

Chapter 18

Teacher-Student Interactions: Theory, Measurement, and Evidence for Universal Properties That Support Students' Learning Across Countries and Cultures



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Abstract Across the globe, strategies and investments to strengthen teacher effectiveness are increasingly a core component of countries' efforts to improve educational outcomes for their citizens and, for many, to elevate standards of living. In this chapter, we present evidence demonstrating the role of teacher-student interactions in teachers' ability to positively influence student development and learning across countries and cultures. We conceptualize teacher-student interactions as proximal processes that drive students' engagement and learning. Evidence clearly demonstrates that interactions can be assessed through observation and improved through professional development interventions. Drawing on our experience and data available on tens of thousands of classroom observations across different countries and cultures, we present a framework that describes core features of effective teacher-student interactions that appear in common across these highly varied settings and cultural contexts. We review research that evaluates this framework in different contexts to examine the effects of interaction quality on student outcomes across the globe. We discuss the cross-cultural applicability of the framework and outline suggestions for education policy and practice and future directions for research.

Keywords Teacher-student interactions · Classroom quality · Teaching through interactions

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1 Introduction

In nearly all theories of education and its impacts, the quality of students' experiences in the classroom (or childcare) setting is often described as a critical, if not necessary, factor in determining the value of education. In numerous studies of educational "inputs" intended to promote student learning (e.g., funding, class size, teacher qualifications, curriculum), over and above students' prior performance and family background (Nye et al., 2004; Reardon et al., 2013). Such large-scale efforts reinforce the idea that the quality of what takes place in classrooms may be the essential ingredient for fostering student success (Heckman, 2000).

In fact, our and others' research (see Morrison & Connor, 2002; Pianta et al., 2007; Sanders & Rivers, 1996) has generated a set of generally-accepted findings and observations about teachers and teaching, albeit largely based on data collected from U.S. and Western society classrooms: (1) teachers are the most potent asset the education system provides to foster student learning and development (Sabol et al., 2013); (2) qualities of teacher-student interactions that foster student engagement and effort, knowledge and thinking, problem-solving and communication skills, and positive relationships with others are the source of these teacher effects (Pianta & Allen, 2008); (3) these qualities of teachers' interactions can be observed and measured, and predict student students' development across a range of indicators (Allen et al., 2011; Pianta et al., 2008); (4) effective teaching can be learned, trained, and improved; and (5) ensuring effective teaching at scale requires workforce development systems that integrate description, measurement, improvement, and implementation support (Pianta et al., 2020).

These conclusions are not just the result of scientific studies conducted by academics. In experience accumulated from working to assess and improve teacher-student interactions at large scale over the past decade (5000 coaches, 17,000 observers trained to agreement on CLASS, 50 countries and all 50 U.S. states), practitioners and policymakers alike describe the unique value created when teachers and their interactions with students are elevated as a developmental and educational resource.

In the present chapter we draw from cross-cultural observations of classrooms using the CLASS to evaluate the extent to which there may be patterns and features of teacher-student interaction that have common value for student learning and development. We draw from countries has varied as Sweden (Castro et al., 2017), Ecuador (Carneiro et al., 2019), and China (Hu et al., 2016) in an effort to capture the relevance of teacher-student interaction across cultures. Also, emerging evidence from international work (e.g., Carneiro et al., 2019) that supports theory of the universality of adult-child interactions for promoting development (<https://www.oecd-ilibrary.org/sites/617837e6-en/index.html?itemId=/content/component/617837e6-en>).

2 Theoretical Framework

To begin, we frame some of the terms used in the discussion. Clearly, the term “international” could have varied meanings (Maulana et al., 2021). For example, for studies pertaining only to CLASS and not to other observational instruments, “international” applications include countries as wide-ranging as Finland, Israel, Kazakhstan, Australia, and Ecuador. Important efforts to understand those sources of variance have revealed not only the complexities of assessing teacher effectiveness cross-nationally, but that there is also evidence of commonalities (e.g., Maulana et al., 2021). Rather, our aim is to advance theoretical perspectives on education and human development that posit the importance of relationships between teachers and students (Ryan & Deci, 2000). Furthermore, we recognize the widely varying nature of “teachers” and “classrooms” in the countries and cultures we include in this analysis. The data available on classroom interactions, particularly when CLASS has been the assessment, skews toward younger ages and U.S. settings, although not exclusively. Accordingly, we will make an effort to present a balanced and well-informed picture.

