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The centrality of immigrant students within teacher-student interaction networks: A relational approach to educational inclusion

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HIGHLIGHTS

- The educational inclusion of immigrant students during mathematics classes was investigated.
- Teacher-student interactions were coded, depicted via sociograms and statistically modeled.
- Immigrant student inclusion was assessed by the initiator and content of interaction.
- Student's country of origin significantly predicts frequency of interactions with teachers.
- There is a significant variation in immigrant student inclusion across classrooms.

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ABSTRACT

The conceptualizations of educational inclusion, previously restricted to securing access to formal education, recently highlight the promotion of equitable social and academic relations as well. This study investigates the inclusion of students with immigrant background within their class' teacher-student interaction networks, while distinguishing by the initiator and content of interactions. Data from 38 Chilean mathematics teachers/classrooms and 933 seventh graders were collected and analyzed using systematic observation, social network visualization and multilevel models. Results show that the inclusion of students depends significantly on their country of origin. There is also significant variation in teacher-immigrant student interactions across classrooms.

1. Introduction

The 2030 Sustainable Development Goals, adopted by all United Nations Member States in 2015, aim to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (United Nations, 2015: p. 14). Ten years before this goal deadline, immigrant students still perform at lower levels than their non-immigrant peers in several education systems (Oecd The Organization for Economic Cooperation and Development, 2019a), and face various challenges in terms of access to, retention in, and completion of, mandatory schooling (UNESCO, 2018). Globally, growing immigration trends are confronting teachers with a more diverse student population than in the past. It is, thus, an increasingly relevant challenge to provide support and resources to immigrant students via inclusive education processes. However, there is a lack of evidence to inform teacher training and practices in this regard (European Union, 2017).

In Chile, the proportion of students with immigrant background has increased rapidly in the last decade, due to a growing influx of intraregional migration (Instituto Nacional de Estadísticas, 2018). While unrestricted access of immigrant students to formal education is ensured, little is known regarding their experiences within schools. The available studies suggest that they face prejudices and discrimination from their school communities (e.g., Riedemann & Stefoni, 2015; Salas et al., 2017; Tijoux, 2013a). However, this literature is usually based on limited samples, corresponds mainly

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to qualitative accounts or tends to rely on teacher self-reports, which can be biased (Larson & Bradshaw, 2017). No previous studies in Chile have systematically observed how teachers actually interact with immigrant students.

In addition, previous international studies on the educational inclusion of immigrant students have tended to focus on their access to formal education systems, and on their relative academic achievement and attainment (e.g., Condon, Filindra, & Wichowsky, 2016; UNESCO, 2018). The social mechanisms that can put immigrant students at educational disadvantage have received less attention and, when explored, the focus has generally been on peer effects and networks (e.g., Boda & Néray, 2015; Leszczensky & Pink, 2015; Moody, 2001; Reynolds & Crea, 2017; Smith, Maas, & Van Tubergen, 2014; Van de Werfhorst & Mijs, 2010). A relational approach to educational inclusion, with a focus on teacher-student interactions, could complement those studies and help us to better understand the educational inclusion of immigrant students. Indeed, understanding this phenomenon from a relational perspective can shed light over critical equity aspects of educational processes, which go beyond access to education, and that could explain immigrant achievement and attainment gaps (Carolan, 2013).

The aims of this study are (1) to investigate the inclusion of immigrant students within Chilean classrooms by analyzing their relative centrality in teacher-student interaction networks, and (2) to study and explain the variation in the inclusion of immigrant students across classrooms.

The contributions of this study are three-fold. Firstly, a relational approach is used to define and operationalize educational inclusion, which expands previous conceptualizations that limit their focus to students' access to formal education. Secondly, the study provides new and robust empirical evidence, based on a large sample, on the educational experiences of immigrant students in Chile, a country with an unprecedented immigration trend. Thirdly, an innovative combination of advanced methods is applied to investigate teacher-student interactions, namely, systematic classroom observation, social network visualization, and multilevel models. This research strategy allows the investigation of within- and between-classroom variation in the inclusion of immigrant students across a variety of interaction contents, while controlling for confounding variables and exploring compositional effects.

2. Conceptual framework

2.1. The social dimensions of educational inclusion

Educational inclusion is a widely used and contested concept that has evolved over time. Initial definitions of educational inclusion restricted its focus to seeking that all students attended regular and similar schools, this is, ensuring access to, and participation in, mainstream formal education (Opertti, Walker, & Zhang, 2014). However, the scope of this concept has widened, based on an understanding that educational inclusion is not achieved simply by promoting that students, regardless of their background, share the same school/classroom. Thus, more recent definitions highlight the social character of educational inclusion. For example, Ainscow (2005) defines inclusive practice as ' … attempts to overcome barriers to the participation and learning of students' that involve 'social learning processes within a given workplace that influence people's actions and, indeed, the thinking that informs these actions' (pp. 112–113). Similarly, Loreman (2009) identifies as key elements of inclusion that all children contribute to regular school and classroom learning activities, and are supported to be socially successful with their peers.

Access to, and participation in, formal education by themselves are, indeed, insufficient indicators of educational inclusion, as inequalities in education can be effectively maintained and reproduced in forms of qualitative differences in students' educational experiences, regardless of educational expansion and enrolment saturation at any given level (Lucas, 2001). Thus, relational factors and processes operating within the classroom are increasingly seen as critical contributors to educational inclusion (Loreman, 2014). More specifically, students' relationships and interactions with teachers are a critical source of pedagogical and emotional support (Contini, 2013; Pianta, Hamre, & Mintz, 2011) that can influence students' educational and social outcomes, such as academic skills, motivation, expectations, self-esteem, behavior problems, and peer acceptance (Agirdag, Van Houtte, & Avermaet, 2012; Cherng, 2017; Hamre & Pianta, 2001; Maldonado-Carreño & Votruba-Drzal, 2011; Opdenakker, Maulana, & den Brok, 2012; Wubbels, Brekelmans, & Mainhard, 2016; Wullschleger, Garrote, Schnepel, Jaquiéry, & Moser Opitz, 2020).

