

The quality of teacher–student interactions: Associations with first graders' academic and behavioral outcomes

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Received 27 November 2009; received in revised form 27 August 2010; accepted 10 September 2010

Abstract

The associations between the quality of teacher–student interactions and first grade academic and adaptive behavior outcomes were examined in a study of 106 Portuguese students in 64 first grade classrooms. Students' vocabulary, print concepts, math, and adaptive skills were assessed both at the end of preschool and in first grade. Classrooms were observed in the spring of first grade. After taking into account family risk factors and preschool skills, the quality of teacher–student interactions, particularly in terms of classroom organization, was positively associated with students' first grade vocabulary and print concepts. In addition, classroom quality predicted number identification outcomes differently depending on student skills prior to school entry. Students with lower preschool math skills seemed to benefit from higher quality teacher–student interactions. These findings provide further support for the unique contribution of the quality of teacher–student interactions in first grade and suggest that it may be an important mechanism to improve academic skills.

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Keywords: Teacher–student interactions; Classroom quality; First grade

The quality of teachers' interactions with students in the classroom is increasingly acknowledged as of major importance for student success in school. Recent research has revealed that student learning outcomes improve when they attend classrooms in which the

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ACTION EDITOR: Kent McIntosh.

teachers are warm and respond to student needs, organize the environment in predictable patterns, stimulate student analysis and reasoning, and monitor and provide feedback focused on the process of learning (Hamre & Pianta, 2005; National Institute of Child Health and Human Development [NICHD] Early Child Care Research Network, 2002, 2004; Perry, Donohue, & Weinstein, 2007; van de Grift, 2007; Wharton-McDonald, Pressley, & Hampston, 1998). However, there is still little standardized observation research into the classroom processes that are likely to contribute positively to students' social and academic development, which restricts the current understanding of the role that classroom interactions might play in student achievement. Moreover, despite some evidence suggesting that classroom interactions related to student learning are comparable across Western countries (van de Grift, 2007), research on the quality and effects of teacher–student interactions in different socio-cultural contexts is still scarce.

1. The importance of classroom interactions

The relevance of students' early school experiences has been recognized in the literature. Findings from different studies have shown that the skills students acquire in the early elementary years are critical for later academic achievement (Duncan et al., 2007), pointing to the importance of understanding what factors influence early skills. Research has considered both (a) structural features, which include teacher characteristics, class size, materials, and space, and (b) process features, which include interactions between teachers and students (Pianta, 2003). As several authors have recently argued, though, much attention has been devoted to the effects of schools' structural features, such as class size or teacher training, without considering the actual activities and experiences that are provided in the classroom (Cohen, Raudenbush, & Ball, 2003; Rutter & Maughan, 2002). The need for examining classroom processes is highlighted, because recent evidence indicates that schools and teachers with the same resources vary widely with respect to their use (NICHD Early Child Care Research Network, 2002, 2004; Pianta, 2003; Pianta & Hamre, 2009; Smith, Hardman, Wall, & Mroz, 2004; Topping & Ferguson, 2005). For instance, a recent large-scale observational study conducted in the United States indicated that structural features were not consistently related to global ratings of the quality of classroom processes (NICHD Early Child Care Research Network, 2002, 2004). Further, studies conducted in England reported that despite dramatic changes in the curriculum, teacher–student interaction patterns remained similar to those that existed before (Galton, Hargreaves, Comber, Wall, & Pell, 1999; Smith et al., 2004). Thus, notwithstanding the importance of structural characteristics, direct observation of classroom interactions may provide valuable and unique information that can assist in improving classroom quality, which is otherwise unlikely to be captured.

2. Global quality of teacher–student interactions

Whereas controversies regarding the conceptualization of classroom quality and the best way to teach students continue (Connor, Morrison, & Katch, 2004; NICHD Early Child Care Research Network, 2002; Pianta, 2003), it is increasingly acknowledged that a well-balanced integration of social-emotional learning and academic instruction will best

incorporate those aspects that are presumed to positively contribute to student learning (Hamre & Pianta, 2005; Perry et al., 2007; Pianta & Hamre, 2009; Pressley et al., 2001; Wharton-McDonald et al., 1998). To support this view, there is converging evidence pointing to associations between defined dimensions of classroom quality and both student engagement and academic outcomes in first grade.

A study that examined more than 800 classrooms across the United States revealed that, in classrooms rated high on emotional and instructional support, students were observed to be more engaged in academic activities and interact more positively with their peers (NICHD Early Child Care Research Network, 2002). More specifically, student engagement was higher in classrooms where teachers were observed to be responsive to students, to foster freedom and choice, and to promote positive social interactions. Similarly, students were more likely to interact positively with both their peers and their teacher in classrooms in which teachers were observed engaging in frequent and high-quality conversations with students and providing evaluative feedback. In a related study that focused on reading skills, findings pointed to the unique influence of first grade classroom quality on reading outcomes (NICHD Early Child Care Research Network, 2004). Accordingly, students in classrooms rated higher on evaluative feedback, instructional conversation, and encouragement of student responsibility had significantly higher reading scores in first grade. Likewise, Connor, Son, Hindman, and Morrison (2005) found that students whose first grade teachers were observed interacting with them in a warm and responsive manner and spending more time focused on academic activities tended to demonstrate stronger first grade outcomes.

In a study examining the role of classroom processes in promoting student social and academic achievement, Perry et al. (2007) demonstrated relative gains on academic achievement associated with teacher practices that are instructionally and emotionally supportive. The authors reported that when teachers were observed attending to students' interest and initiative, providing appropriately challenging learning opportunities, and creating positive social relationships, students showed higher levels of math skills, made greater behavioral gains, and had more positive perceptions of their academic abilities.

Based on in-depth observations of literacy instruction and student engagement in first grade classrooms, Pressley and colleagues characterized excellent instruction as involving multiple practices articulated with one another, including instructional, emotional, and organizational features (Pressley et al., 2001; Wharton-McDonald et al., 1998). Research has demonstrated in a number of studies that engagement was greater in classrooms where an integration of numerous goals in a single lesson took place, as well as extensive use of scaffolding, where the teacher monitored students' learning and provided assistance according to the changing needs of students. With respect to emotional and organizational components, the most effective teachers displayed higher expectations for all students and provided well-planned lessons and activities that encouraged self-regulation.

Van de Grift (2007) conducted a study on more than 800 classrooms from several European countries with the purpose of examining the quality of teaching and learning in elementary school. The findings indicated that five aspects of teaching—efficient classroom management, safe and stimulating learning climate, clear instruction, adaptation of teaching, and teaching-learning strategies—were positively and significantly associated with student engagement and attainment. The importance of teacher practices in predicting

student achievement has also been demonstrated in the United Kingdom (Muijs & Reynolds, 2003). In one study, results indicated that among the influences of classroom social context, classroom structural organization and teacher behaviors, the latter was the main predictor of student progress. Behaviors, such as monitoring the entire classroom, emphasizing key points of the lesson, elaborating on answers, or guiding students through errors, had a greater impact on student progress than classroom structural features, namely class size.

