Conceptualization, Measurement, and Improvement of Classroom Processes: Standardized Observation Can Leverage Capacity

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The authors advance an argument that placing observation of actual teaching as a central feature of accountability frameworks, teacher preparation, and basic science could result in substantial improvements in instruction and related social processes and a science of the production of teaching and teachers. Teachers' behavioral interactions with students can be (a) assessed observationally using standardized protocols, (b) analyzed systematically with regard to sources of error, (c) validated for predicting student learning, and (d) changed (improved) as a function of specific and aligned supports provided to teachers; exposure to such supports is predictive of greater student learning gains. These methods have considerable promise; along with measurement challenges, some of which pertain to psychometrics, efficiency, and costs, they merit attention, rigorous study, and substantial research investments.

Keywords: classroom research; instruction; measurement; observation; quality; teacher education/development; teacher effectiveness

Many children spend more of their waking hours in classrooms than they do at home; within these settings they are exposed to experiences that, for better or worse, intended and unintended, shape their development. They may learn to read, write, and think critically; they make friends and have to face the inevitable challenges of peer relationships; and they are oriented increasingly to become productive, independent members of a larger society. Interest is keen in the extent of these effects in classrooms, the methods of producing and reproducing them at various levels of scale, and understanding the mechanisms responsible for them.

In this article, our overall goal is to help advance a long line of inquiry in the observation of classrooms as settings for learning and development (Brophy & Good, 1986; Shinn & Yoshikawa, 2008; Tseng & Seidman, 2007). Advances in theory, in measurement, and in intervention have led to the possibility that metrics for a "highly effective teacher" rely on neither (a) the proxies of degrees or experience that bear only indirectly (Gordon, Kane, &

Staiger, 2008) or not at all (Pianta & Allen, 2008) on student outcomes, nor (b) the tautology that effective teachers are those who produce achievement gains (Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004). Rather, we argue that it is now feasible to focus on direct assessments of a teacher's performance in the classroom as an instructor, socializer, motivator, and mentor. The scale is staggering; with millions of classroom teachers working each day in public education settings, more than 200,000 are new entrants to the profession each year, and recent reports indicate that 87% leave the profession before a decade of experience (Anderson, 2008; Loeb & Béteille, in press; Pianta & Allen, 2008). Placing validated, standardized observational assessment of teachers' classroom instruction and interactions more squarely in the realm of large-scale education science (e.g., value-added studies, studies of policy and accountability frameworks, and national survey-like studies such as the Early Childhood Longitudinal Program or the National Assessment of Educational Progress) and in protocols evaluating the impacts of teacher education could have tremendous downstream consequences in terms of traction on questions that vex the field.

Classrooms Matter

Over the past decade, the attention of policy makers and school administrators has focused on links between students' classroom experiences and achievement outcomes. Reauthorization of No Child Left Behind (NCLB) is launching a range of discussions that shift the dynamic of accountability to focus on how inputs produce achievement through debate about effective or qualified teachers (e.g., Appalachian Regional Advisory Committee, 2005; Foundation for Child Development, 2005; Gordon et al., 2008; Hamre, Pianta, Mashburn, & Downer, 2007; H. F. Ladd, 2008; Perie, Moran, & Lutkus, 2005). The body of value-added evidence demonstrates quite clearly that classrooms, and teachers, matter. In studies of large-scale statewide testing programs in which multilevel analysis has been used to isolate sources of variance to which achievement growth can be attributed (e.g., Nye, Konstantopoulos, & Hedges, 2004), classrooms are more often than not the greatest source of variation in what students learn and gain as a function of attending school (at least in achievement-related domains; it is not as clear with regard to social outcomes). Recent work, largely motivated by NCLB's focus on highly qualified teachers and an assortment of concerns related to teacher

licensing systems, has focused on teacher characteristics such as degrees, experience, qualifications, and test performance, and show significant returns to achievement as a function of each of these features (see H. F. Ladd, 2008; Loeb & Béteille, in press). Classroom processes are also implicated as significant moderators of treatment effects in highly controlled experimental work (Battistich, Watson, Solomon, Lewis, & Schaps, 1999) in which differences in teachers' implementation of treatments (e.g., curricula) appear to be the single biggest factor determining effects on child outcomes (Domitrovich & Greenberg, 2004), even when teachers are instructed to deliver the intervention in a standardized manner and are provided with regular and intensive supports to maintain fidelity. Thus, in both value-added research and experimental studies, not only is a good part of the value of attending school conveyed at the level of classrooms, but teachers play a major role in determining the value of the classroom environment for student learning and development.