2.2. The educational inclusion of immigrant students

Educational inclusion of immigrants can be understood as an integral part of their overall integration into their host societies. Successful integration is often judged by two criteria: psychological and sociocultural adaption (Ward & Kennedy, 1993; 1999). This includes identification with the host society and psychological well-being on the one hand, and success within the education system and on the labor market on the other hand. The role of the education system is crucial in this process. However, while one of the major goals of modern Western education systems is to decrease social inequalities between students, they often contribute to their reproduction instead (Bourdieu, 1974). Immigrant students and parents usually lack the social capital – the collection of resources one has access to through one's social ties (Bourdieu, 1986; Coleman, 1988) – necessary to succeed in the education system. Positive social ties with non-immigrant students, parents, or teachers could potentially provide immigrant families with instrumental support (e.g., information or access to resources), which contributes to social capital and school success (Stadtfeld, Vörös, Elmer, Boda, & Raabe, 2019; Newgent, Lee, & Daniel, 2007; Woolley & Bowen, 2009). Students could also gain emotional support this way, enhancing their well-being and self-esteem (Cherng, 2017; Mendoza-Denton & Page-Gould, 2008; Walsh, Harel-Fisch, & Fogel-Grinvald, 2010). For social integration, it therefore seems especially beneficial for students with immigration background to build social ties with their non-immigrant peers and teachers.

2.2.1. Teacher interactions with immigrant students

There is a vast amount of research on the inclusion of immigrant students in peer networks, which are usually ethnically and racially segregated (e.g., Boda & Néray, 2015; Leszczensky & Pink, 2015; Moody, 2001; Smith et al., 2014) and show important differences in social integration among racial and ethnic groups within national contexts (Reynolds & Crea, 2017). In this literature, social network analysis has proved to be a useful framework for studying students' inclusion in social and academic interactions in the micro-social spaces of schools and classrooms (e.g., Cappella, Kim, Neal, & Jackson, 2013; Lomi, Snijders, Steglich, & Torló, 2011).

However, less is known about immigrant students' inclusion in teacher-student networks (i.e., social relations, or their smallest building blocks, social interactions, between students and teachers). Previous research suggests that the way teachers communicate vary by students' immigrant background (den Brok & Levy, 2005). For example, some early exploratory studies concluded that teachers establish fewer interactions with pupils of immigrant

background than with other students and that the content of the interactions also tend to differ, with teachers being more critical towards immigrant students and correcting their behavior more frequently, compared to their non-immigrant peers (e.g., Casteel, 1998; den Brok, Wubbels, Veldman, & Van Tartwijk, 2009; Fraser & Walberg, 2005; Irvine, 1985; 1986).

Previous studies also show that the relationship with teachers varies across student racial/ethnic groups with, for example, weaker relationships found for Latino students (Cherng, 2017; Peguero & Bondy, 2011), and higher levels of conflict with black students (Ladd, Birch, & Buhs, 1999) that are also more likely to increase over time (Jerome, Hamre, & Pianta, 2008). A meta-analysis also suggests that teachers' speech vary with students' ethnic backgrounds, with more positive and neutral speech for European American children than for African American and Latino/a (Tenenbaum & Ruck, 2007). Relatedly, a recent review of the literature on teacher interactions with multilingual and monolingual children shows that multilingual students receive fewer opportunities to participate, as compared with their monolingual peers (Langeloo, Mascareño, Deunk, Klitzing, & Strijbos, 2019). Furthermore, it has been suggested that teacher-student interpersonal relationship is more important, in terms of predicting educational outcomes, for immigrant students than for their non-immigrant peers (den Brok, Tartwijk, & Wubbels, 2010). It is relevant to note that most of the quantitative studies available in this area are not based on classroom observation data, but on students' or teachers' self-reports. The later measures are likely to present bias due to social desirability, particularly when teachers assess their own cultural competence (Larson & Bradshaw, 2017).

Regarding national research, few studies have investigated the educational inclusion of students of foreign background in Chile. Qualitative studies conducted in Chilean schools suggest high levels of intolerance, the presence of negative stereotypes, as well as racism and discrimination against immigrant students, in school communities (Bravo, 2011; Pavez-Soto & Chan, 2018; Stefoni, Acosta, Gaymer, & Casas-Cordero, 2008; Tijoux, 2013b). This is in line with studies conducted in South American countries regarding the classroom experiences of indigenous and Afro-descendant children, which stress the invisibility, exclusion of, and discrimination against, these minority groups (Preiss, Calcagni, & Grau, 2015), and point towards symbolic markers related to ethnicity, race and culture that can affect students' educational experiences.

2.2.2. The role of teacher attitudes in the inclusion of immigrant students

Previous research suggests that, in multicultural contexts, teachers hold differential expectations of educational attainment for their students, to the detriment of immigrant, black and Hispanic students (De Boer, Bosker, & van der Werf, 2010; Mahatmya, Lohman, Brown, & Conway-Turner, 2016; Tenenbaum & Ruck, 2007). This field of research has also found associations between teachers' lower expectations towards immigrant students, the relative exclusion of these students from classroom interactions, and lower progress on learning outcomes (e.g., Glock, 2016; Peterson, Rubie-Davies, Osborne, & Sibley, 2016).

In Chile, there are some recent exploratory case studies on teachers' attitudes towards immigrant students. This research suggests that teachers hold stereotyped attitudes and discourses towards immigrants, as they associate students from certain countries of origin with academic deficits and behavioral problems. For example, in qualitative studies teachers have expressed that students from Venezuela and Dominican Republic are more disruptive but also more likely to be high performers, while Peruvian students are seen as more introverted, less prepared academically and less likely to conform to school rules (Cerón, Pérez Alvarado, & Poblete, 2017; Mondaca, Muñoz, Gajardo, & Gairín, 2018; Tijoux, 2013a).

2.2.3. The effect of classroom immigrant composition on the inclusion of immigrant students

While compositional effects have not been studied in teacher-immigrant student interaction research, the peer interaction literature highlights the association of school and classroom ethnic composition with immigrant social inclusion (e.g., Castillo, Santa Cruz-Grau, & Vega, 2018; Contini, 2013; Vitorouslis & Gerogiades, 2017). This research has generally found a non-linear relationship between the group's ethnic composition and different measures of ethnic segregation (i.e. on friendship networks, racial victimization and educational attainment). Thus, it is important to investigate how the proportion of immigrant students in the classroom influences the interactions that teachers hold with students from immigrant and non-immigrant background.

2.3. The measurement of classroom interactions

The methods most frequently used to measure and evaluate classroom interactions include teachers' and students' self-reports – which can be biased (Desimone, Smith, & Frisvold, 2010; Larson & Bradshaw, 2017) –, and systematic observation protocols. Most of the available protocols (e.g., the Classroom Assessment Scoring System (CLASS): Pianta et al., 2011; the International System for Teacher Observation and Feedback (ISTOF): Teddlie, Creemers, Kyriakides, Muijs, & Yu, 2006, etc.) provide indicators of overall quality of classroom interactions. While these observation tools offer important insights, they do not distinguish how teachers interact with different students and, therefore, assume that students' experiences within a class are homogeneous. Thus, potential teacher biases against students from certain groups are hidden in instruments that report on the average quality of relationships between the teacher and the class. Also, statistical power is significantly reduced in instruments that provide aggregated measures of teacher-student interactions.