3. Differential effects of classroom quality

Some evidence suggests that there are complex interactions between instructional effects and specific child needs and skills (Cameron, Connor, & Morrison, 2005; Connor et al., 2004; Hamre & Pianta, 2005; Juel & Minden-Cupp, 2000). Recent research suggests that student reading skills are more likely to improve when classroom instructional practices are matched to their individual initial skill levels (Cameron et al., 2005; Connor et al., 2004, 2005, 2009; Juel & Minden-Cupp, 2000; Morrison & Connor, 2002). The results from a number of studies indicate that the magnitude of the effect of instructional practices depends on the skills students bring to the classroom. In one such study, findings revealed that students with low initial decoding scores achieved greater reading progress in classrooms with more teacher-managed explicit decoding instruction, whereas students with higher initial vocabulary scores achieved stronger reading growth in classrooms with many opportunities for independent reading and writing activities (Connor et al., 2004). In another study providing evidence of the moderating effect of classroom processes for specific groups of students, Hamre and Pianta (2005) examined whether classroom quality during first grade mitigated the risk of early school failure. The results indicated that students at-risk benefit from teacher–child interactions where there are high levels of instructional and emotional support; the students displayed higher achievement and fewer behavior problems than their at-risk peers who did not receive this support. In summary, an understanding of the effects of classroom quality on student learning should include attention to potential moderators related to specific student characteristics and family background.

Taken together, these studies suggest that providing emotional support to students through warm and responsive relationships and providing well-managed activities that intentionally encourage academic competence and student reasoning seem to constitute key areas for student engagement and achievement. It should be mentioned, though, that most of these studies took place in the United States, and few studies have been conducted in other countries.

4. Classroom quality across socio-cultural contexts

Recently, Seidel and Shavelson (2007) conducted a meta-analysis that summarized teaching effectiveness studies and found that the effects of teaching on student learning, even if diverse and complex, were fairly systematic, thus providing further support for the decisive importance of teacher practices. In addition, the authors emphasized the significance of considering context variation in interpreting nuanced findings, calling

attention upon the relevance of conducting research in different cultural contexts. In a study examining the quality of teaching in elementary schools in four European countries, [van de Grift \(2007\)](#) found that the quality of teaching could be compared in a reliable and valid way. More specifically, only a small amount of the variance between teachers could be attributed to socio-cultural differences existing in the four countries.

Although there is increasing evidence that classroom interactions are associated with achievement gains, this association deserves further study, particularly in different countries and socio-cultural contexts. The present study examines the classroom interactions between teachers and students in Portuguese first grade classrooms. As in other countries across Europe and North America, major changes have taken place in the Portuguese educational system as a result of increasing demands to improve school quality and raise educational levels ([Flores, 2005](#); [Ministério da Educação \[ME\], 2006](#)). In contrast to other European and Western countries, however, the rate of early school leaving is extremely high (39% compared to 15% in the European Union; [The Statistical Office of the European Communities \[Eurostat\], 2007](#)). These findings emphasize the need for improvement in classroom instruction. Noteworthy is the fact that although much has changed in Portugal, including increasing regulation and accountability, at present there are no formal procedures for monitoring classroom processes. This fact limits the ability to determine the extent to which the changes introduced are actually improving the experiences offered to students. Investigating the contribution of classroom processes to student learning could lead to improvements in student outcomes. Moreover, using observational measures with adequate reliability and validity, as the experience in other countries has shown, may inform the debate over how to increase school success.

Recently, one such standardized, reliable measurement tool has been developed by Pianta and collaborators ([Hamre, Pianta, Mashburn, & Downer, 2007](#); [La Paro, Pianta, & Stuhlman, 2004](#); [Pianta & Hamre, 2009](#); [Pianta, La Paro, & Hamre, 2008](#); [Pianta, La Paro, Payne, Cox, & Bradley, 2002](#)). The authors conceived a framework, the Classroom Assessment Scoring System (CLASS), based on developmental theory, which conceptualizes quality in terms of teacher–student interactions likely to contribute to student learning and development. In this model, classroom processes are operationalized in several specific dimensions involving emotional, organizational, and instructional features of the classroom. This framework has received empirical support ([La Paro et al., 2004](#); [Pianta & Hamre, 2009](#); [Pianta et al., 2008](#)). Results from several studies indicate that classroom quality, as assessed by the CLASS, is related to student academic skills at the end of preschool and first grade ([Curby, Rimm-Kaufman, & Ponitz, 2009](#); [Pianta et al., 2008](#); [Ponitz, Rimm-Kaufman, Grimm, & Curby, 2009](#)). In addition, because it addresses both emotional and instructional features of the classroom, this innovative framework seems to be more comprehensive than other models of classroom quality ([Hamre et al., 2007](#)).

5. Current study

In the present study, we followed upon and expanded the work of Pianta and colleagues to determine to what extent the teacher–student interactions that have been shown to be important for student learning are also relevant in the Portuguese context. More specifically, this study explored the extent to which the quality of teacher–student

interactions is associated with first grade outcomes, taking into consideration family risk factors and previous skills. Guided by the ecological model, which posits that development occurs through interactions between children and contexts over time (Bronfenbrenner & Morris, 1998), this study examines the contributions of the classroom interactions within the context of multiple sources of influence on child development. Thus, it takes into consideration not only student characteristics and skills before their entry into first grade, but also family risk factors, including those that have been shown to negatively affect student achievement, namely low maternal education, unemployment and poverty (Ackerman, Izard, Schoff, Youngstrom, & Kogos, 1999; Bradley & Corwyn, 2002; Dearing, Berry, & Zaslow, 2005; Duncan & Brooks-Gunn, 2000; Garbarino & Ganzel, 2000; McLoyd, 1998). In addition, this study builds on prior work by examining a range of first grade skills, including academic skills and adaptive behavior, thus addressing the multifaceted process of learning. Specifically, we expected that the quality of teacher–student interactions would contribute uniquely to first grade outcomes.

A second, related goal was to investigate whether the effect of the quality of teacher–student interactions differed depending on family risk and individual skills before entering first grade. Although it was anticipated that the quality of teacher–student interactions would have a positive effect on all students, we also hypothesized that high-quality interactions would be more beneficial for students who started first grade with low academic skill levels.

6. Method

6.1. Participants

One hundred and six students participated in this study. In first grade, their mean age was 6 years and 10 months. Forty-six percent were girls ($n=49$). All students were Caucasian, native Portuguese speakers and were born in Portugal.

The students were recruited from a larger research project conducted in the Metropolitan Area of Porto during their preschool year. The purpose of this larger study was to examine the quality of preschool classrooms and its effects on student social and academic performance. Initially, 60 preschool classrooms were randomly selected. Permission from the centers and the preschool teachers to conduct the study was obtained. Consent forms were sent to parents, and 70% of the parents agreed to participate. Four students per classroom were randomly selected, for a total of 240 students. Their ages ranged from 4 to 5, because most classrooms were mixed-age. In the present study, only the 5-year-old students ($n=134$) who would enter elementary school in the following year were selected.