But we need more evidence on why and how classrooms, and teachers, matter; the need for evidence is not trivial. The production of effective teachers (and presumably teaching quality) is of real concern and has extraordinarily high stakes attached to its success or failure—as just one example, see Pianta, Belsky, Houts, Morrison, and the National Institute of Child Health and Human Development Early Child Care Research Network (NICHD ECCRN; 2007) for observational descriptions of thousands of U.S. classrooms taught by certified teachers that indicate only 25% provide a level of instructional or emotional support consistent with the production of learning gains. As another, refer to the report by Clotfelter, Ladd, and Vigdor (2007) that certain profiles of teacher characteristics actually have *negative* effects on achievement for certain student groups. Placing direct assessment of actual teaching as a central feature of accountability frameworks and provisions for equity of educational opportunity is likely to accomplish several interlocking aims that in a coordinated fashion could result in substantial shifts in the nature and quality of instruction, socialization, mentoring, and tutelage that takes place in classrooms and a robust science of the *production* of teaching and teachers.

Observing Interactions in Classrooms— An Overview

Although studies of student achievement gains have been important in laying a foundation for inquiry into classroom effects (H. F. Ladd, 2008; Nye et al., 2004; Rivkin et al., 2005), they fail to articulate specific processes that may lead to student learning and positive social adjustment. The problem with this atheoretical approach to teacher effects is reflected in Hanushek's (2002) definition of teacher quality, "Good teachers are ones who get large gains in student achievement for their classes; bad teachers are just the opposite" (p. 3); this definition and much of the research using the value-added paradigm (see Gordon et al., 2008, for an overview) provide only limited guidance to efforts to improve teaching and teacher education (Cochran-Smith & Zeichner, 2005), in the sense that they do not inform how training and professional development might focus attention or shape teacher behavior.

Classroom observations could be an important tool for accountability-driven measures of teacher quality, but perhaps the most important reason to conduct observational assessment of classrooms is for the purposes of professional development. There is general consensus within the educational community that the professional development of teachers is of paramount importance (Caspary, 2002). However, professional development typically occurs in the absence of a direct link to actual teaching behavior in classrooms, particularly for already trained and certified teachers (Caspary, 2002). Systematic classroom observation systems provide a standard way of measuring and noting teachers' strengths and weaknesses and evaluating whether professional development activities are actually helping improve classroom interactions (Pianta, 2003).

Classroom observations have been used as measurement tools in education research for more than three decades (Gage & Needels, 1989). The type of classroom observations applied in research evolved over that time in response to advances in methodology and theory and to changing pressures to generate generalizable, empirically based findings. Seeking to better comprehend the components of effective teaching, process–product research in the 1970s and 1980s examined associations between classroom process variables and student achievement. In terms of observational methods, approaches typically focused on specific teacher behaviors (Cochran-Smith & Lytle, 1990; Smith, Waller, & Waller, 1982), for example, using frequency counts to evaluate how the quantity of teaching related to the amount students learned (Brophy, 1986). Other examples include work by Borg (1979) and Good, Grouws, and Beckerman (1978) examining associations between achievement and the number of pages in a curriculum presented to students; studies focused on teachers' time allocation (Brophy & Evertson, 1976; Fisher et al., 1980; Stallings, 1975); and studies of classroom management behaviors (Brophy & Evertson, 1976; Coker, Medley, & Soar, 1980; Good & Grouws, 1979).

Brophy and Good (1986), whose work has been extremely influential in shaping the field's views of effective teaching, present a thorough review of process–product research in their landmark volume. Qualitative observational methods have also been applied in research focused on classroom interaction and effects (e.g., Gudmundsdottir, 1991). Qualitative approaches to observation provide rich, descriptive information about teachers' practices and students' experiences in classrooms using ethnographic approaches. Thus the results tended to be rich and descriptive, but idiosyncratic, leaving open whether patterns detected could be generalized. Qualitative approaches to observation have been important for developing theory, surfacing new constructs, and generating hypotheses regarding mechanisms of classroom impacts on learning.

In recent years, scientists have placed renewed emphasis on developing standardized classroom observational measures with adequate reliability and validity (e.g., Cameron, Connor, & Morrison, 2005; Good, Mulryan, & McCaslin, 2006; NICHD ECCRN, 2002b, 2005; Pianta et al., 2007). Moreover, in the field of early childhood education there is a history of widespread use of observational assessments of program quality, even at statewide levels of scale. The Early Childhood Environment Rating Scale (Harms & Clifford, 1998) and other similar tools have been used to track levels of and access to quality child care for young children and have been used to facilitate professional development with child care professionals. There has also been a

DOMAINS

Emotional Supports | Classroom Organization | Instructional Supports

DIMENSIONS

Positive climate | Negative climate | Sensitivity | Regard for student perspective | Behavior management | Productivity | Instructional learning formats | Concept development | Quality of feedback | Language modeling