2.1 *Defining Effective Teaching*

In a sense, every “measure” of educational quality and opportunity is actually a test of a theory; in considering effective teaching as reflective of educational opportunity, each measure of effective teaching is a set of hypotheses about the process of teaching and learning. Each measure also reflects a set of hypotheses about how to best gather information on the construct of interest, and when a measure is used in the field the resulting data provide a form of confirmation or disconfirmation of the underlying hypotheses and theory. CLASS has been anchored in the science and theory of human development in which proximal processes between individuals are posited to account for students’ growth in broad areas of development, including cognition, achievement, social relationships, self-regulation, motivation, and identity (Bronfenbrenner & Morris, 1998). This conceptual basis drew heavily from theories of human attachment and parent-child relationships (and associated measures) to conceptualize teacher-student interactions and relationships and embarked on studies examining how best to apply this work in classrooms (Pianta, 1999).

There is little question that teachers and their classroom interactions with students matter for student achievement (Carneiro et al., 2019; Goe, 2007; Hu et al., 2016; Kane & Staiger, 2012; Loeb et al., 2012), motivation (Patrick et al., 2001; Ruzek et al., 2016; Wang & Holcombe, 2010), and a range of behavioral and social outcomes (Hoang et al., 2018; Pakarinen et al., 2011; Wang et al., 2020). Efforts to describe effective teaching have been reported in a large number of small-sample studies, and in narrative descriptions that lack evidence of validity or tools for data collection (Lemov, 2010). It has also been challenging to define and measure the

aspects of teacher behavior unique to teaching a certain content area (Hill, 2010; Grossman et al., 2014; van Hover et al., 2012) or grade level (Pianta, 2016). Measures of the same construct also vary with respect to differential suitability for data collection methods such as observation or informant report (Raudenbush & Jean, 2014; Ruzek et al., 2016; Kane et al., 2014).

When studies have included different approaches to assessing teacher-student interactions, such as evaluating multiple observation tools (Kane & Staiger, 2012; Staiger & Rockoff, 2010), or combinations of observation and student report (Brock et al., 2008; Kane et al., 2014; Raudenbush & Jean, 2014) the evidence indicates considerable consistency in identifying clusters of behaviors as reliably detectable and salient for student learning (Hamre et al., 2013). These common clusters include aspects of teachers' *social and emotional behaviors* toward students, their *practices related to classroom management*, and their *delivery of instruction* (Danielson, 2007; Marzano, 2014). Thus, although there is no standard lexicon for "effective teacher behaviors" – and the field lacks the precision and structure of a formal classification system – a scan of the evidence does converge on these common elements that serve as the conceptual foundation for the CLASS. The TTI Framework (Hamre & Pianta, 2007) draws heavily from earlier theoretical and empirical work in the educational and psychological literatures (e.g., Brophy, 1999; Eccles & Roeser, 2011) to describe an overarching theory of classroom practice, operationalized in the CLASS tool.

2.2 *The CLASS: Measuring and Describing the Quality of Teacher-Student Interactions*

As noted above and presented in Table 18.1, a key feature of the TTI framework is its *multi-level and nested* structure: teacher-student interaction is conceptualized and defined at multiple levels: domain, dimension, indicator, behavioral marker. At the most global, CLASS encodes teacher-student interaction within three broad domains—Emotional Support, Classroom Organization, and Instructional Support. At the next, more specific level, each domain is composed of a corresponding set of dimensions – teacher sensitivity, behavioral management, quality of feedback – which are the focus of the observation and for which the actual rating from low to high is obtained on a 1–7 scale. To inform those judgements and ratings, each dimension reflects a set of indicators that define the types of categories of behavior that correspond to that dimension. In this way, the CLASS and accompanying TTI Framework is like a classification system that defines the types of teacher behaviors that are salient for a broader feature of interactions. Finally, each indicator can be described in terms of its value or level of quality using specific behavioral markers that scale from low to high quality. The observer's job is to attend to and identify behavioral markers within the indicators for each dimension and make a judgement of the degree to which, as a collective pattern, these markers and indicators reflect a