In the first grade year, some families ($n=11$) could not be contacted again, one family refused to participate, and three schools declined our invitation to take part in the study. In addition, 13 students were excluded from the study because it was not possible to collect information regarding family environment. Attrition analyses revealed that there were no differences between the students who did not participate in first grade and students who participated, concerning sex, $\chi^2(1)=0.13$, *ns*, preschool receptive vocabulary, $t(132)=-0.54$, *ns*, or preschool classroom behavior scores, $t(111)=-0.36$, *ns*. Participants were recruited in the Metropolitan Area of Porto, the second biggest urban area in the country.

This area is highly industrialized, with one third of the population working in this sector. Similar to national education levels, 57% of the population has no more than four years of schooling (Instituto Nacional de Estatística, 2002).

The 106 student participants were distributed across 64 first grade classrooms; each classroom had 1 to 4 participating students. The classrooms were situated in 55 schools, of which 96% were public. The mean class size was 20.27, ranging from 10 to 26 students. Each classroom had a qualified elementary school teacher, holding at least a Bachelor's degree. The teachers' average years of teaching experience was 16.81, ranging from 1 to 32 years. A national curriculum issued by the Portuguese Ministry of Education is mandatory, and therefore all the teachers follow these guidelines, although some flexibility is permitted. In Portugal, first grade is the first year of compulsory education, starting at age 6, and the school network is predominantly public. For students aged from 3 to 5 years, attendance is not compulsory, and there is no kindergarten year. The national preschool network is both public and private. The public network comprises nearly 50% of all existing centers, and it is fully financed by the state. The private network includes for-profit and non-profit centers. Financial support may be provided to low-income families for students attending non-profit centers.

6.2. Measures

6.2.1. Student measures

Four measures were used to assess students' academic skills, and teachers completed a rating of children's behavior.

6.2.1.1. Receptive vocabulary. The Portuguese translation of the Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn, 1986) was used to assess vocabulary skills, both in preschool and first grade. This measure has been widely used and demonstrated to correlate well with measures of language and academic achievement. The translated Portuguese version has been used in various studies (e.g., Bairrão, Leal, Fontes, & Gamelas, 1999; European Child Care and Education [ECCE] Study Group, 1997), with reasonably reliable and valid scores. In a Portuguese sample involving nearly 600 preschool students, 24-week test–retest reliability was .68 and performance on PPVT-R correlated both with chronological age, $r = .30$, and with teachers' ratings of adaptive behavior, $r = .38$ (Bairrão et al., 1999). In this test, four pictures are presented to the student, and the researcher asks him or her to point to the one that corresponds to the word said. Raw scores were used in the analyses. The possible maximum score was 115. Cronbach's alphas for this sample were $\alpha = .96$ and $.97$ for preschool and first grade, respectively.

6.2.1.2. Print concepts. Student's knowledge of print conventions was evaluated using the translated Portuguese version of the Concepts About Print test (CAP; Clay, 2003) in preschool and first grade. In this test, the examiner reads a book specifically conceived for the task and asks the student several questions. Requests include, among others, pointing to words as the examiner reads them (directional movement), indicating where the story begins and ends (book conventions), or noticing the changed word order (one to one matching of spoken words to printed words). It has been shown to be an ecologically valid

task that assesses the student's understanding of print (Alves, Aguiar, Castro, & Bairrão, 2004; Clay, 2000). Psychometric analyses for the Portuguese version of this instrument indicated good internal consistency, with a reported Cronbach's alpha of .95; it also showed sensitivity to grade level, with a significant increase in the correct responses from preschool to third grade, $F(3, 37)=125.13$, $p<.001$ (Alves et al., 2004). In the present analyses, we used the sum of correct responses, with a possible maximum score of 23 (sample $\alpha=.78$ and .79 in preschool and in first grade, respectively).

6.2.1.3. Counting. In this single-item task, specifically designed for this study, the student was asked to count by rote as high as he or she could. If the student hesitated during counting, the examiner could prompt once, repeating the last three numbers counted by the student (e.g., "21, 22, 23, and..."). This task was applied in the preschool year. The score used in the present analyses was the highest number counted by the student.

6.2.1.4. Number identification. Both in preschool and in first grade, the student was asked to read one- to three-digit numbers, each presented on a small card, for a total of 20 numbers (Abreu-Lima, 2006). The validity study of this task for Portuguese five-year-old students showed that its scores were highly correlated with scores on the Arithmetic subtest of the WPPSI-R, $r=.63$ (Abreu-Lima, Oliveira, & Tormenta, 2006). The sum of correct responses was converted to percentages and used in the analyses (sample $\alpha=.92$ and .91 in preschool and in first grade, respectively).

6.2.1.5. Global math. First-grade math ability was assessed with the Portuguese translation of the Test of Early Mathematics Ability (TEMA-3; Ginsburg & Baroody, 2003). This test measures both informal and formal concepts and skills across different domains, such as numbering skills, calculation skills, and understanding of concepts. Questions of increasing difficulty are presented to the student. This test has been used in Portugal, demonstrating good validity and reliability evidence (Cadima, Abreu-Lima, Gomes, Coelho, Lobo, & Ramalho, 2008). The validity and reliability studies of TEMA-3 for Portuguese students involved 281 children ages 4 to 7 year olds. Internal consistency coefficients were reported to be above .90; test–retest reliability was adequate, with a correlation coefficient of .90; and its scores were demonstrated to be highly correlated with scores on the Arithmetic subtest of the WISC-III, $r=.62$ (Cadima et al., 2008). In this study, the sum of correct responses was used, with a possible maximum score of 72 (sample $\alpha=.94$).

6.2.1.6. Adaptive classroom behaviors. The Classroom Behavior Inventory (CBI; Schaefer, Edgerton, & Aaronson, 1978a) was used to assess students' behaviors, both in preschool and first grade. In this questionnaire, the teacher is asked to rate each item for how well it describes the student in terms of attention, independence, sociability, and consideration (e.g., the child is agreeable and easy to get along with; the child easily loses interest in what she or he is doing), using a 5-point scale (from not at all to very much). This scale has been widely used in studies indicating associations between teacher ratings of classroom behavior and observed behavior in the classroom (e.g., Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002; Peisner-Feinberg et al., 2001). Both preschool and

elementary school forms have been translated to Portuguese, with psychometric analyses revealing the adequacy of this instrument for Portuguese students (Abreu-Lima & Cadima, 2006; Rocha, 2009). Specifically, for the preschool form of the Portuguese version, a principal component analysis revealed four factors, accounting for 61% of the variance. The internal consistency coefficients were high for all subscales, ranging from .90 to .97 (Abreu-Lima & Cadima, 2006). For the elementary school form of the Portuguese version, a principal component analysis revealed three factors, explaining 67% of the variance (Rocha, 2009). The internal consistency reported ranged from .89 to .98. These factor structures replicated other factor analyses of the CBI (Peisner-Feinberg et al., 2001). The CBI global score encompasses a range of social skills, including interpersonal skills, such as sociability and consideration to others, and learning-related social skills, such as task-orientation and independence. Given that it provides a general understanding of students' behavior in the classroom (ECCE Study Group, 1999), the total score was used in the analyses, with higher scores indicating more adaptive skills (sample $\alpha = .96$ and $\alpha = .95$, respectively, in preschool and in first grade).

