly L. Maxwell, Margaret Burchinal, Soumya Alva, Randall H. Bender, Donna Bryant, Karen Cai, Richard M. Clifford, Caroline Ebanks, James A. Griffin, Gary T. Henry, Carollee Howes, Jeniffer Iriondo-Perez, Hyun-Joo Jeon, Andrew J. Mashburn, Ellen Peisner-Feinberg, Robert C. Pianta, Nathan Vandergrift, and Nicholas Zill. 2007. “Teachers’ Education, Classroom Quality, and Young Children’s Academic Skills: Results from Seven Studies of Preschool Programs.” *Child Development* 78, 2: 558-580.

Farran, Dale C., and Carol Bilbrey. 2004. “Narrative Record.” Unpublished instrument. Nashville, TN: Vanderbilt University.

Goodson, Barbara D., Carolyn Layzer, W. Carter Smith, and Tracy Rimdzius. 2006. “Observation Measures of Language and Literacy Instruction (OMLIT).” Unpublished instrument. Cambridge, MA: Abt Associates, Inc.

Harms, Thelma, Richard M. Clifford, and Debby Cryer. 2005. *Early Childhood Environment Rating Scale (ECERS-R), Revised Edition*. Williston, VT: Teachers College Press.

Harvard Center on the Developing Child. 2007. *The Science of Early Childhood Development: Closing the Gap Between What We Know and What We Do*. Cambridge, MA: Harvard University.

Hirsch, Eric D., Jr. 2006. “The Case for Bringing Content into the Language Arts Block and for a Knowledge-Rich Curriculum Core for All Children.” *American Educator* 30: 8-51.

Howes, Carollee, Margaret Burchinal, Robert C. Pianta, Donna Bryant, Diane Early, Richard Clifford, and Oscar Barbarin. 2008. “Ready to Learn? Children’s Pre-Academic Achievement in Pre-Kindergarten Programs.” *Early Childhood Research Quarterly* 23, 1: 27-50.

Justice, Laura M., Andrew Mashburn, Bridget Hamre, and Robert C. Pianta. 2008. "Quality of Language and Literacy Instruction in Preschool Classrooms Serving At-Risk Pupils." *Early Childhood Research Quarterly* 23, 1: 51-68.

Kostons, Danny, and Greetje van der Werf. 2015. "The Effects of Activating Prior Topic and Metacognitive Knowledge on Text Comprehension Scores." *The British Journal of Educational Psychology* 85, 3: 264-275.

Landry, Susan H., April Crawford, Susan B. Gunnewig, and Paul R. Swank. 2001. "Teacher Behavior Rating Scale." Unpublished instrument. Houston, TX: Center for Improving the Readiness of Children for Learning and Education, University of Texas Health Science Center.

Ludwig, Jens, and Deborah A. Phillips. 2008. "Long-Term Effects of Head Start on Low-Income Children." *Annals of the New York Academy of Sciences* 1136, 1: 257-268.

Mashburn, Andrew J., Robert C. Pianta, Bridget K. Hamre, Jason T. Downer, Oscar A. Barbarin, Donna Bryant, Margaret Burchinal, Diane M. Early, and Carollee Howes. 2008. "Measures of Classroom Quality in Prekindergarten and Children's Development of Academic, Language, and Social Skills." *Child Development* 79, 3: 732-749.

McCormick, Meghan, JoAnn Hsueh, Christina Weiland, and Michael Bangser. 2017. *The Challenge of Sustaining Preschool Impacts: Introducing ExCEL P-3, a Study from the Expanding Children's Early Learning Network*. New York: MDRC.

McNamara, Danielle S., and Walter Kintsch. 1996. "Learning from Texts: Effects of Prior Knowledge and Text Coherence." *Discourse Processes* 22, 3: 247-288.

Neuman, Susan B. 2006. "The Knowledge Gap: Implications for Early Education." Pages 29-40 in David K. Dickinson and Susan B. Neuman (eds.), *Handbook of Early Literacy Research*. New York: Guilford Press.

Neuman, Susan B. 2014. "Content-Rich Instruction in Preschool." *Educational Leadership* 72, 2: 36-40.

Pianta, Robert C., Jason Downer, and Bridget Hamre. 2016. "Quality in Early Education Classrooms: Definitions, Gaps, and Systems." *The Future of Children* 26, 2: 119-137.

Pianta, Robert C., Karen M. La Paro, and Bridget K. Hamre. 2008. *Classroom Assessment Scoring System [CLASS] Manual: Pre-K*. Baltimore, MD: Brookes Publishing Company.

Puma, Michael, Stephen Bell, Ronna Cook, Camilla Heid, Pam Broene, Frank Jenkins, Andrew Mashburn, and Jason Downer. 2012. *Third Grade Follow-Up to the Head Start Impact Study: Final Report*. Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.

Recht, Donna R., and Lauren Leslie. 1988. "Effect of Prior Knowledge on Good and Poor Readers' Memory of Text." *Journal of Educational Psychology* 80, 1: 16-20.