INDICATORS

Relationships, Affect, Respect, Communication | Punitiveness, Sarcasm/disrespect, Negativity | Awareness, Responsiveness, Action to address problems, Comfort | Flexibility, Autonomy, Student expression | Clear expectations, Proactiveness, Redirection | Maximized time use, Efficient routines and transitions | Variety, Promotion of student interests, Clarity, Engaging approach | Analysis/reasoning, Creativity, Integration | Feedback loops, Encouragement of responses, Expansion of performance | Conversation, Open-endedness, Repetition/extension, Advanced language
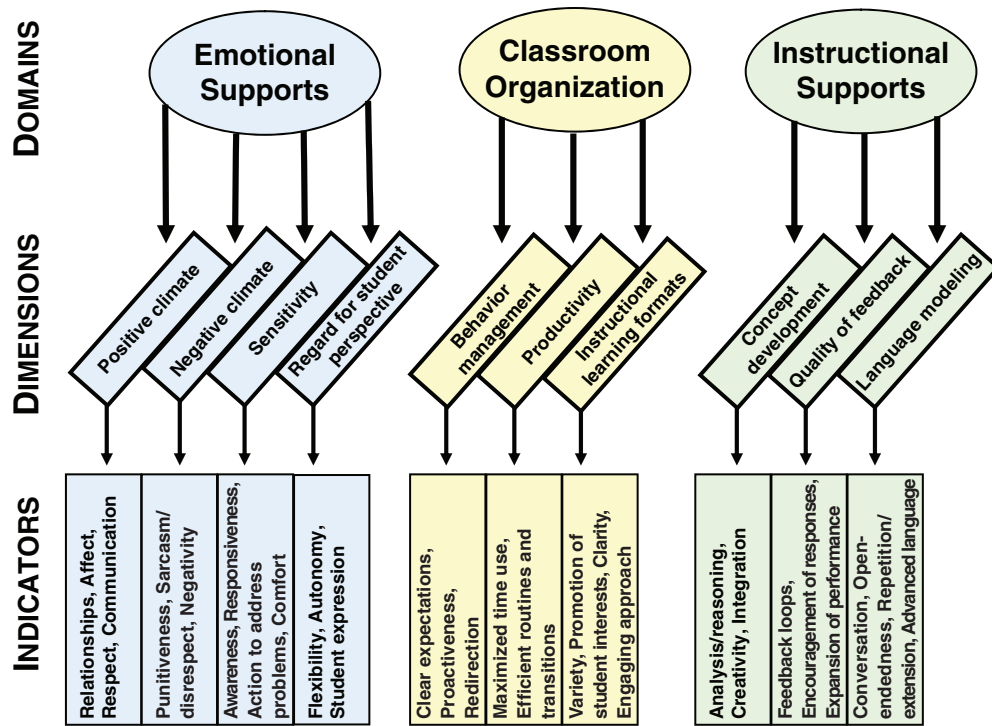
FIGURE 1. *The CLASS conceptual framework for classroom interactions.*

movement to include observational assessments in large-scale studies of the effects of child care and classroom settings on developmental trajectories. In one such example, the NICHD Study of Early Child Care and Youth Development is a major longitudinal research initiative that followed a cohort of children from birth until their 15th birthdays to investigate the relations between child care experiences and characteristics and children's developmental outcomes. During the child care and school-age periods the study investigators developed an assortment of observational tools to measure child care and classroom environments. For example, the Observational Record of the Caregiving Environment (ORCE; NICHD ECCRN, 1996) was developed and used to observe and measure the interactions between child care providers and children in various care settings prior to school entry. An upward extension of the ORCE, the Classroom Observation System—First Grade (COS-1; NICHD ECCRN, 2002b) was developed to facilitate observation of study participants in the first grade and was then completely revised for use in third and fifth grades (COS-3/5; NICHD ECCRN, 2004). These measures successfully captured many features of the elementary classroom related to students' social and academic development (Hamre & Pianta, 2005; NICHD ECCRN, 2002a, 2004; Pianta et al., 2007; Rimm-Kaufman et al., 2002).

The NICHD Study of Early Child Care and Youth Development assessments not only captured discrete behaviors and classroom conditions through a time-sampling method but drew from a long tradition of success in developmental science using global ratings scales to code complex, rich interpersonal interactions. Thus the COS protocols use a time-sampling approach to collect information about specific teacher behaviors in the classroom and use ratings of the quality of teacher–child interactions to capture features of classroom processes.

Importantly, these observational methods demonstrated adequate reliability and validity (Hamre & Pianta, 2005; Hamre et al., 2007; Howes et al., 2008; Pianta et al., 2005) and, by virtue of their use in these larger studies, have shown promise in being usable at scale (Pianta et al., 2007).