6.2.2. *Family measures and covariates*

A demographic questionnaire was used to request information about family and socio-cultural variables. We included a total of six risk factors that have been consistently linked to low academic performance in previous research (Bradley & Corwyn, 2002; Commission of the European Communities, 2008; Dearing et al., 2005; Garbarino & Ganzel, 2000; McLoyd, 1998). Poverty, low occupational status, and low maternal education have been shown to be associated with lower cognitive and social performance (Bradley & Corwyn, 2002; Commission of the European Communities, 2008; Dearing et al., 2005; McLoyd, 1998). Research has also demonstrated that single parenthood acts as a risk factor (Commission of the European Communities, 2008; Garbarino & Ganzel, 2000; McLoyd, 1998). A larger family size has also been shown to have negative effects on a broad range of outcomes (McLoyd, 1998). Research also suggests that experiencing a greater number of negative life events is related to later negative outcomes (Gutman, Sameroff, & Cole, 2003; McLoyd, 1998).

A cumulative risk strategy was used. This approach, proposed by Sameroff and colleagues (Gutman, Sameroff, & Eccles, 2002; Gutman et al., 2003; Sameroff & Fiese, 2000), considers the accumulation of risk factors, instead of considering each individual factor separately. Studies using the cumulative risk approach have shown associations between risk concentration and poor student outcomes (Ackerman et al., 1999; Atzaba-Poria, Pike, & Deater-Deckard, 2004). This approach has also been found to be particularly useful for small to moderate-sized samples (Burchinal, Roberts, Hooper, & Zeisel, 2000; Hooper, Burchinal, Roberts, Zeisel, & Neebe, 1998).

Each of the family risk indicators was dichotomized, indicating the perceived presence (1) or the absence (0) of the specific risk factor in the student's life. The inclusion criterion for five of the risk indicators was an objective definition based on previous studies with a cumulative risk approach (e.g., Gutman, Sameroff, & Cole, 2003; Gutman, Sameroff, & Eccles, 2002) as well as on statistical information regarding Portuguese populations (Commission of the European Communities, 2008; Instituto Nacional de Estatística, 2007). The risk indicators and respective inclusion criteria were the following: (a) single parent,

(b) low maternal education (risk=6 years of education or less), (c) low status of maternal occupation (risk=mother unemployed or with an unskilled occupation), (d) low-income (risk=families receiving financial support from the Portuguese Social Security or with a level of income below the National Minimum Salary), (e) large household size (risk=three or more children under 18 in the household), and (f) frequent negative life events (risk=two or more negative life events involving immediate family members, such as death or imprisonment, in the last 2 years; see Cadima, McWilliam, & Leal, 2010, for complete details regarding this strategy and its application on this sample).

The risk factors were summed to create the family risk index. Table 1 displays information concerning each risk factor and the family risk index. Nearly half of the students experienced one or fewer risk factors (34.9% and 17.9%, respectively), 26.4% experienced two risk factors, and 20.7% experienced three or more risk factors. The mean of the cumulative risk index was 1.51 ($SD=1.49$).

6.2.3. Classroom measures

A rating scale was used to observe classrooms, and teachers completed a questionnaire.

6.2.3.1. Teacher–student interaction quality. The quality of teacher–student interactions was assessed using the Portuguese version of the CLASS (Pianta, La Paro, & Hamre, 2006). The CLASS is an observational measure that assesses the quality of classroom interactions in terms of three major domains: (a) Emotional Support, which reflects the emotional connection and the sensibility of the teachers, (b) Classroom Organization, which includes the processes related to management and time, and (c) Instructional Support, which focuses on the interactions that underlie cognitive and language development. It consists of 11 dimensions measured on a 7-point Likert scale, with scores from 1 to 2 considered to be the *low* range, 3 to 5 the *middle* range, and 6 to 7 the *high* range. A confirmatory factor analysis of the CLASS items with data from Portuguese classrooms, including the classrooms in this sample, corroborated the three-factor solution, representing the three major domains, as well as good internal consistency for each domain (Cadima & Leal, 2008). Specifically, all of the factor loadings exceeded .70, with the exception of Behavior Management, which was .55, and each domain had adequate internal consistency, with Cronbach’s alphas of .91, .79, and .95 for Emotional Support, Classroom Organization, and Instructional Support, respectively. The fit indices were acceptable and similar to the results obtained previously in the United States.

Table 1
Family risk characteristics ($N=106$).

	<i>n</i>	%
Families		
Risk 1. Single parent	14	13.2%
Risk 2. <6 years of maternal education level	50	47.2%
Risk 3. Unemployed/unskilled occupation	50	47.2%
Risk 4. Low level of income	17	16.0%
Risk 5. >3 children household	14	13.2%
Risk 6. >2 negative life events	15	14.2%

Before collecting the data, the observers participated in 11 training sessions using the materials provided by the authors and following their instructions; the first sessions included video observations and discussions of the ratings among the participants. A series of five video sessions were then conducted to reach a minimum interrater agreement of 80%. All observers met this criterion. During data collection, pairs of observers rated the same classroom in more than 30% of the classrooms. The exact interrater agreement was 79%, ranging from 50% to 100%; the mean weighted kappa was .74. For the present analysis, the global score was used (sample $\alpha = .92$), as well as each of the three domains (Emotional Support, sample $\alpha = .87$; Classroom Organization, sample $\alpha = .71$; Instructional Support, sample $\alpha = .94$).

6.2.3.2. Classroom and teacher characteristics. A questionnaire designed for this study was used to collect data concerning teacher, classroom, and school characteristics. Teachers were asked to report their highest level of education, years of experience teaching first grade, sex and age, class size, the number of students with disabilities or with perceived learning difficulties in their class, and school characteristics, including school enrollment, and the socioeconomic level of the majority of students.

6.3. Procedure

Students' skills were measured in preschool, in the spring of 2006, and again one year later, in the spring of first grade. Trained research assistants assessed each student individually at the student's preschool center and again at his or her school setting. Information regarding family characteristics was collected in preschool, from May to July of 2006. Both the preschool teacher and the elementary school teacher completed the Classroom Behavior Inventory for each student, in the respective year. Elementary school classrooms were observed with the CLASS measure on one occasion, between January and April of 2007. Trained data collectors observed each classroom once with the CLASS measure for approximately two and a half hours, starting at the beginning of the school day. Four 30-minute cycles were completed for observation and scoring. After each observation, the data collectors administered the classroom and teacher questionnaire and provided any needed assistance in completion.