Ritchie, Sharon, Carollee Howes, Martha Kraft-Sayre, and Billie Weiser. 2001. "Emergent Academic Snapshot Scale." Unpublished instrument. Los Angeles: University of California-Los Angeles.

Sarama, Julie, and Douglas H. Clements. 2007. "Effects of a Preschool Mathematics Curriculum: Summative Research on the Building Blocks Project." *Journal for Research in Mathematics Education* 38, 2: 136-163.

Sarama, Julie, and Douglas H. Clements. 2009. *Manual for Classroom Observation of Early Mathematics Environment and Teaching*. Buffalo, NY: University at Buffalo-State University of New York.

Smith, Miriam W., and David K. Dickinson. 2002. *Early Language and Literacy Classroom Observation (ELLCO) Toolkit, Research Edition [with] User's Guide*. Baltimore, MD: Brookes Publishing Company.

Snow, Catherine E., and Timothy J. Matthews. 2016. "Reading and Language in the Early Grades." *Future of Children* 26, 1: 57-74.

Tseng, Vivian, and Edward Seidman. 2007. "A Systems Framework for Understanding Social Settings." *American Journal of Community Psychology* 39, 3-4: 217-228.

Weiland, Christina, Kchersti Ulvestad, Jason Sachs, and Hirokazu Yoshikawa. 2013. "Associations between Classroom Quality and Children's Vocabulary and Executive Function Skills in an Urban Public Prekindergarten Program." *Early Childhood Research Quarterly* 28, 2: 199-209.

Yoshikawa, Hirokazu, Christina Weiland, Jeanne Brooks-Gunn, Margaret Burchinal, Linda Espinosa, William Gormley, Jens Ludwig, Katherine Magnuson, Deborah Phillips, and Martha Zaslow. 2013. *Investing in Our Future: The Evidence Base on Preschool Education*. Ann Arbor, MI: Society for Research in Child Development.

Zaslow, Martha, Rachel Anderson, Zakia Redd, Julia Wessel, Louisa Tarullo, and Margaret Burchinal. 2010. *Quality Dosage Thresholds and Features in Early Childhood Settings: A Review of the Literature*. Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.

ACKNOWLEDGMENTS

The work reflected in this brief would not be possible without a number of MDRC research staff, including Desiree Alderson, Noemi Altman, Ilana Blum, Rubin Danberg Biggs, Emily Davies, Mervett Hefyan, Mirjana Pralica, Sharon Huang, Amena Sengal, Electra Small, Marie-Andree Somers, Marissa Strassberger, Amy Taub, Mallory Undestad, Sam Xia, and Jennifer Yeaton. A special thanks to Christopher Boland for editing the brief and to Carolyn Thomas for creating Figure 2 and preparing the brief for publication.

This work has also benefited enormously from our relationships with research partners from other institutions, including Mike Fishman, Carly Morrison, Addie Currin, and Liza Rodler from MEF Associates; Christina Weiland, Amanda Ketner, Lillie Moffett, and Paola Guerrero Rosada from the University of Michigan; Jason Sachs from the Boston Public Schools Department of Early Childhood; and Margaret Burchinal. We are grateful to Catherine Snow, Sibyl Holland, and a large team of data collectors from the Harvard Graduate School of Education and our research partners at RTI International, including Jean Lennon, Jennifer Keeney and the many dedicated data collectors.

This brief was made possible by Arnold Ventures.

Dissemination of MDRC publications is supported by the following organizations and individuals that help finance MDRC's public policy outreach and expanding efforts to communicate the results and implications of our work to policymakers, practitioners, and others: The Annie E. Casey Foundation, Arnold Ventures, Charles and Lynn Schusterman Family Foundation, The Edna McConnell Clark Foundation, Ford Foundation, The George Gund Foundation, Daniel and Corinne Goldman, The Harry and Jeanette Weinberg Foundation, Inc., The JPB Foundation, The Joyce Foundation, The Kresge Foundation, and Sandler Foundation.

In addition, earnings from the MDRC Endowment help sustain our dissemination efforts. Contributors to the MDRC Endowment include Alcoa Foundation, The Ambrose Monell Foundation, Anheuser-Busch Foundation, Bristol-Myers Squibb Foundation, Charles Stewart Mott Foundation, Ford Foundation, The George Gund Foundation, The Grable Foundation, The Lizabeth and Frank Newman Charitable Foundation, The New York Times Company Foundation, Jan Nicholson, Paul H. O'Neill Charitable Foundation, John S. Reed, Sandler Foundation, and The Stupski Family Fund, as well as other individual contributors.

The findings and conclusions in this report do not necessarily represent the official positions or policies of the funders.

For information about MDRC and copies of our publications, see our website: www.mdrc.org.

NEW YORK
200 Vesey Street, 23rd Flr., New York, NY 10281
Tel: 212 532 3200

OAKLAND
475 14th Street, Suite 750, Oakland, CA 94612
Tel: 510 663 6372

WASHINGTON, DC
1990 M Street, NW, Suite 340
Washington, DC 20036

LOS ANGELES
11965 Venice Boulevard, Suite 402
Los Angeles, CA 90066