In consequence, a complementary approach is required that allows the empirical study of educational inclusion in terms of the interactions that the teacher establishes with individual students within a class. In this regard, Good and Brophy (1970) made an important contribution by developing an observational protocol that shifted the focus from the whole class to individual students. The Brophy-Good Dyadic Child Interaction System was designed to capture dyadic interaction data, this is, to identify the teacher's interactions with each individual child in the class, and among several features, distinguishes among work-related contacts, behavior evaluations and procedural contacts, and identifies whether the student or the teacher initiated each interaction. This instrument elicited research on teachers' differential treatment of student groups, defined by gender and race, among other categories (Brophy & Good, 1974). In this study, we developed a similar protocol to analyze differential teacher-student interaction patterns within classrooms, and focused on differences by student immigrant background.

3. The chilean context

3.1. Recent immigration trend in Chile

The foreign-born population in Chile has increased significantly in the last decade due to a growing influx of intraregional migration (DEM, 2016). According to census data, the migrant population rate increased from 1,3% in 2002 to 4,4% in 2017, showing an explosive evolution since 2010 (Instituto Nacional de Estadísticas, 2018). This

new scenario is reflected in Chile's school enrolment trends. Official national reports show that 113,585 immigrant background students were enrolled in the school system in 2018, which is four times the number observed for this group in 2015. These students mainly originate from Latin American and Caribbean nations, such as Peru, Bolivia and, more recently, Colombia, Venezuela, and non-Spanish-speaking Haiti (MINEDUC, 2018).

In Chile, where the legislation gives immigrant children unconditional access to the educational system, the immigration patterns described above have been shifting the composition of some schools dramatically, leading to more diverse classroom environments. Immigrant students in Chile are unequally distributed both geographically and in terms of school sector. Migrant families tend to cluster in central areas of large cities, which leads to some schools in those areas showing higher proportions of pupils with immigrant background (Fernández, 2018). In addition, immigrant students are more likely to attend public schools (57.5% of immigrant students attend public schools, compared to 35.3% of non-immigrant students) (MINEDUC, 2018). In Chile's market-oriented and socially segregated education system, public schools usually serve low socio-economic status families (García-Huidobro, 2007; Valenzuela, Bellei, & De los Ríos, 2014) and show poorer educational results (Cox, 2004). Recent studies show that, overall, immigrant students in public schools perform better regarding attendance, grade repetition, and achievement scores, and their parents' show higher educational levels and educational expectations, compared to their peers in public schools (Eyzaguirre, Aguirre, & Blanco, 2019; Rojas & Vicuña, 2019).[1]

In addition, there is evidence suggesting that Chilean teachers are not trained on dealing with diverse classrooms and do not have the necessary intercultural abilities, knowledge and pedagogical tools to support immigrant students in their processes of integration. The Teaching and Learning International Survey (TALIS) 2018, shows that 'teaching in a multicultural or multilingual environment' and 'communication with people from different cultures or countries' are the second and third areas where Chilean teachers identify the highest needs for professional development, with 33.8 and 26.4% of teachers indicating high needs for professional development in these areas, respectively. However, these contents are the least included in the professional development activities available to them (Oecd The Organization for Economic Cooperation and Development, 2019b).

4. Hypotheses

The evidence on immigrant children inclusion, specifically in terms of teacher-student interactions, is scarce in Chile, as it is elsewhere. This paper explores the relative position of immigrant students within their class' teacher-student interaction networks, as well as the magnitude and predictors of the variance in the inclusion of immigrant students across Chilean classrooms. This is the first study that provides systematic evidence on teacher-immigrant student interactions within Chilean classrooms. The analyses will be guided by the following hypotheses:

- **Hypothesis 1a**: Students with immigrant background are significantly more peripheral in their class' teacher-student interaction networks than their non-immigrant peers.
- **Hypothesis 1b**: These differences in centrality will vary by immigrant students' country of origin.
- **Hypothesis 2**: There is significant variation in the effect of student immigrant background on the frequency of interactions with the teacher across classrooms, with some classrooms being significantly more inclusive of immigrant students than others.
- **Hypothesis 3**: The classroom-level variation on the effect of student immigrant background is partially explained by the immigrant composition of the classroom and the teacher's attitude towards diversity in the classroom.

All the hypotheses above are formulated for both teacher-initiated and student-initiated interactions.

5. Methods

5.1. Sample

The target population of this study was 7th grade mathematics classes in public schools located in five municipalities with high proportions of immigrant students in Santiago, Chile's capital. Participation in the study was voluntary for schools, teachers and students. The directors of the 75 eligible schools were invited to participate in the study. In those 50 schools where the director authorized participation, all the 55 math teachers assigned to 7th grade classes consented participation. However, only 38 teachers/classes were part of the analyses reported in this article.[2] Thus, the study analyses data from a sample of 38 mathematics teachers and 933 seventh graders (typically aged 12 to 13) in 37 Chilean public schools, which represent 49.3% of the schools in the target population.[3][4]

Table 1 shows that the average proportion of immigrant students in the participant classrooms was 42%, ranging from 3 to 90%.

Tables 2 and 3 provide descriptive statistics on students' mathematics achievement and their parent's educational level, by immigrant origin, language spoken at home and country of origin. No statistically significant differences in the achievement levels in mathematics by immigrant background were found. However, when analyzing mathematics achievement levels by *Country of origin*, students from Chile (M = 561.4, SD = 26.3) performed significantly higher than students from Haiti (M = 548.6, SD = 25.1; t (548) = 2.199, $p < .05$) and significantly lower than students from the category Other countries (M = 574.2, SD = 29.6; t (547) = -2.122, $p < .05$).

With regard to parental educational level, the parents of students of immigrant origin attended university in a significantly larger proportion (30.5%) than parents of students that are not from immigrant origin (14.4%) (χ^2 (1) = 35.08, $p < .001$), which is the case of students from Colombia (37.3%), Haiti (33.3%), Venezuela (64.1%),

[1] While in Chile the educational level of immigrant students' parents is higher than that of their non-immigrant peers, just as in the majority of OECD countries, immigrant students in Chile are socio-economically disadvantaged compared to native students (Oecd The Organization for Economic Cooperation and Development, 2018; Oecd The Organization for Economic Cooperation and Development, 2019a). Indeed, in 2017, on average, immigrant adults had attained one and a half years more of education than native adults (12.6 and 11.0 years, respectively) (Instituto Nacional de Estadísticas, 2018, Instituto Nacional de Estadísticas, 2018), but qualified immigrants tend to work in low-skilled jobs (Expósito, Lobos, & Roessler, 2019).