6.4. Data analysis

To address nesting of students in classrooms, regression models were conducted using Generalized Estimating Equations (GEE; Liang & Zeger, 1986). This method provides consistent estimates of the regression parameters and, like hierarchical linear models (HLM; Bryk & Raudenbush, 1992), it accounts for correlation within data due to sampling multiple students in some classrooms. This method can be used appropriately when there are many clusters with only one or few observations (Ghisletta & Spini, 2004; Norton, Bieler, Ennett, & Zarkin, 1996). In addition, GEE methods are flexible in that the number of students per classroom may vary. Thus, it easily handles the fact that the number of participating students in each classroom ranged from one to four. Although HLM does not require the same number of observations per cluster, estimation generally produces

inaccurate random variance estimates to account for nesting when there are many clusters that consist of a single observation. The GEE approach is also advantageous because it requires few assumptions about the distribution of the dependent variable, and it is relatively simple to apply (Norton et al., 1996). In addition, in this approach, parameter estimation is conducted under weak assumptions about the intracluster dependence structures (Ghisletta & Spini, 2004; Liang & Zeger, 1986). The interpretation of estimates is identical to that for commonly used regression models (Zorn, 2001). What is specific to the GEE approach is that data are weighted taking strata membership into account when estimating parameters. As such, the GEE is like a regression-based approach, but in addition, it allows for dependencies among observations. It is not a hierarchical linear approach where individual intercepts or slopes are computed with random-effects variance components (i.e., assuming systematic differences among individuals in terms of level). Instead, it is a marginal (or population-averaged) approach that estimates the average response over the population accounting for inherent stratification in data and the corresponding lack of independence among observations within strata (e.g., classrooms in our model).

The models tested whether overall classroom quality predicted student first grade skills when adjusting for family risk and the student preschool skills. Measures administered in both preschool and first grade included vocabulary, print concepts, and adaptive classroom behaviors. For both global math and number identification, the preschool measure was created as a composite by averaging preschool counting and number identification scores ($\alpha = .82$). The initial model included two other covariates, the student's sex and age. These covariates were removed when preliminary analyses revealed that neither sex nor age were significant predictors of any of the outcomes. Our model can be described as follows, where Y_{ij} is the predicted first grade outcome for child i in classroom j :

$$Y_{ij} = b_0 + b_1(\text{prior achievement})_i + b_2(\text{family risk})_i + b_3(\text{classroom quality})_j + e \quad (1)$$

A series of models were fitted hierarchically. First, a main effects model included preschool skills, family risk, and classroom quality. For this model, all predictors were centered at the grand mean to enhance the interpretability of the results. The centering method used was considered the most appropriate because our primary interest was to determine the influence of classroom quality, a predictor at the cluster level (Enders & Tofighi, 2007). Secondly, we examined whether classroom quality interacted with preschool skills and with family risk. For this model, the predictors at the individual level were centered at the group mean to prevent problems with estimating coefficients due to the correlations among them (Enders & Tofighi, 2007). Effect sizes were computed to interpret the magnitude of each association as follows: the unstandardized regression coefficient times the standard deviation for the predictor divided by the standard deviation for the outcome. Standard deviations were calculated using the raw scores and thus without partitioning individual level and cluster level components. In keeping with previous research, the following values were used to interpret the magnitude of the effects: .10 indicated a *small* effect, .30 a *moderate* effect, and .50 a *large* effect (see Burchinal, Roberts, Zeisel, Hennon, & Hooper, 2006, for details). When moderating effects were detected, effect sizes were computed at one standard deviation above and below the mean of

the moderator, as recommended by Jaccard, Wan, and Turrisi (1990) for continuous variables.

Finally, the individual CLASS domain scores were examined when the CLASS total was a significant predictor to determine which components of classroom quality were related to these outcomes. Given the high intercorrelation among the domains, raising multicollinearity issues, a different model was created for each of the three domains. The models included the individual CLASS domain scores as predictors, adjusting for family risk and preschool skills. Bonferroni adjustments were applied to reduce the likelihood of Type 1 error, resulting in an adjusted criterion value of .017.

7. Results

7.1. Descriptive results

Regarding academic and social skills, as shown in Table 2, student academic skills tended to increase from preschool to first grade, as expected, and adaptive behaviors tended to be stable.

With regard to the quality of teacher–student interactions, the descriptive findings are reported in Table 3. The means for Emotional Support and Classroom Organization were in the medium quality range, with ratings above 4 on a 7-point scale, indicating that, in general, teachers were rated as positive in their interactions with students, and classrooms were moderately organized in terms of behavior and instructional time management. Although Instructional Support was also rated in the medium quality range, the mean of 3.04 on a 7-point scale suggested that, for the most part, the observed activities focused more on basic skills than understanding and thinking skills. The mean for overall classroom quality was 3.92 ($SD=0.92$), although the range of values indicated that there was considerable variability across classrooms. Correlations among the three CLASS domains were strong and positive and ranged from .78, between Emotional Support and Classroom Organization, to .86, between Emotional and Instructional Support.

Concerning time devoted to each subject area, students were most often exposed to literacy activities. With few exceptions, teachers spent at least half of the observed time teaching language and literacy to students. Math activities took place in 25% of the classrooms, and science activities rarely occurred (6%). These findings were not surprising,

Table 2
Descriptive statistics for student measures ($N=106$).

	Preschool		First-grade	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Vocabulary	44.10	15.20	57.59	16.06
Print concepts	7.85	3.11	15.63	3.49
Number identification	37.83	24.90	76.04	22.88
Preschool counting	40.35	23.95		
First-grade global math			32.90	8.39
Classroom behaviors	3.83	0.60	3.81	0.44

Table 3

Descriptive statistics for classroom quality ($N=64$).

	<i>n</i>	%	<i>M</i>	<i>SD</i>	Range
Classroom overall quality					
CLASS global score			3.92	0.92	2.28–6.06
CLASS low quality (1–2.49)	2	3.1			
CLASS medium quality (2.50–5.49)	57	89.1			
CLASS high-quality (5.5–7.0)	5	7.8			
CLASS domains					
CLASS Emotional Support			4.60	0.88	2.81–6.69
CLASS Classroom Organization			4.11	0.90	2.25–6.33
CLASS Instructional Support			3.04	1.13	1.33–5.92

Note. CLASS=Classroom Assessment Scoring System.

given that in Portugal, the first grade corresponds to the first year of compulsory education; thus, teaching students to read and write seems to assume greater importance.

7.2. Results from the regression models

Table 4 presents the correlations among the preschool skills, the first grade outcomes, family risk, and overall classroom quality. Modest to moderate bivariate associations were observed between first grade outcomes and preschool outcomes, the child's age, family risk, and classroom quality.

7.2.1. Main effects

Table 5 displays the summary of the results obtained in the final models using GEEs, listing the unstandardized regression coefficients and standard errors. The analyses demonstrated that family risk and prior achievement were related to first grade outcomes. Not surprisingly, prior achievement was a noteworthy predictor in the models. Large effects were found for vocabulary, $b=0.73$, $SE\ b=0.06$, $p<.001$, effect size=.69, global math, $b=7.13$, $SE\ b=0.65$, $p<.001$, effect size=.77, and number identification, $b=14.84$, $SE\ b=1.88$, $p<.001$, effect size=.59. For print concepts and classroom behaviors, modest to moderate effects of prior achievement were detected on those outcomes, $b=0.30$, $SE\ b=0.09$, $p=.001$, effect size=.27, and $b=0.29$, $SE\ b=0.07$, $p<.001$, effect size=.38, respectively. These results suggest that the preschool skills are stronger predictors than the environmental factors, the quality of teacher–student interactions and family risk considered in this study, as one would expect.