Table 18.1 CLASS framework for early childhood and elementary classroom quality

Area	Dimension	Description
Emotional support	Positive climate	Reflects the overall emotional tone of the classroom and the connection between teachers and students.
	Negative climate	Reflects overall level of expressed negativity in the classroom between teachers and students (e.g., anger, aggression, irritability).
	Teacher sensitivity	Encompasses teachers' responsiveness to students' needs and awareness of students' level of academic and emotional functioning.
	Regard for student perspectives	The degree to which the teacher's interactions with students and classroom activities place an emphasis on students' interests, motivations, and points of view, rather than being very teacher-driven.
Classroom management	Behavior management	Encompasses teachers' ability to use effective methods to prevent and redirect misbehavior, by presenting clear behavioral expectations and minimizing time spent on behavioral issues.
	Productivity	Considers how well teachers manage instructional time and routines so that students have the maximum number of opportunity to learn.
	Instructional learning formats	The degree to which teachers maximize students' engagement and ability to learn by providing interesting activities, instruction, centers, and materials.
	Classroom chaos	The degree to which teachers ineffectively manage children in the classroom so that disruption and chaos predominate.
	Classroom management	The degree to which teachers provide clear instructions, rules, and routines that children clearly know and understand, as well as well-timed proactive behavioral strategies rather than control techniques.
	Child responsibility	The extent to which teachers provide children with the opportunity to take on roles and operate autonomously in the classroom.
Instructional support	Concept development	The degree to which instructional discussions and activities promote students' higher order thinking skills versus focus on rote and fact-based learning.
	Quality of feedback	Considers teachers' provision of feedback focused on expanding learning and understanding (formative evaluation), not correctness or the end product (summative evaluation).
	Language modeling	The quality and amount of teachers' use of language-stimulation and language-facilitation techniques during individual, small-group, and large-group interactions with children.
	Instructional conversation	Considers the extent to which teachers' verbal interactions with children are reciprocal and focus on the facilitation of reasoning, concept development, expression of ideas, and cognitive elaboration.
	Literacy instruction	The extent to which teachers reads to children, provides explicit phonics instruction, elaborates on books with comprehension and process questions, and exposes children to written language.
	Richness of instructional methods	The extent to which teacher use a variety of strategies to promote children's thinking and understanding of material at deeper and more complex level.

certain level of quality on that dimension. This multi-level framework is intentionally designed to yield scores that are more reflective of broad and organized patterns of teacher behavior while at the same time providing specific, concrete examples of use to observers and practitioners.

Research using the CLASS provides evidence confirming the three hypothesized common domains of teacher-child interactions in the TTI framework – Emotional Support, Classroom Organization, and Instructional Support – as a theoretically and empirically sound approach to describing teacher-student interactions in classrooms (Hamre et al., 2013). Results from a study of CLASS-derived observational data from over 4000 preschools to fifth grade U.S. classrooms (Hamre et al., 2013) supported the three-domain structure and analysis of CLASS-based observations in upper elementary and secondary grades from the Measures of Effective Teaching sample of more than 3000 classrooms (Kane & Staiger, 2012), also affirmed the importance of these three broad areas of practice. Thus, the evidence from large-scale use of CLASS observations in U.S. classrooms provides empirical support for the hypothesis of a common set of features on which teacher-student interactions can be described and distributed.

What do we know about the quality of interactions with teachers experienced by the typical American preschool or k-12 student? Many studies have found that quality of teacher-student interaction varies markedly across U.S. samples, ranging from sensitive and stimulating, to dismissive and harsh. In the National Center for Early Development and Learning's study of state prekindergarten programs, only 15 percent of classrooms demonstrated high-quality interactions in both emotional and instructional support, whereas 19 percent of classrooms scored well below the mean on almost all dimensions of emotional, organizational, and instructional supports (Pianta et al., 2005). Poor and African American children are more likely to experience less effective interactions in early childhood programs (Kuhfeld et al., 2019).

Evidence from national-level observations of American elementary school classrooms shows clearly that the nature and quality of the instructional and social supports offered to young students is generally low, and even lower for less advantaged students (NICHD ECCRN, 2005; Pianta et al., 2007; MET Project, 2010; Kane & Staiger, 2012). The Measures of Effective Teaching (MET) Study, funded by the Bill and Melinda Gates Foundation, reported on the nature of experiences across two consecutive years in more than 3000 4th-10th grade classrooms in 4 large school districts (Kane et al., 2014; Kane & Staiger, 2012). Using a suite of standardized observation protocols that scanned for general qualities of teachers' interactions toward students (including CLASS) and teaching practices relevant to specific content areas, the MET findings corroborate the impressions gleaned years earlier from the NICHD Study of Early Child Care and Youth Development observations – classroom learning experiences were largely rote in nature and rarely called for reasoning, problem solving, or analytic skills; instruction was delivered primarily in large groups; content was discrete and isolated rather than made relevant and connected to other knowledge; and students were engaged in very passive ways (Kane et al., 2014; Kane & Staiger, 2012).

2.3 *Teacher-Student Interactions and Student Outcomes*

In numerous studies, the three domains of teacher-student interactions described earlier (emotional, organization, instruction) have each been linked to students' social, emotional, regulatory, and cognitive development (see Downer et al., 2010 for a review). Effect sizes obtained between these ratings of the features of teachers' interactive behaviors and student outcomes such as achievement test scores are small (Brock et al., 2008; Burchinal et al., 2010; Mashburn et al., 2008; Pakarinen et al., 2011; Rimm-Kaufman et al., 2009), with larger correlations for students with higher risk profiles (Hamre & Pianta, 2005; McCartney et al., 2007), or for associations with students' motivation (Ferguson & Hirsch, 2014). In U.S. studies, children who come from low-income families, who are dual language learners, or who have problems with self-regulation appear to benefit even more from effective teacher-student interactions than do their more-resourced peers (e.g., Ansari et al., 2020; Desimone & Long, 2010; Hamre & Pianta, 2005). And children reap the most academic benefit from effective teacher-student interactions when they are exposed to such interactions for a number of years (Cash et al., 2018; Vernon-Feagans et al., 2019).