Over the course of the past decade or so, multiple observational measures that assess the classroom environment globally or examine more specific aspects of the classroom setting have been developed. The Early Childhood Classroom Observation Measure (Stipek, 1996; Stipek & Byler, 2004) assesses the nature and quality of classroom instruction as well as the social climate and management of the classroom. The Classroom Assessment Scoring System (CLASS; Pianta, La Paro, & Hamre, 2008) is a standardized observation measure of global classroom quality that assesses three domains of quality—Emotional Supports, Classroom Organization, and Instructional Supports—and can be used in prekindergarten classrooms through 12th grade. The Framework for Teaching Observation Survey (Danielson, 1996) is an observation protocol based on PRAXIS III: Classroom Performance Assessments criteria developed by the Educational Testing Service (2004). In this framework, the activity of teaching is divided into 22 components constituting four broad domains. Elements describing a feature of each component are rated according to a teacher's level of performance. The Danielson protocol is used widely, and at times as the basis for systems of professional evaluation of teachers. More research is needed to confirm its psychometric integrity, but several studies have begun this work. However, standardized observation measures appropriate for use in the upper grades, particularly from the 9th through 12th grades, are the exception rather than the norm. Researchers have typically collected information about the secondary classroom environment via student- and teacher-report measures. For

example, the Classroom Environment Scale (Moos & Trickett, 1974), the Individualized Classroom Environment Questionnaire (Fraser, 1990), and the Learning Environment Inventory (Fraser, Anderson, & Walberg, 1982) assess student and teacher perceptions of the learning environment of middle and secondary classrooms via questionnaires. Although student- and teacher-report measures such as these elicit important information about the classroom setting, data collected about secondary classrooms from observational measures can offer an added, different perspective of the classroom that is not filtered through the perceptions of a classroom participant.

Theoretical and Methodological Challenges and Alternatives: Illustrations From Use of the CLASS

To help organize the diverse literatures that might inform the task of describing teacher–student interactions in classrooms, Hamre and Pianta (2007) presented the CLASS framework as a conceptual "claim" regarding the structure and nature of teacher–child interactions likely to contribute positively to students' development as a consequence of experience in the classroom. The CLASS framework is a theoretically driven and empirically supported conceptualization of classroom interactions. Within each of its three major domains—Emotional Supports, Classroom Organization, and Instructional Supports—are a set of more specific dimensions of classroom interactions that are presumed to be important to students' academic and/or social development (see Figure 1). The CLASS framework starts with an understanding of the nature and regulators of developmental change at a given period (Hamre & Pianta, 2007; Pianta & Allen, 2008), then applies that understanding in an analysis of classroom settings and teacher–child interactions, maps that understanding back onto the rich and deep literature on classroom teaching and educational effectiveness, and then organizes this analysis within a framework that could inform measurement. A similar approach has been taken by McCaslin and colleagues (2006) in their approach to measuring classroom setting effects on student motivation. We readily acknowledge the value of other observational approaches and in fact believe the field undoubtedly benefits from systematic inquiry into competing alternatives—in relation to standardization, replication, and scalability.

The CLASS framework is one of several descriptions of classroom environments or quality teaching put forth in the educational and developmental literatures (e.g., Brophy, 1999; Brophy & Good, 1986; Eccles & Roeser, 1999; Gage, 1978; Pressley et al., 2003; Soar & Soar, 1979). For example, Brophy (1999) describes 12 principles of effective teaching, including supportive classroom climates, opportunities to learn, curricular alignment, thoughtful discourse, scaffolding engagement, and achievement expectations, each of which are based on research findings and theories of teaching and learning. Others organize teachers' practices into larger domains of teaching and classroom environments. Pressley and colleagues (2003) draw from their studies of effective teachers (e.g., Bogner, Raphael, & Pressley, 2002; Pressley, Allington, Wharton-McDonald, Block, & Morrow, 2001; Wharton-McDonald, Pressley, & Hampston, 1998) to suggest that effective teaching strategies can be organized into decisions regarding motivational atmosphere, classroom management, and curriculum and instruction. Similarly, Eccles and

Roeser (1999) suggest that schooling is characterized by organizational, social, and instructional processes that help regulate children's and adolescents' development across cognitive, social-emotional, and behavioral domains.