Family risk was also associated with print concepts, $b=-0.66$, $SE\ b=0.21$, $p=.002$, effect size=.28, and classroom behaviors, $b=-0.07$, $SE\ b=0.03$, $p=.015$, effect size=.22. The family risk index modestly and negatively predicted print concepts and classroom behaviors, indicating that, as the number of risks in the family environment increased, students tended to have a lower growth in print concepts and to show fewer behaviors considered positive by the teacher. The number of family risks did not make a statistically significant contribution to the other outcomes once classroom quality and prior achievement were taken into account, for vocabulary, $b=-0.67$, $SE\ b=0.55$, $p=.223$,

Table 4
Correlations among variables.

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Sex	–											
2. Age	–.09	–										
3. Family risk index	–.07	.03	–									
4. Classroom quality	.03	.01	–.18	–								
5. Preschool vocabulary	–.10	.34 **	–.39 **	.18 *	–							
6. Preschool print concepts	–.05	.30 **	–.20 *	.16	.52 **	–						
7. Preschool math	–.27 **	.24 **	–.33 **	.13	.47 **	.56 **	–					
8. Preschool adaptive behavior	.12	.15	–.24 *	.23 *	.42 **	.53 **	.49 **	–				
9. First-grade vocabulary	–.07	.23 *	–.37 **	.34 **	.76 **	.49 **	.43 **	.43 **	–			
10. First-grade print concepts	–.01	.06	–.39 **	.35 **	.49 **	.40 **	.55 **	.48 **	.58 **	–		
11. First-grade global math	–.18	.28 **	–.33 **	.15	.53 **	.57 **	.82 **	.48 **	.54 **	.61 **	–	
12. First-grade number id	–.17	.17	–.24 *	.22 *	.31 **	.48 **	.63 **	.46 **	.39 **	.53 **	.74 **	–
13. First-grade adaptive behavior	.06	.14	–.36 **	.04	.39 **	.28 **	.32 **	.41 **	.40 **	.38 **	.39 **	.27 **

Note. Correlations did not take nesting of students within classrooms into account.

* $p < .05$.

** $p < .01$.

global math, $b = -0.43$, $SE\ b = 0.36$, $p = .235$, and number identification, $b = -0.43$, $SE\ b = 1.19$, $p = .719$.

Regarding classroom quality, the models indicated that, after taking into account family risk and preschool performance, classroom quality positively predicted first grade vocabulary, $b = 3.42$, $SE\ b = 1.13$, $p = .002$, and print concepts, $b = 0.87$, $SE\ b = 0.30$, $p = .003$. The effect sizes of .21 for vocabulary and .24 for print concepts indicated small associations. Hence, a 1-point increase in classroom quality was associated with gains of about one fifth of a standard deviation in the scores. For number identification, there was also a small effect size of .13, albeit not statistically significant, $b = 3.11$, $SE\ b = 1.85$, $p = .093$. These results indicate that students in first grade classrooms with higher quality instruction showed greater increases in vocabulary and print concepts. No effect of classroom quality was detected for first grade global math, $b = 0.37$, $SE\ b = 0.49$, $p = .446$, effect size = .04 or for classroom behaviors, $b = -0.04$, $SE\ b = 0.05$, $p = .415$, effect size = .09.

Table 5

Unstandardized regression coefficients from analyses predicting first-grade outcomes from classroom quality ($N=106$).

	Vocabulary		Print concepts		Global math		Number identification		Adaptive classroom behavior	
	<i>b</i>	(<i>SE b</i>)	<i>b</i>	(<i>SE b</i>)	<i>b</i>	(<i>SE b</i>)	<i>b</i>	(<i>SE b</i>)	<i>b</i>	(<i>SE b</i>)
Intercept	57.59	(0.96)	15.63	(0.28)	32.89	(0.47)	76.04	(1.69)	3.82	(0.04)
Prior achievement ^a	0.73 **	(0.06)	0.30 **	(0.09)	7.13 **	(0.65)	14.84 **	(1.88)	0.29 **	(0.07)
Family risk index	-0.67	(0.55)	-0.66 **	(0.21)	-0.43	(0.36)	-0.43	(1.19)	-0.07 *	(0.03)
Classroom quality	3.42 **	(1.13)	0.87 **	(0.30)	0.37	(0.49)	3.11	(1.85)	-0.04	(0.05)
Class quality * Prior achievement ^a	-0.01	(0.14)	-0.12	(0.15)	0.57	(1.30)	-5.34 *	(2.34)	0.02	(0.12)

Note. ^a For first grade vocabulary, preschool vocabulary was entered as the preschool predictor. For first grade print concepts, preschool print concepts was entered as the preschool predictor. For both first grade global math and first grade number identification, preschool mathematics was entered as the preschool predictor. For first grade classroom behavior, preschool classroom behavior was entered as the preschool predictor.

* $p < .05$.

** $p < .01$.

7.2.2. Interaction effects

Some evidence emerged suggesting that classroom quality predicted outcomes differently depending on the student's skills prior to school entry but not family risk. Interactions between classroom overall quality and first grade outcomes revealed a moderating effect for number identification, $b = -5.34$, $SE\ b = 2.34$, $p = .022$ (see Table 5). The interpretation of the interaction effects suggested that students with lower preschool math skills tended to demonstrate greater improvement on number identification skills when they attended higher quality classrooms, whereas students with higher prior skills did not (respective effect sizes = .29, for 1 *SD* below and -.06, for 1 *SD* above the mean of the moderator variable). Interactions involving family risk were not statistically significant.

7.2.3. CLASS domain effects

The final set of analyses examined the individual CLASS domain scores. The three domains of classroom quality – Emotional Support, Classroom Organization, and Instructional Support – were examined, substituting for the overall classroom quality in the models described above. The estimates of unstandardized regression coefficients and standard errors are displayed in Table 6. After making Bonferroni adjustments in alpha levels, analyses indicated that the coefficients of all three domains were statistically significant for vocabulary, $b = 3.82$, $SE\ b = 1.15$, $p = .001$, $b = 2.97$, $SE\ b = 1.03$, $p = .004$, $b = 2.53$, $SE\ b = 0.96$, $p = .009$, respectively. For print concepts, Classroom Organization and Instructional Support yielded statistically significant effects, $b = 0.73$, $SE\ b = 0.28$, $p = .009$, $b = 0.77$, $SE\ b = 0.21$, $p < .001$, respectively, whereas the association between Emotional Support and print concepts was not statistically significant at the Bonferroni-corrected

Table 6

Unstandardized regression coefficients from analyses predicting first-grade outcomes from each CLASS domain ($N=106$).