Although much of the research using classroom observation has been conducted in U.S. elementary classrooms, recent work in a variety of international settings—including Central and South America, Europe, and Asia—has also documented that teacher-child interactions support development and learning. For example, in a large-scale study of classroom quality and child outcomes in rural Ecuador that spanned the first two years of schooling (ages six and seven) in which children were assigned randomly to teachers, children's academic skills improved more when they were assigned to classrooms in which teachers demonstrated particularly high levels of instructional support (Campos et al., 2021). Other studies in Ecuador (Araujo et al., 2014), Chile (Yoshikawa et al., 2015), and Finland (Pakarinen et al., 2011), and from observations in secondary grades (Allen et al., 2011; Kane et al., 2014) have produced similar findings. Although the nature and magnitude of the associations between teacher-child interactions and student outcomes has varied across these studies, evidence is growing that elements of these interactions are important for children's learning across a wide spectrum of settings and cultures and perhaps a universal resource for children's development.

Most published studies have used statistical controls to reduce or adjust for *selection effects*—primarily, the concern that higher-achieving children may sort into classrooms in which teachers are more likely to display higher-quality interactions. However, evidence from recent intervention studies and random assignment studies demonstrates a more compelling causal link. For example, when teachers improve their practices after they receive training and coaching on teacher-student interactions, the children in their classrooms benefit academically, socially, and behaviorally (Pianta et al., 2021). Other evidence for a causal link between interactions and development comes from large-scale studies that randomly assigned children to classrooms to evaluate how classrooms affected achievement and

development. Two such studies have found significant associations between children's learning and their exposure to interactions (Campos et al., 2021; Yoshikawa et al., 2015). One of them, conducted in Ecuadorian first- and second-grade classrooms, estimated that teachers in the top 25 percent in terms of the quality of their interactions with students produced the equivalent of almost 9 months more of achievement growth among children than did teachers in the bottom 25 percent (Campos et al., 2021). Moreover, over the past 5–6 years several professional development interventions designed to improve teacher-student interaction – including a coaching model and a college course—provide additional empirical support for the unique value of teacher-student interactions by demonstrating positive impacts of targeted professional development on both teacher-student interaction and student outcomes, from preschool through high school (e.g., Allen et al., 2011; Boston Consulting Group, 2019; Pianta et al., 2020).

2.4 Summary of U.S. Findings

Across the available studies based on largely U.S. samples, we have presented a summary of findings concerning teacher-student interactions. By and large these findings suggest that features of teacher-student interactions are often described in terms of broad domains of emotional, organizational, and instructional behaviors, that can be measured reliably and at scale, using observational methods. The CLASS is one such example of an observational approach that has been used widely in the U.S. and studied in countries across the world. Numerous studies, mostly quasi-experimental in design but also including a small number of experiments (studies of students assigned randomly to teachers and teacher-focused intervention experiments), indicate that teacher-student interactions have a small and significant, and perhaps causal, impact on student outcomes. And finally, controlled evaluations demonstrate that teacher-student interactions are malleable and can be improved through focused feedback and improvements in teachers' knowledge and observational skills.

3 Method

3.1 Systematic Literature Search

To identify international research or education systems that used the CLASS, we completed a systematic search of published and unpublished literature, including several search engines (PsychInfo, ERIC, Google Scholar, Academic Search Complete, Education Research Complete, Education Full Text), databases for masters and dissertations (ProQuest and LIBRA Institutional Repository hosted out of

the University of Virginia), websites of documents from large scale studies. Citations were uploaded into Covidence software, where duplicates were removed, and the remaining entries were systematically screened. Journal articles, reports, briefs, or theses that include information about CLASS data from at least 20 lead or subject-specific teachers in preK-12 educational settings were retained. Thus, literature from toddlers or childcare settings, summer or after school programs, or that includes fewer than 20 teachers and/or does not include CLASS data in the document were excluded. Furthermore, in order to account for the quality of data collected, we excluded studies that did not include trained raters and that did not provide information about the reliability of CLASS observations. Finally, to ensure that our search was exhaustive, we emailed the first author from each document to request information about other published or unpublished documents that met our inclusion criteria and included any new documents in the database. The full database includes 365 documents from 133 studies, among which 52 published documents are from 19 studies that used the CLASS outside of the United States. The final international database includes 19 documents (all of which are peer reviewed journal articles from the 19 studies) that use the CLASS outside of the United States (see Fig. 18.1). All documents were coded for sample characteristics, CLASS data collection and analysis, CLASS data, and other study findings (see Table 18.2 for a selective overview).