[2] The other 17 classes were excluded for not having immigrant students ($n = 3$), due to quality issues with the video (poor audio or image) that did not allow reliable coding ($n = 10$) or because it was not possible to collect other data necessary for the analyses ($n = 4$).

[3] When comparing the 37 schools that were part of the study's sample with those 38 schools that were part of the target population but that, for the reasons mentioned above, were not included in the analyses, we found no statistical differences in terms of school overall socio-economic status, size, achievement or percentage of immigrant students in 2018.

[4] All the students that were present in the videotaped lessons were included in the analyses, regardless of whether they interacted with the teacher or not. However, those students who did not attend the videotaped lesson were not considered in the analyses. The average attendance rate for the videotaped lessons was 87.4% and, in our data, non-attendant students were not more likely to be immigrants.

Table 1
Demographics of the sample classrooms ($n_{classrooms} = 38$).

	Number of students	Percentage of immigrant students (%)	Number of countries of origin (Immigrant Diversity)	Number of total Teacher-student interactions	Number of teacher-initiated interactions	Number of student-initiated interactions
Mean	24.6	42.0	4.61	132.4	73.0	59.4
Median	23.5	34.5	5.00	133.0	68.0	57.5
Standard Deviation	7.1	27.0	1.57	43.4	37.5	23.6
Minimum	14.0	3.3	2	33.0	6.0	23.0
Maximum	44.0	89.5	8	204.0	165.0	106.0

Table 2
Descriptive statistics for teacher-initiated interactions by immigrant background, language spoken at home and country of origin.

	N Student	*% Parents' University Studies*		*Math Score*	Teacher-initiated interactions				
					Behavior Management	*Instructions*	*Administrative*	*Pedagogical*	*Total*
Immigrant Background									
Students without Migrant Background	513	14.43	Mean	561.8	0.81	0.13	1.09	1.03	3.16
			SD	25.9	1.69	0.43	1.45	1.53	3.52
Students with Migrant Background	420	**30.48*****	Mean	562.3	**0.59****	0.12	**0.97**†	0.98	**2.74***
			SD	30.0	**1.35**	0.43	**1.51**	1.59	**3.39**
Total	933	21.65	Mean	562.0	0.71	0.13	1.04	1.00	2.97
			SD	27.8	1.55	0.43	1.48	1.55	3.47
Language Spoken at Home									
Spanish	898	21.27	Mean	562.2	0.70	0.13	1.03	0.97	2.92
			SD	27.9	1.53	0.43	1.49	1.52	3.43
Other	35	31.43	Mean	556.1	1.00	0.11	1.20	**1.83****	**4.23***
			SD	25.6	2.03	0.40	1.30	**2.09**	**4.05**
Total	933	21.65	Mean	562.0	0.71	0.13	1.04	1.00	2.97
			SD	27.8	1.55	0.43	1.48	1.55	3.47
Country of Origin									
Chile	529	13.99	Mean	561.4	0.81	0.13	1.08	0.99	3.11
			SD	26.3	1.70	0.43	1.44	1.50	3.53
Peru	196	17.86	Mean	562.8	**0.52****	0.07	**0.84**†	**0.69****	**2.21****
			SD	31.0	**1.18**	0.30	**1.25**	**1.18**	**2.60**
Bolivia	11	27.27	Mean	564.6	1.09	0.18	0.64	1.18	3.09
			SD	32.1	1.81	0.60	0.81	1.17	3.39
Colombia	51	**37.26*****	Mean	564.0	0.43	0.10	**0.76***	0.84	**2.25***
			SD	19.7	0.92	0.36	**1.26**	1.53	**2.98**
Haiti	21	**33.33***	Mean	**548.6***	1.24	0.14	**1.48**†	**2.05****	**5.00***
			SD	**25.1**	2.59	0.36	**1.40**	**2.27**	**4.24**
Ecuador	13	15.39	Mean	559.0	1.38	**0.54***	1.92	1.38	5.31
			SD	18.3	2.57	**0.97**	2.18	1.71	5.50
Venezuela	64	**64.06*****	Mean	564.2	**0.39***	0.20	1.25	1.36	3.23
			SD	37.0	**0.85**	0.62	2.29	2.10	4.35
Dominican Republic	17	**52.94*****	Mean	564.7	0.35	0.12	0.94	1.53	3.00
			SD	24.2	0.70	0.33	1.25	2.24	3.43
Other countries[a] (Argentina, China, Cuba, El Salvador, Spain, United States, Uruguay, Paraguay, Brazil, Nigeria)	20	**45.00*****	Mean	**574.2***	0.95	0.15	1.25	1.25	3.65
			SD	**29.6**	1.61	0.37	1.71	1.74	3.31
Missing	11	27.27	Mean	554.6	0.55	0.00	0.91	**1.82**†	3.55
			SD	18.4	0.82	0.00	1.14	**2.14**	2.98
Total	933	21.65	Mean	562.0	0.71	0.13	1.04	1.00	2.97
			SD	27.8	1.55	0.43	1.48	1.55	3.47

Notes: †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$ in Chi-squared test (for parents' university studies), T-test (for math achievement score) and Mann-Whitney U Tests (for the rest of the variables).
Baseline for comparisons is Chile, for the Country of Origin variables.
[a] Countries with less than 10 students in our sample were classified as 'Other countries'.

Dominican Republic (52.9%) and those from the category Other countries (45.0%).

Finally, in line with the recent national immigration trends, the composition of the sample in terms of countries of origin is not equally distributed across immigrant generations. As shown in Table A1, students who are second-generation immigrants are mainly from Peru (71.3%) and from Other Countries (13.8%), whereas, among first-generation immigrants, the percentage of students from Peru is lower (40.9%), with students from Venezuela (18.5%), Colombia (13.8%), Haiti (5.9%) and Dominican Republic (5.0%) and other countries showing an increased presence.

5.2. Measures

5.2.1. Teacher-student interaction measures

The dependent variables in this study refer to the degree centrality of students in teacher-student interaction networks, that is, the frequency of interactions with the teacher, in terms of both, interactions initiated by the teacher (students' in-degree centrality) and by the student (students' out-degree centrality). Thus, in this study, students who participate in the interaction networks more frequently than their classmates are conceived as more central, and those not participating, or participating less frequently, as more

Table 3
Descriptive statistics for student-initiated interactions by immigrant background, language spoken at home and country of origin.