	Vocabulary		Print concepts		Number identification	
	<i>b</i>	(<i>SE b</i>)	<i>b</i>	(<i>SE b</i>)	<i>b</i>	(<i>SE b</i>)
<i>Model 1: Emotional support</i>						
Intercept	57.59	(0.95)	15.63	(0.29)	76.04	(1.70)
Prior achievement ^a	0.73 *	(0.06)	0.30 *	(0.10)	15.04 *	(1.83)
Family risk index	−0.70	(0.55)	−0.70 *	(0.22)	−0.53	(1.21)
Emotional support	3.82 *	(1.15)	0.77	(0.37)	2.58	(2.02)
Emotional support * prior achievement					−5.51	(2.61)
<i>Model 2: classroom organization</i>						
Intercept	57.59	(0.97)	15.63	(0.28)	76.04	(1.67)
Prior achievement ^a	0.74 *	(0.07)	0.32 *	(0.10)	14.73 *	(1.89)
Family risk index	−0.58	(0.57)	−0.66 *	(0.22)	−0.26	(1.20)
Classroom organization	2.97 *	(1.03)	0.73 *	(0.28)	3.75	(1.82)
Class organization * prior achievement					−6.64 *	(2.19)
<i>Model 3: instructional support</i>						
Intercept	57.59	(0.96)	15.63	(0.28)	76.04	(4.97)
Prior achievement ^a	0.72 *	(0.07)	0.30 *	(0.09)	15.00 *	(2.27)
Family risk index	−0.81	(0.55)	−0.68 *	(0.21)	−0.55	(1.32)
Instructional support	2.53 *	(0.96)	0.77 *	(0.21)	2.10	(1.45)
Instructional support * Prior achievement					−2.64	(2.00)

Note. ^a For first grade vocabulary, preschool vocabulary was entered as prior achievement. For print concepts, preschool print concepts was entered as prior achievement. For first grade number identification, preschool mathematics was entered as the preschool predictor.

* $p < .017$.

significance level, $b=0.77$, $SE\ b=0.37$, $p=.037$. Effect sizes ranged from .17 to .25. The magnitude of these associations was small, suggesting gains of approximately one fifth of a standard deviation in the scores for every 1-point increase in classroom domains. For number identification, there was a small association with Classroom Organization, effect size=.16, but it was no longer statistically significant after applying the Bonferroni procedure, $b=3.75$, $SE\ b=1.82$, $p=.040$. Emotional Support and Instructional Support failed to reach levels of significance, $b=2.58$, $SE\ b=2.02$, $p=.202$, and $b=2.10$, $SE\ b=1.45$, $p=.148$, respectively. When the interaction term between each domain of classroom quality and prior achievement was included in the models, a statistically significant interaction was detected between Classroom Organization and prior achievement for number identification, $b=-6.64$, $SE\ b=2.19$, $p=.002$. Students with low preschool math skills showed greater improvement when they attended classrooms with higher Classroom Organization, effect size=.36, whereas higher achievers did not, effect size=−.03. A similar differential effect between Emotional Support and prior achievement was detected, albeit not statistically significant after Bonferroni adjustment, $b=-5.51$, $SE\ b=2.61$, $p=.035$.

8. Discussion

The main purpose of this study was to determine the extent to which the quality of teacher–student interactions was associated with first grade outcomes. The results revealed that beyond the contribution of family risk and previous student achievement, classroom quality was positively related to first grade vocabulary, print concepts, and to a less extent, to number identification outcomes. Specifically, and consistent with recent studies of classroom quality (NICHD 2002, 2004; Perry et al., 2007; Pianta & Hamre, 2009), student learning was fostered in classrooms in which the teachers were observed providing well-planned activities, offering proactive behavior management, extending reasoning and language through feedback and instructional conversations with the students, and to being warm and sensitive to students' needs. These findings further support the unique contribution of the quality of teacher–student interactions in first grade, adjusting for family and student predictors (Connor et al., 2005; NICHD Early Child Care Research Network, 2002, 2004; Perry et al., 2007). These results are noteworthy, even if the effect sizes were modest, given that they emerged after taking into consideration not only family risk but also the student's skills prior to starting school. Few studies have examined first grade teacher–student interactions, particularly in Europe, which highlights the importance of these results. Our findings replicated the findings from previous work using the CLASS framework (Curby et al., 2009; Pianta & Hamre, 2009; Pianta et al., 2008; Ponitz et al., 2009). Research previously conducted in the United States indicated that students in higher quality classrooms achieved greater academic gains, particularly in the literacy domain (Curby et al., 2009; Pianta et al., 2008; Ponitz et al., 2009). As in the present study, the magnitude of these effects was modest, but they were fairly consistent across studies (Pianta & Hamre, 2009).

8.1. Associations with literacy, math, and adaptive behavior

Another important finding was that, clearly, literacy skills were enhanced when students experienced higher levels of quality in their first grade classrooms, whereas for math skills, the effects of classroom quality were not as evident. One possible reason for this finding concerns time devoted to each subject area. Recent research revealed that the amount of time spent on math in elementary classrooms positively contributed to improve math achievement (Pianta, Belsky, Houts, Morrison, & the NICHD Early Child Care Research Network, 2007). Not surprisingly, given the importance that teaching to read and write seems to have in the first year of compulsory education, literacy instruction was the prevalent activity in most classrooms, thus restricting time spent teaching math. It is therefore possible that a less evident effect on math achievement might be due to limited time spent on math instruction. Similar results were found in the NICHD Early Child Care Research Network study (2004), which indicated that the first grade classroom quality significantly predicted reading but not math achievement.

In terms of adaptive classroom behaviors, in contrast to reading and math, teacher–student interaction quality was not significantly associated with adaptive behavior. Possible reasons for the lack of change detected in adaptive classroom behaviors may be related to the range of social behaviors that were considered. Rimm-Kaufman, La Paro, Pianta, and

Downer (2005) found that classroom quality was associated with fewer negative behaviors but not with more positive behaviors. This finding suggests that classroom quality seems to affect some social skills, though not necessarily all of them. In another study, classroom experiences have been shown to particularly affect social behaviors that are highly dependent on the setting, such as engagement in the activities and cooperation with peers and the teacher (NICHD Early Child Care Research Network, 2003). In the present study, the total score of classroom behaviors used in the analyses was quite broad, including attention, sociability, and compliance skills. It would be important to include more finely honed measures to understand the effects of classroom quality. Moreover, in the present study, the information was obtained through teacher reports and not directly observed. Thus, one cannot exclude the possibility that these indirect ratings may not have captured any potential classroom effects; the NICHD Early Child Care Research Network study (2003) indicated that significant results of classroom quality were obtained for mother-reported problem behaviors and observed social skills but not for teacher-reported social skills. Although further research is needed, these results do appear to highlight that learning is a multifaceted process, suggesting that specific teacher–student interactions may be influential for some students' skills.

8.2. Moderating effects of the quality of teacher–student interactions

A second related goal of this study was to investigate whether the effect of classroom quality on first grade outcomes varied as a function of the level of family risk or skills students had before entering first grade. Findings suggest that the quality of teacher–student interactions predicted number identification outcomes differently depending on the skills students acquired prior to school entry. Specifically, students with lower preschool skills tended to show greater improvement. These findings provide some evidence that improving classroom quality may be an important means to increase more basic skills among students with low academic achievement, but an alternative explanation should be addressed. Examination of score distributions on number identification raised the possibility of ceiling effects that may have limited the discrimination power. The main effect of classroom quality may have been therefore underestimated. For that reason, it is possible that classroom quality may be equally relevant for high and low achievers in relation to more basic skills, including number identification, in addition to literacy outcomes.