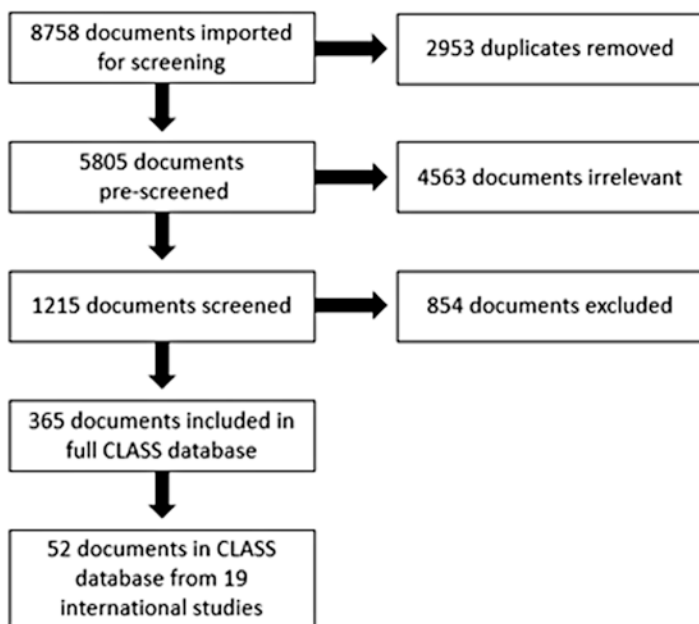


Fig. 18.1 PRISMA report of systematic search and screen of published and unpublished CLASS documents

Table 18.2 Studies of international classrooms that measure the quality of teacher-student interactions with the Classroom Assessment Scoring System

Description	Country	# Teachers	# Students	Mean class size	Grade(s)	Overall CLASS score				Emotional support mean			Instructional support			Classroom organization		
						Mean	SD	ICC (Kappa)	Mean	S.D.	α	Mean	SD	α	Mean	S.D.	α	
Niklas & Taylor, 2018	Australia	265 ^f	2123	9	Pre-K	4.04 ^a	0.93 ^a	0.80 ^a	5.14	0.91	0.87	2.38	0.96	0.85	4.60	0.92	0.89	
Besnard & Letarte, 2017	Canada	53	180	3 ^a	Pre-K	4.22 ^a	0.69 ^a	0.80 ^a	5.26	0.72	.	2.59	0.63	.	4.82	0.73	.	
Taut et al., 2019 ^e	Chile	51	1784	35	7	.	.	.	.	.	.	.	.	.	.	.	.
Yoshikawa et al., 2015	Chile	119	1876	21 ^a	Pre-K	3.55	.	(0.94)	4.64 ^a	.	.	1.72 ^a	.	.	4.30 ^a	.	.	
Hu et al., 2016	China	180	5841 ^a	32	K	3.98 ^a	0.70 ^a	0.89 ^a	5.03	0.69	0.78	2.12	0.61	0.84	4.80	0.81	0.92	
Slot et al., 2018	Denmark	402	3132	21	Pre-K	4.66 ^a	0.48 ^a	0.90 ^a	5.85	0.42	0.73	2.45	0.55	0.64	5.69	0.47	0.83	
Campos et al., 2021	Ecuador	2316	14,407	38	K-4	3.30	0.24	0.87	3.80	0.33	.	1.10	0.15	.	3.80	0.33	.	
Pöysä et al., 2019	Finland	51	709	14 ^a	7	4.72 ^a	0.84 ^a	0.90 ^a	4.31 ^a	0.90 ^a	.	3.94 ^a	0.78 ^a	.	5.90 ^a	0.83 ^a	.	
Pakarinen et al., 2010	Finland	49	679	14	K	4.81	0.79	0.85	5.13	0.80	0.93	3.97	0.92	0.88	5.34	0.66	0.90	
Virtanen et al., 2018	Finland	46	949 ^a	21	6	4.73 ^a	0.65 ^a	0.55	5.04 ^a	0.66 ^a	0.83	3.01 ^a	0.70 ^a	0.82	4.00	0.57 ^a	0.90	
Stuck et al., 2016	Germany	57 ^a	390	7 ^a	Pre-K	4.44 ^a	0.61 ^a	0.73	5.57 ^a	0.67 ^a	0.86	1.63 ^a	0.54 ^a	0.90	6.13 ^a	0.61 ^a	0.90	
Von Suchodoletz et al., 2014	Germany	63	1323 ^a	21	Pre-K	4.21 ^a	0.85 ^a	0.80 ^b	5.33 ^a	0.75 ^a	0.89	2.47 ^a	0.78 ^a	0.81	4.82 ^a	1.02 ^a	0.85	