Hamre and Pianta (2007) propose a *latent* structure for organizing teaching behaviors that in most approaches are simply culled and categorized by type. The latent structure in the CLASS model poses explicit, testable hypotheses regarding the organization of meaningful patterns of behavior (or behaviors) that are tied to underlying developmental processes. In this structure, meaningful units of teacher–child interaction are organized by patterns, which in turn are the basis for identifiable and scalable dimensions of interaction. These dimensions are then organized into one of three broad domains of classroom supports. For example, the domain of Emotional Supports includes three dimensions: positive classroom climate, teacher sensitivity, and regard for student perspectives. Organizational Support includes effective behavior management, productivity, and instructional learning formats. And the Instructional Support domain includes the dimensions of concept development, quality of feedback, and language modeling. The organization of these dimensions into these three broad domains has been tested and validated for pre-kindergarten to Grade 5, and a somewhat different set of dimensions, within the same hypothesized three-domain structure, has been specified for Grades 6 to 12. The dimensions included in the current pre-K–5 framework have received the most empirical support but are not exhaustive; there are likely to be other dimensions that could fit within each domain, and as we suggest, dimensions may vary with developmental period or epoch.

Within each of these dimensions are posited a set of behavioral indicators reflective of that dimension, which in turn are operationalized at various anchor points on a 1–7 scale using specific behaviors and interaction patterns that can be reliably observed in a specified window of time. For example, the positive classroom climate dimension includes observable behavioral indicators such as the frequency and quality of teacher affective communications with students (smiles, positive verbal feedback) as well as the degree to which students appear to enjoy spending time with one another. This detailed, multilevel conceptualization of teacher–child interactions in classroom environments presents a set of testable hypotheses concerning the organization of behavior at varying levels of abstraction. There is empirical support for this organization of classroom processes that derives from large-scale studies of actual classrooms (Hamre et al., 2007). Drawing from a sample of just under 4,000 preschool to fifth-grade classrooms that were a part of several large national and regional studies, Hamre and colleagues sorted observed dimensions into the domains described by the CLASS framework and used confirmatory factor analysis to examine the extent to which this organization of classroom interactions was consistent with actual observations in these settings and to test alternative organizational structures. Results suggested adequate fit of the three-factor model and that the fit of this model was superior to that of a one- or two-factor model, evidence that the three-domain structure suggested by the CLASS framework fits the natural variation in classrooms.

A final feature of the CLASS framework is that it was developed to apply to teacher–student interactions in classroom

contexts *across* grades and *across* content areas, from preschool to high school. This focus then also poses a series of questions related to pedagogical behaviors and content knowledge, such as the contribution to achievement gains of content-neutral CLASS ratings, content-specific behaviors, or teacher content knowledge. We describe below, in brief, the three major domains of interactions.

Emotional Supports

Students' social and emotional functioning in the classroom is increasingly recognized as an indicator of school readiness (Blair, 2002; Denham & Weissberg, 2004; Raver, 2004), a potential target for intervention (Greenberg et al., 2003; Zins, Bloodworth, Weissberg, & Walberg, 2004), and even a student outcome that might be governed by a set of standards similar to those for academic achievement (Illinois State Board of Education, 2004). Children who are more motivated and connected to others are much more likely to establish positive trajectories of development in both social and academic domains (Hamre & Pianta, 2001; Harter, 1996; Hughes, Cavell, & Willson, 2001; G. W. Ladd, Birch, & Buhs, 1999; Pianta, Steinberg, & Rollins, 1995; Roeser, Eccles, & Sameroff, 2000; Ryan, Stiller, & Lynch, 1994; Silver, Measelle, Essex, & Armstrong, 2005; Wentzel, 1998). Teachers' abilities to support social and emotional functioning in the classroom are therefore central to any conceptualization of effective classroom practice. Two broad areas of theory guide much of the work on emotional support in classrooms, specifically attachment theory (Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby, 1969; Pianta, 1999) and self-determination theory (Connell & Wellborn, 1991; Ryan & Deci, 2000; Skinner & Belmont, 1993). Attachment theorists posit that when parents provide emotional support and a predictable, consistent, and safe environment, children become more self-reliant and are able to take risks as they explore the world because they know that they have an adult who will be there to help them if they need it (Ainsworth et al., 1978; Bowlby, 1969). This theory has been broadly applied to and validated in school environments (Birch & Ladd, 1998; Hamre & Pianta, 2001; Howes, Hamilton, & Matheson, 1994; Lynch & Cicchetti, 1992; Pianta, 1999). Self-determination (or self-systems) theory (Connell & Wellborn, 1991; Ryan & Deci, 2000; Skinner & Belmont, 1993) suggests that children are most motivated to learn when adults support their need to feel competent, positively related to others, and autonomous (Roeser, Eccles, & Sameroff, 2000). Related work by Wentzel (1999, 2002) suggests that students who see teachers as supportive are more likely to pursue goals valued by teachers, such as engagement in academic activities. Building from these two theoretical backgrounds, we describe three dimensions of emotional support in the classroom: classroom climate, teacher sensitivity, and regard for student perspectives.