	N Students	*% Parents' University Studies*		*Math Score*	Student-initiated interactions				
					Behavior Management	*Task Instructions*	*Administrative*	*Pedagogical*	*Total*
Immigrant Background									
Students without Migrant Background	513	14.43	Mean	561.8	0.01	0.13	0.80	1.36	2.38
			SD	25.9	0.10	0.45	1.53	2.60	3.68
Students with Migrant Background	420	**30.48*****	Mean	562.3	0.00	0.13	**0.65**†	**1.62***	2.47
			SD	30.0	0.05	0.55	**1.52**	**2.66**	3.80
Total	933	21.65	Mean	562.0	0.01	0.13	0.73	1.48	2.42
			SD	27.8	0.08	0.50	1.53	2.63	3.73
Language Spoken at Home									
Spanish	898	21.27	Mean	562.2	0.01	0.13	0.74	1.46	2.41
			SD	27.9	0.08	0.50	1.54	2.63	3.75
Other	35	31.43	Mean	556.1	0.00	0.09	0.69	1.83	2.60
			SD	25.6	0.00	0.38	1.08	2.50	3.26
Total	933	21.65	Mean	562.0	0.01	0.13	0.73	1.48	2.42
			SD	27.8	0.08	0.50	1.53	2.63	3.73
Country of Origin									
Chile	529	13.99	Mean	561.4	0.01	0.14	0.80	1.35	2.37
			SD	26.3	0.10	0.47	1.51	2.57	3.65
Peru	196	17.86	Mean	562.8	0.01	**0.05****	**0.49****	0.99	**1.59***
			SD	31.0	0.07	**0.21**	**1.68**	1.72	**3.00**
Bolivia	11	27.27	Mean	564.6	0.00	0.09	0.55	1.00	1.73
			SD	32.1	0.00	0.30	0.52	1.26	1.68
Colombia	51	**37.26*****	Mean	564.0	0.00	0.39	0.90	**2.75****	**4.22***
			SD	19.7	0.00	1.22	1.57	**3.53**	**5.19**
Haiti	21	**33.33***	Mean	**548.6***	0.00	0.00	0.52	1.19	1.71
			SD	**25.1**	0.00	0.00	0.87	1.83	2.08
Ecuador	13	15.39	Mean	560.7	0.00	0.00	0.00	0.00	0.00
			SD	18.3	0.00	0.60	1.95	1.68	2.84
Venezuela	64	**64.06*****	Mean	564.2	0.00	0.19	0.84	**2.84*****	**3.98****
			SD	37.0	0.00	0.73	1.51	**3.64**	**4.72**
Dominican Republic	17	**52.94*****	Mean	564.7	0.00	0.12	0.88	**2.53**†	3.53
			SD	24.2	0.00	0.33	1.41	**3.64**	4.52
Other countries[a] (Argentina, China, Cuba, El Salvador, Spain, United States, Uruguay, Paraguay, Brazil, Nigeria)	20	**45.00*****	Mean	**574.2***	0.00	0.05	0.75	1.95	2.75
			SD	**29.6**	0.00	0.22	1.12	3.47	4.13
Missing	11	27.27	Mean	554.6	0.00	0.00	0.55	1.73	2.27
			SD	18.4	0.00	0.00	1.21	2.49	3.20
Total	933	21.65	Mean	562.0	0.01	0.13	0.73	1.48	2.42
			SD	27.8	0.08	0.50	1.53	2.63	3.73

Notes: †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$ in Chi-squared test (for parents' university studies), T-test (for math achievement score) and Mann-Whitney U Tests (for the rest of the variables).
Baseline for comparisons is Chile, for the Country of Origin variables.
[a] Countries with less than 10 students in our sample were classified as 'Other countries'.

peripheral. This is in line with the social network literature, where centrality refers to the "node importance" (Robins, 2015, p. 182), and is related to how "traffic flows through the network" (Borgatti, 2005, p. 55).

To identify each interaction, and code their relevant attributes, a systematic observation protocol was designed, using features from the Brophy-Good Dyadic Child Interaction System (Good & Brophy, 1970), such as its focus on dyadic interactions between the classroom teacher and each individual student in the class, and the coding of content and initiator of interactions. Thus, our instrument's unit of observation is teacher-student interactions. All exchanges that involved the teacher and that consisted of at least one verbal turn were identified as interactions. Each interaction observed was coded using the following attribute indicators:

- *Initiator of interaction*: A dichotomous indicator registering if the first turn of the interaction was performed by the student or the teacher.
- *Content of the interaction*: A categorical variable specifying the focus of the interaction, among the following:
  - o *Behavior Management*: Interactions that focus on the rules of behavior in the classroom, such as controlling and redirecting behavior (e.g., calls to keep order, silence, etc.).
  - o *Administrative*: Interactions that focus on administrative tasks or classroom management (e.g., taking attendance, announcing the structure of the class, announcing the activity to be carried out, etc.).
  - o *Task Instructions*: These interactions focus on the specific management of instructional activities; they inform how to carry out the activities without explaining the content (e.g., dictation of a guide, distributing students in groups for an activity, etc.)
  - o *Pedagogical*: Interactions that refer to the content or pedagogical skills addressed; they focus on the process of academic teaching (e.g., explaining the subject matter, verbally evaluating the contribution of a student, asking questions about the content addressed, etc.).

Distinguishing by content, when analyzing teacher-student interactions, is particularly relevant in the Chilean context as Chilean teachers declare to dedicate only 70% of their class time to teaching and learning (Oecd The Organization for Economic Cooperation and Development, 2019b). The remaining 30% of the time in the

classroom is devoted to administrative tasks and maintaining discipline, activities that are not always considered in teacher-student interaction studies.[5]

5.2.2. Student-level variables

- *Immigrant Origin:* A dichotomous variable indicating if the student, as well as their father and their mother, were born in Chile (0) or either the student, their father or their mother were born abroad (1). Therefore, in this study, students of immigrant origin are those who are first- or second-generation immigrants.
- *Country of origin:* A series of dummy variables indicating the student's country of origin. Countries with less than 10 students in our sample were classified as 'Other countries'. Chile was used as the baseline category.
- *Language Spoken at Home:* A dichotomous variable distinguishing if the main language spoken at the student's home is Spanish (0) or other (1).
- *Female:* A dichotomous variable that distinguishes boys (0) from girls (1). This is an important control variable as previous studies, both international and conducted in the Chilean context, have found that girls interact less frequently with their mathematics teacher (Ortega, Gelber, & Treviño, 2020; Jones & Dindia, 2004).
- *Mathematics Achievement*: The score on the standardized SEPA mathematics test, developed by the MIDE UC Assessment Center. This standardized test is based on the national curriculum, consists of 40 multiple-choice items and presents satisfactory estimates of internal consistency (Cronbach's $\alpha > 0.85$) (Manzi, García, & Godoy, 2017). Scores were standardized and centered to the class average.
- *Parents' University Education:* A dichotomous variable indicating if at least one of the student's parents/guardians attended university (1) or not (0).
- *Years at School:* The number of years since the student entered their current school, ranging from 0 to 6 years.
- *Sitting Row*: The row in which the student sat for most of the videotaped lesson, with values ranging from 1 (first row) to the total number of rows (8 at most, in this sample).