The studies include data from 2186 prekindergarten and kindergarten classrooms, 2042 elementary school classrooms, and 177 secondary classrooms. For the CLASS observations, on average raters observed 3.3 cycles of classroom instruction over 1.6 days, about half of which were rated live (10/19), while the others rated video recordings of classroom interactions (9/19). Most of the studies describe their raters as being trained (18/19) and passing certification (15/19). The overall inter-rater reliability across studies (reported as intraclass correlations, percent agreement, or kappa scores) was reported as good to excellent, with the exception of two studies – one of Portuguese preschools (Cadima et al., 2014) and another of Finnish sixth grade classrooms (Virtanen et al., 2018), both of which had moderate inter-rater reliability (Ranganathan et al., 2017; Table 18.2).

4 Results

4.1 Internal Consistency

Reliability generalization reveals that the internal consistency of CLASS domains is sustained across the different cultural contexts. A reliability generalization is a meta-analytic technique that establishes 95% confidence intervals (Rodriguez & Maeda, 2006) for each of the three CLASS domains for the studies in which internal consistency coefficients were reported, which is mostly reported at the domain-level (see Table 18.2, Cohen's alpha, α). The Emotional Support domain had a reliability C.I. of 0.81 to 0.89, Instructional Support had a C.I. of 0.87 to 0.94, and Classroom Organization of 0.78 to 0.87. This indicates that the internal reliability for each domain was high across the international studies. This contributes important preliminary evidence that the TTI framework captures aspects of teacher-student interactions that are fundamental and appear in classrooms in very different cultural contexts.

4.2 Factor Structure

Several studies used the proposed 3 domain framework in which classroom quality consists of emotional support, instructional support, and classroom organization (Besnard & Letarte, 2017; Cadima et al., 2014; Castro et al., 2017; Gamlem & Munthe, 2014; Gasser et al., 2018; Niklas & Tayler, 2018; Pöysä et al., 2019; Sandstrom, 2012). Among the studies that evaluated the factor structure of the CLASS, support for 3-domain framework was found in early education classrooms across the globe, including prekindergarten samples in Chile (Yoshikawa et al., 2015 as cited in Leyva et al., 2015), Denmark (Slot et al., 2018), and Turkey (Ertürk Kara et al., 2017), and in kindergarten samples in Germany (Von Suchodoletz et al.,

2014), Vietnam (Hoang et al., 2018), and in China, where there was also support for a bi-factor model (Hu et al., 2016) (see papers for specific adjustments to factor analyses like correlating errors or residuals). One study of seventh graders in Chile (Taut et al., 2019) reported that they did not confirm the 3-factor structure and so instead chose to report the components of quality at the dimension-level (which we did not aggregate to the domain or overall levels of quality for meta-analysis or review).

In some cases, certain dimensions did not contribute to capturing classroom quality in a given cultural sample or setting. This is particularly the case with the Negative Climate dimension, which did not appear to be a significant component of the Emotional Support domain in several countries. In the first systematic examination of the CLASS in Europe, for example, Pakarinen et al. (2010) found that quality of the Finnish kindergarten teachers in their samples was best represented when the Negative Climate dimension was omitted.

Similarly, noting the poor discriminate validity of the Negative climate dimension in the previous study, Stuck et al. (2016) also omitted the dimension their study of 57 prekindergarten teachers in Germany. In another study of almost 180 prekindergarten teachers in Portugal, Cadima et al. (2018) found that when they omitted the Negative Climate dimension, the three-factor model provided the best relative fit to the data. It should be noted that contemporary guidance on the use of CLASS in research and in applied implementations suggests excluding Negative Climate from the domain-level computations.

Finally, in a study of sixth grade Finnish teachers, Virtanen et al. (2018) found support for a 3-factor model after excluding the Regard for Adolescent Perspectives and Instructional Learning Formats dimensions, each of which tended to cross-load with domains other than the hypothesized structure. These two dimensions have also been noted to cross-load in some U.S. studies (Hamre et al., 2013).

4.3 Levels of the Quality of Teacher-Student Interaction

Of considerable interest for this first multi-country view of teacher-student interaction was the pattern of levels of interaction quality seen across countries. Overall, the mean level of quality reported across the international studies reflects what we see in the American research: mostly mid (4) to middle-high scores (5) for the Emotional Support and the Classroom Organization domains, and mostly lower (2) to low-mid scores (3) for the Instructional Support domain (e.g., Harnes et al., 2014; La Paro et al., 2009). Internationally, the highest scores are reported in Classroom Organization, with multiple studies reporting a high score (mean level of almost or over 6), which is somewhat higher than in the U.S., in which the highest scores are typically associated with the Emotional Support domain, at least in younger-grade samples. Not dissimilar to results from the U.S., this multi-national analysis indicates the mean level of Instructional Support is 2.7 across the studies; several studies reported Instructional Support in the low range (1–2), with only a few reporting

mid-range scores (3–5). This pattern of low levels on the CLASS Instructional Support domain is consistent with U.S. findings and suggests that most of the instruction in classrooms has a focus on learning discrete facts and skills through instruction that has a rote focus.