Classroom Organization

Teacher–child interactions have value for development through processes related to the organization and management of students' *behavior, time,* and *attention* in the classroom (Emmer & Stough, 2001). The theoretical underpinnings of this domain include work on children's self-regulatory skills (Blair, 2002; Paris & Paris, 2001; Raver, 2004) and studies examining actual classroom practices that contribute to students' self-regulatory abilities (see Arnold, McWilliams, & Arnold, 1998; Cameron, Connor, & Morrison, 2005). Existing research provides consistent evidence that classroom organization is a critical feature of the environment, with direct links to a range of social and academic outcomes. Classrooms that use more effective behavior management strategies (Arnold et al., 1998; Emmer & Stough, 2001; Evertson, Emmer, Sanford, & Clements, 1983; Evertson & Harris, 1999), that have more organized and routine management structures (Bohn, Roehrig, & Pressley, 2004; Cameron et al., 2005), and that use effective strategies for making students active participants in classroom activities (Bowman & Stott, 1994; Bruner, 1996; Rogoff, 1990; Vygotsky, 1978) have less oppositional behavior and higher levels of engagement in learning; ultimately, students in these classroom learn more. The CLASS framework posits three dimensions of this classroom-level regulation: behavior management, productivity, and instructional learning formats.

Instructional Supports

Instructional methods have been put in the spotlight in recent years as more emphasis has been placed on the translation of cognitive science, learning, and developmental research to educational environments (Carver & Klahr, 2001). The exemplary work of the National Research Council's (2005) series *How Students Learn* summarizes research across disciplines to emphasize how specific teaching strategies can enhance young children's learning (Bransford, Brown, & Cocking, 1999). The theoretical foundation for the conceptualization of instructional supports in the CLASS framework comes primarily from research on children's cognitive and language development (e.g., Carver & Klahr, 2001; Catts, Fey, Zhang, & Tomblin, 2001; Fujiki, Brinton, & Clarke, 2002; Romberg, Carpenter, & Dremock, 2005; Taylor, Pearson, Peterson, & Rodriguez, 2003; Vygotsky, 1991; Wharton-McDonald et al., 1998). A student's cognitive and language development is contingent on the opportunities adults provide to express existing skills and scaffold more complex ones (Davis & Miyake, 2004; Skibbe, Behnke, & Justice, 2004; Vygotsky, 1991). The development of metacognitive skills, or the awareness and understanding of one's thinking processes, are also critical to children's academic development (Veenman, Kok, & Blöte, 2005; Williams, Blythe, White, Gardner, & Sternberg, 2002).

Instructional supports do not focus solely on the content of curriculum or learning activities, but rather on the ways in which teachers implement these to effectively support cognitive and academic development. Teachers who use strategies that focus students on higher order thinking skills; give consistent, timely, and process-oriented feedback; and work to extend students' language skills tend to have students who make greater achievement gains (Hamre & Pianta, 2005; Justice, Meier, & Walpole, 2005; Meehan, Hughes, & Cavell, 2003; Romberg et al., 2005; Taylor et al., 2003; Wharton-McDonald et al., 1998).

Methodological Challenges and Results

In this section we present a very brief summary of results from a series of analyses conducted on data sets involving standardized observations of roughly 2,500 classrooms in the elementary

grades, each of which reflected important variations in terms of time of data observed, content area observed, number of observers, unit of analysis (discrete behaviors or ratings), and length of the observational window. These results involve a number of data sets and statistical procedures, and all are described in detail in a report that is available on request (Chomat-Mooney et al., 2008). A full and detailed presentation of these results is contained in the referenced report, and in this section we summarize key findings as *illustrative* of the type of results obtainable and work that can be conducted through analysis of standardized observation of complicated classroom processes. We recognize that these analyses and results are limited by the available data sets, the samples included in those observations, and the approaches to observation that were implemented. Again, we report these results as illustrations from analysis of a large number of classrooms.

As noted above, observational methods can vary in terms of the unit or level of analysis (discrete behaviors or broad dimensions), and one question we sought to address was whether such methods correlate when applied to the same classroom. In a series of analyses of correlations among different methods for observation, few associations were detected between approaches involving teacher report, time sampling, and global observations across multiple studies. These results suggest that various methods for assessing the classroom may indeed capture different aspects of the classroom environment, so that even though certain methods may indeed measure teacher behaviors that predict achievement gains (e.g., Hamre & Pianta, 2005; Morrison, Bachman, & Connor, 2003), all methods are to some extent limited in scope with regard to measuring the multifaceted nature of the classroom.