5.2.3. Classroom-level variables

- *Proportion of Immigrant Students:* Indicates the number of students with immigrant background within the classroom divided by the total number of students in the classroom. This variable was centered to the sample mean.
- *Proportion of Immigrant Students*[2]: The above variable transformed to obtain its quadratic term, to assess non-linear effects of the immigrant composition of the classroom.
- *Teacher's attitude towards diversity in the classroom:* Scale collected through a self-administered teacher questionnaire. It consists of a factor score calculated from four Likert scale items. Table A3 lists the items that compose the scale, which were answered on a four-point scale. The scale showed high internal consistency in our sample (Cronbach's $\alpha = 0.88$). The higher the score on this scale, the more negative the teacher's attitude towards diversity in the classroom is.
- *Class Size:* Indicates the number of students in the classroom.

5.3. Data collection

The study's data collection took place between March and April of 2018, at the beginning of the school year. Participant students completed a standardized mathematics test. Both students and teachers completed self-administered questionnaires.

In addition, a regular mathematics lesson conducted by each participant teacher, lasting approximately 80 min, was videotaped. These videotaped lessons were coded using the systematic observation protocol described above. The context of filming can be considered as low stakes, for both teachers and students. Participants were informed about the general focus of the study, this is, investigating teaching processes and student inclusion. However, the more specific analytical focus on teacher-immigrant student interactions was omitted to avoid introducing bias in the results and capture, to the greatest extent possible, classes and interactions that were typical of the observed classrooms.[6]

5.4. Data analysis

Teacher-student interactions were observed and coded by two professionals with teaching experience in Chilean schools, who were trained on the classroom observation protocol designed for this study. In total, 5031 teacher-student interactions were identified, of which 2187 (43.5%) were teacher-immigrant student interactions.

Out of the 38 lessons that were videotaped and analyzed in this study, a random sub-sample of 23.7% of the videos ($n_{classes} = 9$, $n_{students} = 218$) was double coded to assess inter-rater reliability. Thus, during the coding process, the level of agreement of the trained coders was monitored and meetings were held with the team to solve disagreements. The reliability between coders was assessed for the different types of interactions analyzed, using a two-way mixed consistency single-measures intra-class correlation (ICC). As shown in the Appendix (Table A2), the ICC was in ranges considered moderate to excellent (ICC = 0.53–0.82) (Koo & Li, 2016).

The data derived from the coding process resembles partial ego-networks, with a focal node, "ego" (i.e., the teacher), and the nodes to whom ego is directly connected to, "alters" (i.e., the students). Teacher-student interaction networks were depicted via sociograms, which are graphical representations of social links, using the graphical capabilities of the *igraph* package in R (Csardi & Nepusz, 2006). Fig. 1 shows the teacher-student interaction networks' sociograms for the 38 participant classes by students' country of origin.

Then, interaction data were aggregated at the student level to depict individual students' frequencies of interactions with the teacher. As shown in Fig. 2, the inclusion of immigrant students can vary by the initiator and content of the interactions considered. Therefore, the following seven types of interactions were modeled separately:

[5] Classroom interaction instruments usually distinguish by, and focus on, either contents of interactions (e.g., the Brophy-Good Teacher-Child Dyadic Interaction System; Good & Brophy, 1970) or teacher affect in interactions (e.g., the Student-Teacher Relationship Scale (STRS); Pianta, 1992). In this study, we chose the former approach. This, mainly because, at a piloting stage, our instrument was not able to capture variation among interactions on the dimensions of teacher affect and teacher validation. This is in line with previous studies of classroom interactions using the CLASS observation protocol in Chilean classrooms, which have shown that primary school teachers maintain stable, and generally neutral, interactions with students (Treviño, Varas, Godoy, & Martínez, 2016; Treviño, Varela, Rodríguez, & Straub, 2019).

[6] Before the study was conducted, it was approved by the research ethics committee at Pontificia Universidad Católica de Chile, which operates in accordance with international standards.