To describe average quality across samples from each country, we generated means for the overall CLASS score that adjust for the reliability among raters in each study (Wiernik & Dahlke, 2020). Each overall CLASS mean reflects the average overall quality, within a range of error that in part relates to the level of alignment among raters. Adjusting for inter-reliability across samples provides a better sense of the range within which the true CLASS mean could reside. The corrected means account for inter-rater reliability by using the methods implemented in the psychmeta package (Dahlke & Wiernik, 2019; Wiernik & Dahlke, 2020). The two most common ways that reliability was reported in the selected studies were the intra-class coefficient (ICC) and percent agreement between raters. Overall, the quality of teacher-student interactions from these samples across the globe varies within the mid-range, with the overall mean adjusted for reliability at 3.69 (95% CI: 3.33, 4.06).

4.4 Teacher-Student Interaction and Student Outcomes

Due to variation in outcomes and outcome measures, it was not possible to use meta-analysis to assess how the quality of interactions measured with the CLASS relate to student outcomes. Instead, we review and synthesize the study findings in all documents across the studies.

Altogether, the international studies contribute to evidence that the quality of interactions with teachers shape children's developmental and academic success. In the first years of school, interaction quality promotes self-regulation among students in different cultural contexts. The overall quality of interactions is highly correlated with preschoolers' attention and impulse control in Turkey (Ertürk Kara et al., 2017), and cognitive self-regulation among socially disadvantaged preschoolers in Portugal (Cadima, Enrico, et al., 2016a). Furthermore, the Portuguese study suggests that teacher-student interactions can be a protective factor for young children at risk, such that interaction quality can be particularly effective in supporting students who are low in self-regulation skills (Cadima, Verschueren, et al., 2016b) and among children who are exposed to more family risk factors (Cadima, Enrico, et al., 2016a). Among kindergarten students in China, instructional support, in particular, is associated with growth in students' executive function skills (Hu et al., 2020). And in a large longitudinal experimental study of interaction quality in Ecuador, children in grades K-4 who were randomly assigned to teachers with higher quality interactions had higher executive function skills, particularly for working memory (Campos et al., 2021). Higher quality interactions also reduced the likelihood of behavioral problems in the same year (Campos et al., 2021).

Interactions that structure learning opportunities supports children's social development and adaptive classroom behavior in international settings. In a sample of Canadian preschoolers, Besnard and Letarte (2017) found that interactions that structure children's concept development and instructional learning support growth in social competence and overall adaptability, respectively. Similarly, among a sample of Finnish kindergarten students, the quality of instructional support was positively associated with empathy and negatively associated with disruptive behavior (Siekkinen et al., 2013) and less task avoidant behavior in class (Pakarinen et al., 2011). Furthermore, the quality of teachers' classroom organization predicted learning motivation among Finnish kindergartners (Pakarinen et al., 2010) and self-reports of behavioral and cognitive engagement among Finnish secondary students (Pöysä et al., 2019).

The international studies also verify that warm and supportive interactions with teachers are important to children throughout their education. Across various cultural settings, teachers' ability to identify and respond to the emotional needs of their students supported student engagement in learning. In Swedish preschools, emotional support predicted student engagement over time (Castro et al., 2017) and a combination of positive climate, instructional learning formats, and language modeling predicted children's engagement in literacy learning (Norling et al., 2015). In Finnish elementary classrooms, first graders who experienced low levels of emotional support were more likely to display passive avoidance when faced with academically challenging work in second grade (Pakarinen et al., 2014). Among Finnish adolescents, emotionally supportive interactions with teachers are associated with students' own report of their situational engagement (Pöysä et al., 2019). Emotional support also reflected and reinforced the quality of teachers' relationships with their students. In a sample of Swiss fifth graders, observer ratings of emotional support were related with students' perceptions of their teacher as caring and high level of emotional support protected students who were highly disengaged from academics from developing perceptions of their teacher as unjust (Gasser et al., 2018).

Each of the three domains of interaction quality are associated with direct assessment of academic skills across the various cultural contexts. Overall quality of interactions is associated with growth in both language and preliteracy skills among Danish preschoolers (Slot et al., 2018) and Ecuadorian K-fourth grade students, with the strongest effects in kindergarten and first grade (Campos et al., 2021). Researchers in the Ecuador study also found that the effects of experiencing high quality interactions with a kindergarten teacher are evident into sixth grade (Campos et al., 2021).