8.3. Emotional, organizational, and instructional features of classroom quality

Consistent with previous studies (Hamre & Pianta, 2005; Pianta et al., 2008), the emotional, organizational, and instructional domains of classroom quality were related to one another. Teachers who were observed to be warmer and consistently responsive to students also tended to be more proactive, managed the activities and student behavior more efficiently, and provided activities that encourage higher-order thinking. Nevertheless, the results indicate that whereas all domains seemed similarly important for literacy outcomes, classroom organization seemed to play a major role for math. For number identification, lower achieving students had higher scores in classrooms offering better classroom organization. These findings seem to be in agreement with other research, which found that

classroom organization moderated the association between initial achievement and growth in mathematics, whereas for literacy, both emotional and instructional support were significant moderators (Curby et al., 2009). Considering the varying importance of different domains of classroom quality for distinct outcomes and for students with varied skill levels indicates an increasingly sophisticated understanding of classroom quality (Hamre et al., 2007). Globally, findings from this study support that various interrelated facets of the classroom may play an important role in improving academic skills in school, although limited support is provided for differential effects of each domain.

It is also worth noting that findings from the present study clearly demonstrate that prior achievement and, to a lesser extent, family risk were associated with student performance in first grade, indicating that, consistent with ecological models, multiple factors contribute to school achievement. As a direct consequence of the accumulation of risks within the family environment, students were likely to demonstrate low literacy, math, and social skills in preschool. In first grade, family risk was no longer associated with some of the outcomes, particularly in the mathematics domain, specifically number identification and global math, in addition to vocabulary. It is worth mentioning that most students were not exposed to many risk factors, and the limited range may explain these results. Despite this point, family risk remained significantly associated with print concepts and adaptive classroom behaviors, even when preschool variables were controlled for, indicating that family risk seemed to continue to exert a negative effect on those skills in first grade. Prior research conducted in Portugal has suggested that students with higher levels of family risk factors in their lives were likely to fall behind their peers in respect to literacy skills (Cadima et al., 2010; Pessanha, Cadima, Nunes, Novais, & Alves, 2009). On the other hand, and as expected, the most important predictor of first grade outcomes was the student's own skills in preschool. As a result, differences in academic and social development among students seem to appear early in life. These findings indicate the importance of intervening early in addition to improving the quality of classroom processes in the early grades.

Taken together, the results of the current study provide evidence that the quality of teacher–student interactions, expressed in terms of what teachers do in classrooms, even when based on the same curriculum, is related to improved academic outcomes. Results also show that observing the classroom processes proved to be a reliable means to detect effects on student learning. This study adds to the growing body of research that demonstrates the importance of classroom quality (Curby et al., 2009; Perry et al., 2007; Pianta & Hamre, 2009). By examining the classroom effects in a particular socio-cultural context, this study expands the current knowledge about specific teacher–student interactions that are associated with academic achievement and shows that specific emotional, organizational and instructional indicators are also relevant for Portuguese students.

To the extent that Western societies increasingly value and share common goals for education, such as fostering students' abilities to think critically and creatively, make responsible decisions, and behave ethically, it might be reasonable to expect that specific teacher–student interactions would have equivalent effects on student learning across different countries. The results of this study support that the comparable models of classroom processes may be employed across diverse socio-cultural contexts. It is worth noting that by no means do these findings suggest that the full ranges of dimensions relevant for student learning are being considered. Other features, in particular those

specific to each socio-cultural context, may assume an important role in improving learning. What these results do indeed indicate is that common features across countries appear to be relevant. Documenting the quality of the interactions in first grade may be an important mechanism to improve students' skills, and therefore, current investments in the Portuguese educational system should attend to the quality of teacher–student interactions.

As the governments of Portugal and other countries increasingly invest on raising the educational levels of young people, it seems essential to focus on how teachers instruct and interact with students. Consistent with the position of several authors (Cohen et al., 2003; Nye et al., 2004; Pianta, 2003), the results of this study emphasize the need to look beyond structural indicators that are under regulation to the observed quality of teachers' interactions. Research on classroom processes may provide valuable and empirically based information that could assist in establishing standards for school quality, as well as in classroom monitoring and evaluation.

8.4. *Limitations*

A number of limitations of this study need to be considered. First, classroom observations were conducted within a single day. Although there is some evidence pointing to relative stability across the school year, suggesting that one day is representative of general classroom practices (Pianta et al., 2008), it would be important to gather more information. Secondly, the measure of adaptive behaviors relied on teacher reports rather than on external observations. In addition, the information for both preschool and first grade was collected based on different sources, preschool teacher and first grade teacher, respectively, which may introduce additional error in the models. It would have been helpful to have more sources of information. It also should be mentioned that this measure did not seem to exhibit identical psychometric properties across ages, given that the basic factorial structure was different at different ages. An additional limitation concerns the measures used to evaluate literacy and math skills; although the measures have been shown to be reliable for Portuguese students, they are not nationally standardized, as this type of test is not available for Portuguese students. Two further limitations should be noted. Only one to four students were assessed in each classroom. Despite evidence that GEE methods provide robust estimates of regression parameters (Ghisletta & Spini, 2004; Norton et al., 1996), small cluster sizes might decrease the power for testing the cross-level effects (Snijders, 2005). Finally, our findings were correlational, and thus, causal links cannot be inferred.

Despite these limitations, this study provides further evidence of the positive associations of the quality of teacher–student interactions with academic outcomes in a cultural context other than the United States. The results highlight the potential importance of classroom processes for student learning. The results support the view that efforts to attend to teacher–student interactions, and not merely structural indicators, are essential (Cohen et al., 2003; NICHD Early Child Care Research Network, 2004; Pianta, 2003).

8.5. *Future research*

From a broad perspective, these findings may be particularly relevant, taking into consideration the lack of studies examining both classroom interactions and student skills,

particularly in European countries. Further understanding of the classroom processes that foster learning in different socio-cultural contexts may contribute considerably to current efforts to improve social and academic skills of students worldwide. Further research should investigate the accumulated effects of classroom quality throughout elementary school. Portuguese teachers follow the same group of students from first to fourth grade, an uncommon practice in most countries. Research focusing on the associations between classroom quality and students' learning for more than a single year is rather scarce, and much more can be learned through longitudinal research in Portugal. In addition, as noted by Raudenbush (2004), randomized trials that assess the effects of interventions designed to enhance classroom quality are required to elucidate how to best support teachers in this effort. As a final point, research examining how classroom quality moderates student skill growth, and social skills in particular, would be relevant to shed light on other relevant moderating effects that, ultimately, lead to a more comprehensive model of classroom quality.

Acknowledgements

This research was supported in part by a Doctoral Fellowship from the Foundation of Science and Technology, Portugal (SFRH/BD/28870/2006).

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