From the standpoint of psychometrics, there are a number of questions that pertain to sources of variation in observational approaches, a prominent one being effects of observers or raters. In our analysis using a generalizability framework (Raudenbush & Sadoff, 2008), rater effects are evident across multiple studies in both time-sampling and global observational indicators (4%–14% of the variance for global scores and 1%–7% of the variance for time-sampled codes). However, although apparently reflecting fewer rater effects, time-sampled codes appear to reflect very little teacher-level variance, with most of the variance found at the level of the situation or the time at which the observation occurred. On the other hand, although somewhat greater rater effects are present for global ratings of classroom processes, they nonetheless reflect more teacher-level variance and less situational variance than do the time-sampled codes. Thus the majority of variance in time-sampled codes appears due to moment-to-moment changes for the same teacher, whereas variance in global ratings reflect, to a larger extent, more aspects of teaching and the classroom environment that are more stable within teachers and across time and situations.

Furthermore, within a school day, global ratings of classroom processes were found to be more stable than time-sampled codes. And there was evidence that, on average, the quality of the classroom as a setting for learning gradually declined over the course of the day. Over the course of a school year, teacher report of the classroom environment was slightly more stable than global ratings of the classroom environment, and there was a sharp decline in the quality of the classroom as a setting for learning during the last month of the year. Interestingly, within a given day, for a particular teacher, both global ratings of teacher behavior (using CLASS or a similar metric) and time-sampled codes of discrete activities were not related to the content focus of an instructional activity occurring during an observational window. That is, the same teacher taught math in much the same way that he or she taught reading or social studies.

Finally, when considering costs of observations, several factors require consideration, including how observations are structured, staffing, travel, and training and materials. The single largest cost center is the actual visit (placing a live observer in a classroom setting), and so researchers should base estimates on that as the primary driver and attempt to reduce costs by including multiple observations within a day or by adjusting the length of the observational window in any given classroom setting, as just two examples of dimensions of the ways in which protocols can be adjusted.

In sum, there is a growing focus on observation as a useful approach to capturing the quality of classrooms as settings for learning and development, even in rather large-scale applications. When standardized approaches are used and facets of observations (length of window, level of analysis, focus of analysis, raters, time of day) are varied systematically, then results can be analyzed in ways that address not only important questions pertaining to how best to design and apply classroom observation, but also questions that have implications for theories of the classroom setting (Tseng & Seidman, 2007) and for policy (Gordon et al., 2008).

Large-Scale Observations of and Approaches to Improving Classrooms

It is stunning, given the importance of classroom settings as vehicles for the transmission of knowledge and skill in our system of education, that little to no population-level data exist pertaining to exposure of children and adolescents to particular classroom practices that are either known to relate to academic success or failure, desired on the basis of certain policies or values, or even hypothetically expected to relate to outcomes. Although, as we describe below, there is evidence emerging for early education and elementary classrooms, in secondary classrooms there is no current work that provides national-level observational data on these environments. In fact, we argue that designing standardized observation protocols into current value-added state-standards tests and large-scale student assessments (such as NAEP) could leverage considerable understanding. Lacking such assessments, we describe below results from two large national studies conducted over the past 10 years that provide some of the first epidemiological data on preschool to fifth-grade U.S. classrooms (Early et al., 2005; NICHD ECCRN, 2002b, 2005; Pianta et al., 2005; Pianta et al., 2008).

Overall these studies suggest that the average child is exposed to moderate levels of emotional support and classroom organization and to fairly low levels of instructional support throughout preschool and elementary school (Early et al., 2005; NICHD ECCRN, 2002b, 2005; Pianta et al., 2005; Pianta et al., 2008). In general teachers are fairly positive in their interactions with students, and examples of teacher or student negativity are relatively rare (NICHD ECCRN, 2002b, 2005). However, these interactions between teachers and students appear to be fairly impersonal, with very few instances in which individual students

have positive, one-to-one interactions with their teachers. For example, in fifth-grade classrooms, positive, individual interactions with a teacher occurred in only 1% of observed intervals across a school day (Pianta et al., 2007). The typical student also has few interactions with teachers around behavior management issues in schools, either positive or negative (NICHD ECCRN, 2005). However, one clear indication of problems in classroom organization comes from consistent findings that students spend a great deal of their time in classrooms without being exposed to any learning activity at all, ranging from 42% of the time in preschool classrooms to 30% of time in fifth-grade classrooms. Evidence on the quality of instructional supports is particularly concerning—with consistent evidence that children across grades are unlikely to be exposed to high-quality supports such as concept development and feedback. For example, children in fifth-grade classrooms are exposed to instructional activities (across any content area) that focus on basic skills, in contrast to a focus on analysis, inference, or synthesis of information, by a ratio of nearly 5:1 (Pianta et al., 2008).