In early childhood education centers in Australia, the quality of teachers' instructional support predicted verbal abilities among children 4 years or older (Niklas & Tayler, 2018). In China, instructional support has been positively associated with reading, math, and science achievement among preschoolers (Hu et al., 2017) and emotional support has been linked with kindergartener's reading attitudes, and children with better reading attitudes benefited more from instructional support and exhibited greater gains in their vocabulary scores (Hu et al., 2018). Emotional

support in kindergarten was also positively associated with Finnish children's reading skills in first grade (Silinskas et al., 2017). In Portugal, the quality of teachers' classroom organization was positively associated with first grade students' vocabulary and print concepts, even after taking family risk and prior learning into account (Cadima et al., 2010).

There was also important evidence that interaction quality can address or exacerbate social disparities in education outcomes. In their study of Australian preschoolers, Niklas and Tayler (2018) found that, in classrooms with low quality interactions, the prestige of parents' occupations predicted children's verbal ability, whereas in high quality classrooms, there was no relationship between parent occupational prestige and verbal ability. Similarly, in classrooms with low quality organization, parent education predicted children's performance on mathematics assessments, whereas there was no relationship between parent education and mathematics achievement in classrooms rated high on classroom organization (Niklas & Tayler, 2018). Correspondingly, in a study of Portuguese students, Cadima et al. (2010) found that students with low math skills in preschool benefit more from high quality interactions with their first-grade teacher, which could contribute to narrowing math achievement gaps among students who start skills with disparate levels of math skills.

Together, research from international studies contributes additional empirical support for the teacher-student interactions as a developmentally salient feature of educational settings across the globe. In a combination of large-scale implementations, quasi-experimental, and experimental studies, the quality of teacher-student interactions predicts developmental and academic outcomes in very different cultural settings. The overall pattern of results suggests the value of teacher-student interactions for students' learning and development is significant and consistent across countries and cultures.

5 Conclusions and Discussion

In the educational context, teacher-student interactions play a fundamental role in determining the impact of teachers on student development and learning across wide-ranging countries and cultures. Describing, measuring, and improving teacher-student interactions are critical to large-scale efforts to build and improve public education systems.

The present study is an effort to draw upon theory and empirical research on teacher-student interaction conducted in the U.S. to examine the extent to which there is consistency in findings drawn from samples of teachers and students in non-U.S. countries across the globe.

By and large the results obtained from this multinational synthesis are notably consistent with those reported in U.S. samples. Across the 16 countries, 4400 teachers, and 42,000 students included in these analyses, empirical support was found for

the following conclusions: (1) teacher-student interactions can be describing using a common set of descriptors and reliably observed using those descriptors across countries that vary widely in cultural and educational circumstances; (2) teacher-student interactions appear to have a common underlying organization such that aspects of their emotional supports, instructional interactions, and classroom organization form a framework for description that can be used consistently across countries; (3) these three features of interaction have significant and beneficial impacts on students' learning and development.

Although not directly reported here and with many fewer exemplars internationally (e.g., Yoshikawa et al., 2015), it is clear from U.S. studies that these features of interaction can be improved through focused training and supports. Collectively, these are notable results with powerful implications for investments in workforce development systems that focus on teacher-student interaction as a means to improve the quality of educational opportunity and outcomes.

The conclusions above should be framed by certain caveats and limitations. The CLASS was used as a common classroom observation tool to capture general properties of classroom interactions, without modifications to reflect nuances unique to culture, ethnicity, race, or language. Moreover, the descriptive statistics reported (e.g., means, variance) are all drawn from convenience samples; none are representative of the countries' populations or school systems (this includes those from the U.S.). Therefore, cross-country comparisons in these indicators of effective teaching are not advised, nor is it appropriate to draw conclusions about the level of effective teaching in a given country. That said, the descriptive findings point to the potential use of observations, such as CLASS or other scalable measures, in samples more representative of countries or important political, geographic, or cultural groups, which might drive investments in education systems and teacher development.

With these general conclusions in mind, there are several implications for further research. Assuming the aim to use a common observational tool across countries, questions of interest might involve the extent to which characteristics of observers (e.g., prior knowledge, cultural background or differences, experience) are associated with differential levels of agreement. Additionally, questions related to training observers include whether observer reliability is related to the nature and amount of didactic training, practice in scoring video, and the types and ranges of video to be used in training. These questions essentially focus on the conditions that enable or limit the use of a common tool across wide-ranging cultures. Furthermore, even under circumstances in which a common tool might be applicable, research that informed refining both common and country/culture specific features of interaction that are important for students' learning and development, would inform observational systems that are best suited to a culture's uniqueness as well as capturing what common elements of effective teaching. Finally, research that helps to efficiently and cost-effectively scale measurement and improvement systems for teacher-student interaction will have considerable value for efforts to invest more systematically in improving public education systems across the globe.

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