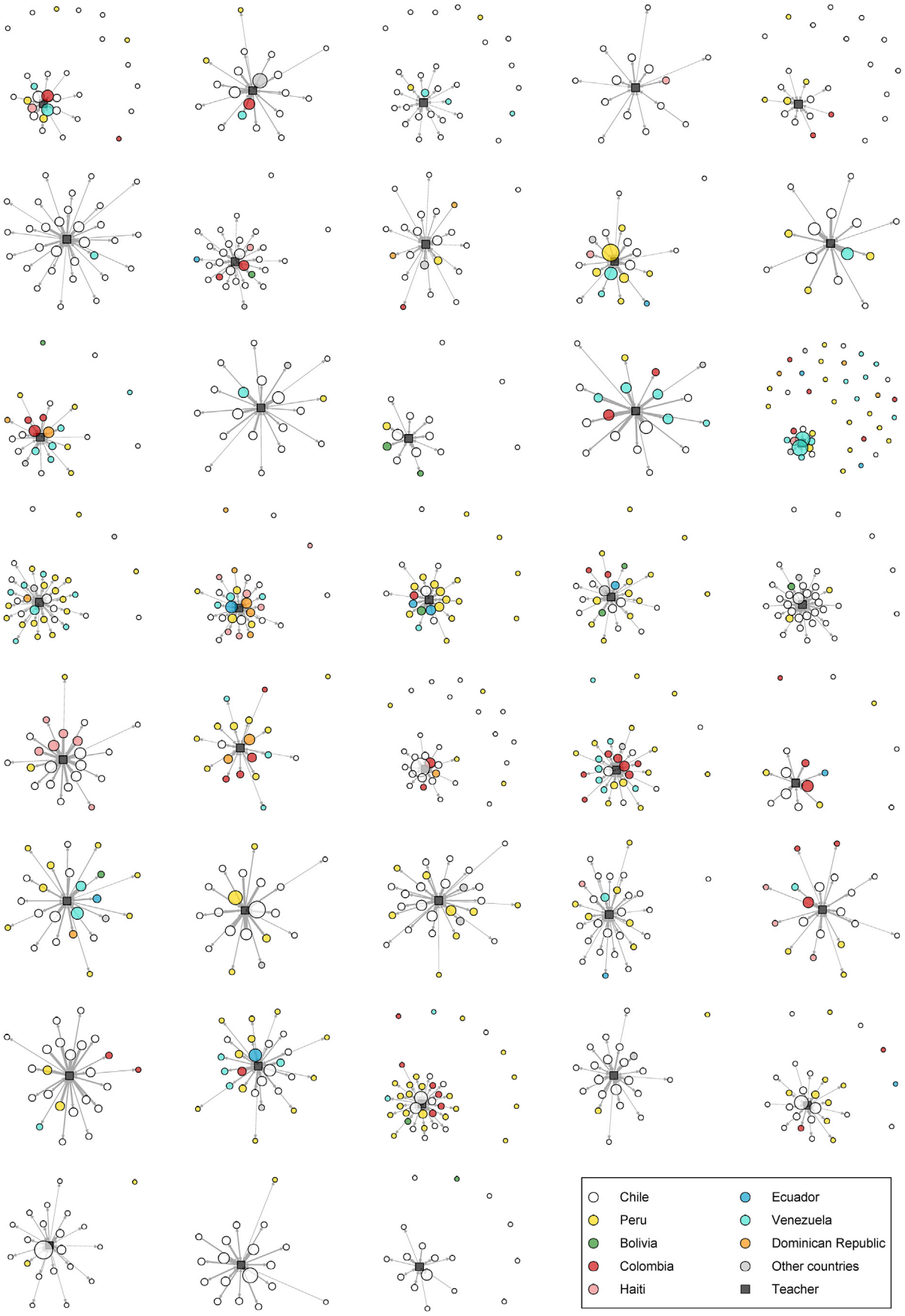

Fig. 1. Teacher-student interaction networks in participant classes by students' country of origin (node size and arrow width weighted by degree centrality of the student).

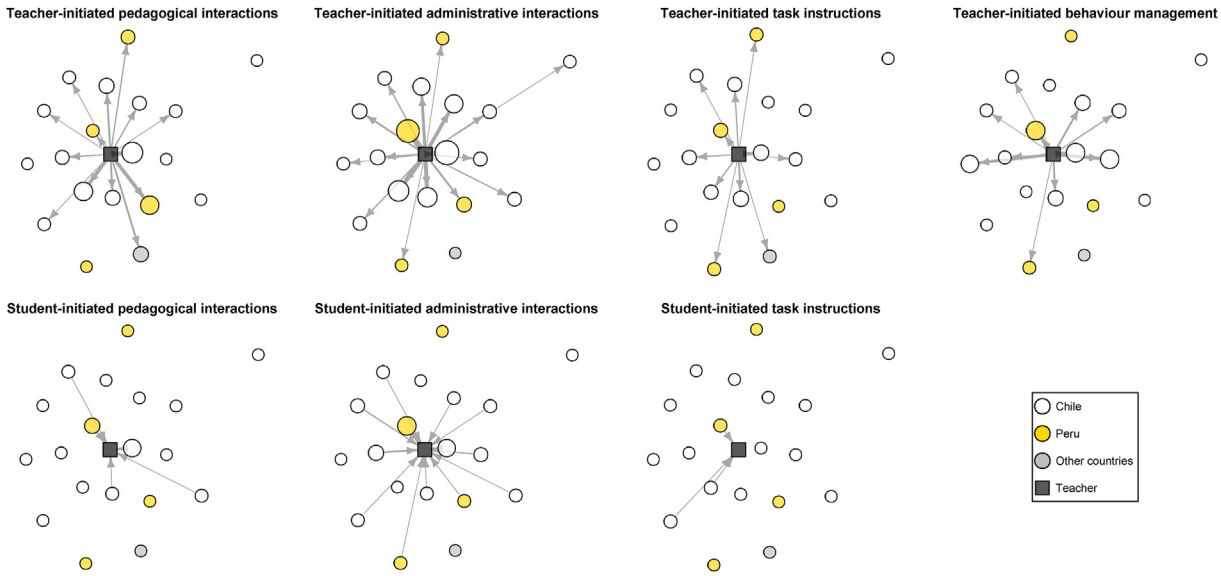

Fig. 2. Teacher- and student-initiated interaction networks by interaction content and by students' country of origin in 1 of the participant classes (node size and arrow width weighted by in- and out-degree centrality of the student, respectively).

- Teacher-initiated interactions: Pedagogical, Administrative, Task Instructions, and, Behavior Management.
- Student-initiated interactions: Pedagogical, Administrative, and Task Instructions.[7]

Given the non-parametric distribution of frequencies of interactions, and the hierarchical structure of the data, a multilevel approach (students nested within classrooms) was applied using a random intercept Poisson model with robust standard errors.[8] In Model 1, only the fixed effect of the variable *Immigrant Origin* was included. Thus, as shown in Equation (1), the expected number of interactions with the teacher y_{ij} for student i in classroom j was specified as a log-linear model and a random classroom-level intercept u_{1j} was included.

$$\ln(y_{ij}) = \beta_1 + \beta_2 \text{ImmigrantOrigin}_{2ij} + u_{1j} \quad (1)$$

In this model, it is assumed that u_{1j} and the co-variable are independent, that u_{1j} are independent across the classrooms j, that the distribution of the random intercept is Gaussian and of variance $\sigma^2_{\mu 1}$, and that the conditional distribution of the dependent variable, given the random effect, is Poisson.