Most notable in these and other studies, however, is the high degree of variability in classroom quality. A typical school day for some students includes spending the majority of time engaged in productive instructional activities with caring and responsive adults who consistently provide feedback and challenge students to think critically. For others, a typical day consists of spending most of the time sitting around, watching the teacher deal with behavioral problems, and engaging in boring and rote instructional activities such as completing worksheets and spelling tests (Early et al., 2005; NICHD ECCRN, 2002b, 2005; Pianta et al., 2005, Pianta et al., 2008). These problems of inconsistent exposure to high-quality classrooms are compounded by clear evidence of inequity. Students coming from disadvantaged backgrounds are more likely than their peers to be exposed to poor quality (Hamre & Pianta, 2005; Pianta et al., 2005). Also troubling is evidence that even the student lucky enough to experience a high-quality classroom one year is very unlikely to be systematically exposed to high quality over a period of years, even if that student remains in the same school (NICHD ECCRN, 2005; Pianta et al., 2008), suggesting that school-level resources such as professional development supports and school climate are insufficient to ensure high-quality classroom environments. Taken together, these studies suggest that very few of the students who are in greatest need of high-quality classroom experiences receive them, and the few who do are unlikely to receive them consistently, making it unlikely that the positive effects will be sustained.

Another area in which very little is known concerns patterns of exposure to various classroom supports as children change classrooms from year to year. Most research that does exist in this area has looked specifically at transition periods: from preschool to kindergarten, into middle school, or into high school (Anderman & Midley, 1997; Eccles, Flanagan, Lord, & Midgley, 1996; Ferguson & Fraser, 1998; Hamre et al., 2007; Rimm-Kaufman & Pianta, 2000). For example, work on the transition to kindergarten has focused on ways in which classrooms become more oriented toward learning and less oriented toward social development (Hamre et al., 2007). Others have provided evidence of the shift in goal orientations and student–teacher interactions from elementary to middle school, with students typically rating teachers as more distant and less supportive of autonomy in middle school—just at the time when, developmentally, young adolescents may be most in need of those positive supports from teachers (Anderman & Midgley, 1997; Eccles et al., 1996; Ferguson & Fraser, 1998). A recent study provides evidence that this shift is reported by teachers as well; as children move from kindergarten through sixth grade there is a general pattern of decreased relational connections (both positive and negative), particularly around fifth grade (Jerome, Hamre, & Pianta, in press). Finally, during the transition from middle school to high school, students report decreased levels of engagement with the content of schooling (Yair, 2000). However, we know little about normative shifts outside these crucial transition periods.

Summary and Implications

There is a reasonable body of evidence (see Gordon et al., 2008; Jones, Brown, & Aber, 2008; McCaslin et al., 2006), that teachers' performance in classrooms, in terms of their actual behavioral interactions with students, can be assessed observationally using standardized protocols, analyzed systematically with regard to various sources of error and in turn shown to be valid for predicting student learning gains, and changed (improved) as a function of specific and aligned supports provided to teachers, and that exposure to such supports is predictive of greater student learning gains. Although modest, these effects are robust and consistent across investigator groups, samples of teachers, and samples of students that vary by grade and socioeconomic and geographic background.

We have argued that a major advantage of observational assessments of teachers for leveraging improvements in educational outcomes is that they can be directly related to the investigation and experimentation of specific interventions aimed at improving teaching. For this reason, these methods have considerable promise. Yet measurement challenges, some of which are noted above pertaining to psychometric issues, are not inconsequential. In addition to those challenges described earlier, observational assessments require technical supports that enhance efficiency and lower costs when used at scale. The questions related to psychometrics, efficiency, and costs compel attention and rigorous study, yet the investment in research related to assessments of such inputs pales in comparison to research investments in outcomes, specifically standardized tests. Nonetheless, recent Institute of Education Sciences (IES) requests for applications do include research centers on teacher effectiveness and specific topical areas on teacher quality, and the assessment and measurement goals in the IES framework also include research on assessment of teachers' performance in classrooms.

It seems important that investment in measurement studies, in cost-efficiency studies, and in investigations of the determinants and regulators of the quality of teacher–child interactions—and the value of teacher preparation programs for improving such interactions—could be key areas for research and development support. We envision studies that would identify early predictors of teacher competence, effective supports that improve teaching, virtual reality environments that accelerate teacher development, and networks of teacher preparation programs studying the natural history and course of teachers' competence in these performance domains. Although this work can be complemented by

value-added metrics of teacher quality and effectiveness, we suspect the route to useful interventions, assessment tools, program development, and policy will be quicker, perhaps more efficient, and more scalable if centered on standardized observation of teacher–student interactions in classroom settings.

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