In Model 2, shown in Equation (2), the fixed effects of most of the student-level variables listed in Section 5.2.2, except for the effects for country of origin, were included. This, to assess whether any significant effect of the variable *Immigrant* persisted or appeared after controlling for relevant student-level variables.

$$\ln(y_{ij}) = \beta_1 + \beta_2 \text{ImmigrantOrigin}_{2ij} + \beta_3 \text{LanguageSpokenatHome}_{3ij} + \beta_4 \text{MathAchievement}_{4ij} + \beta_5 \text{Female}_{5ij} + \beta_6 \text{Parents'University Education}_{6ij} + \beta_7 \text{YearsinSchool}_{7ij} + \beta_8 \text{SittingRow}_{8ij} + u_{1j} \quad (2)$$

Then, in Model 3, we assess if there are significant differences by students' country of origin:

$$\ln(y_{ij}) = \beta_1 + \beta_2 \text{LanguageSpokenatHome}_{2ij} + \beta_3 \text{MathAchievement}_{3ij} + \beta_4 \text{Female}_{4ij} + \beta_5 \text{Parents'UniversityEducation}_{5ij} + \beta_6 \text{YearsinSchool}_{6ij} + \beta_7 \text{SittingRow}_{7ij} + \beta_8 \text{Peru}_{8ij} + \beta_9 \text{Bolivia}_{9ij} + \beta_{10} \text{Colombia}_{10ij} + \beta_{11} \text{Haiti}_{11ij} + \beta_{12} \text{Ecuador}_{12ij} + \beta_{13} \text{Venezuela}_{13ij} + \beta_{14} \text{DominicanRepublic}_{14ij} + \beta_{15} \text{OtherCountries}_{15ij} + u_{1j} \quad (3)$$

In a fourth model, the classroom-level variation on the effect of the student's immigrant background was explored. This is, we analyzed whether some classrooms were significantly more inclusive of immigrant students than others. For this, the goodness of fit of the random intercept model (Model 2), which assumes that the student immigrant-background effect on the frequency of interactions with the teacher is the same for all classrooms, was compared with that of a random slope model, which represents the differential effect of student immigrant background across classrooms (Model 4). Thus, in Model 4, a random coefficient was introduced for the variable *Immigrant Origin* at the classroom level u_{2j}:

$$\ln(y_{ij}) = \beta_1 + \beta_2 \text{ImmigrantOrigin}_{2ij} + \beta_3 \text{LanguageSpokenatHome}_{3ij} + \beta_4 \text{MathAchievement}_{4ij} + \beta_5 \text{Female}_{5ij} + \beta_6 \text{Parents'UniversityEducation}_{6ij} + \beta_7 \text{YearsinSchool}_{7ij} + \beta_8 \text{SittingRow}_{8ij} + u_{1j} + u_{2j} \text{Immigrant Origin}_{2ij} \quad (4)$$

This specification allows the immigrant background effect $\beta_2 + u_{2j}$ to vary across classrooms j. It was assumed that, given the covariates entered, the intercept and random coefficient have a normal bivariate distribution with zero mean and the following covariance matrix:

$$\begin{bmatrix} \sigma^2_{\mu 11} & \sigma^2_{\mu 12} \\ \sigma^2_{\mu 21} & \sigma^2_{\mu 22} \end{bmatrix}, \quad \sigma_{21} = \sigma_{12}$$

Finally, in Model 5, we evaluate to what extent this variation is explained by the classroom-level variables listed in Section 5.2.3, by

[7] Student-initiated Behavior Management interactions were extremely rare and, therefore, not considered in these analyses.

[8] Including a random intercept and using the sandwich estimator for the standard errors can, at least to some degree, address the common problem of over-dispersion in count data (Rabe-Hesketh & Skrondal, 2008).

adding the fixed effects of these variables[9] and the cross-level interactions between them and the variable *Immigrant*:

$$\ln(y_{ij}) = \beta_1 + \beta_2 \text{ImmigrantOrigin}_{2ij} + \beta_3 \text{LanguageSpokenatHome}_{3ij} + \beta_4 \text{MathAchievement}_{4ij} + \beta_5 \text{Female}_{5ij} + \beta_6 \text{Parents'UniversityEducation}_{6ij} + \beta_7 \text{YearsinSchool}_{7ij} + \beta_8 \text{SittingRow}_{8ij} + \beta_9 \text{ProportionImmigrants}_{9j} + \beta_{10} \text{ProportionImmigrants}^2_{10j} + \beta_{11} \text{TeacherattitudeDiversity}_{11j} + \beta_{12} \text{Immigrant}_{2ij} \text{XProportionImmigrants}_{9j} + \beta_{13} \text{Immigrant}_{2ij} \text{XProportionImmigrants}^2_{10j} + \beta_{14} \text{Immigrant}_{2ij} \text{XTeacherattitudeDiversity}_{11j} + \beta_{15} \text{ClassSize}_{15j} + u_{1j} + u_{2j} \text{ImmigrantOrigin}_{2ij} \quad (5)$$

The models were fitted via the *gllamm* command in Stata, using additional options to obtain exponentiated regression coefficients and robust standard errors (Rabe-Hesketh & Skrondal, 2008). The goodness of fit of these nested models were compared using likelihood-ratio tests.

In sum, the three methods applied in this study (i.e., systematic classroom observation, descriptive social network analysis and multilevel modeling) are different components of a research strategy that combines them to identify, depict and model teacher-student interactions. Thus, these methods complement each other to provide detailed and robust evidence on classroom interactions and their predictors.

6. Results

6.1. Differences in frequency of interactions with teachers by student immigrant origin

In Fig. 3, teacher-student interaction networks for a random sub-sample of 19 classrooms, out of the 38 participant classrooms, are depicted considering separately teacher-initiated and student-initiated interactions.[10] In these sociograms, teachers are the central grey squared node, students of immigrant origin are depicted in orange color and non-immigrant students are shown in white. The size of each student node and the width of the arrows indicating the directionality of the interactions are based on the number of interactions between the teacher and the given student.

Fig. 3 shows that, in some of the networks, immigrant students are more peripheral to their teacher-student interaction networks than their peers. However, to tell if this difference corresponds to a systematic trend, it is necessary to conduct statistical tests.

In what follows, the results from descriptive analyses and multilevel Poisson regression models, for each type of interaction, are presented. These are reported in separate sections by type of initiator of the interaction.

6.1.1. Teacher-initiated interactions

As shown in Table 2, when comparing the average frequency of total teacher-initiated interactions, immigrant students were found to be significantly less central to their class' teacher-student interaction networks than their non-immigrant peers, with an average of 0.42 fewer interactions ($U = 97{,}343$, $p < .05$). Interestingly, when analyzing differences by *Language Spoken at Home,* we can see that, overall, teachers initiate significantly more interactions with students who report languages other than Spanish as their predominant language at home ($U = 12{,}607$, $p < .05$).

Then, when looking specifically at *Country of Origin,* we observe that, overall, teachers tend to initiate significantly more interactions with students from Chile than with students from Peru ($U = 43{,}980$, $p < .01$) or Colombia ($U = 10{,}871$, $p < .05$). Conversely, teachers initiate significantly more interactions with students from Haiti than with students from Chile ($U = 3{,}843$, $p < .05$).

We now focus on the results of the multilevel Poisson regression models for teacher-initiated interactions, presented in Tables 4 and 5. Models 1 and 2 evaluate Hypothesis 1a. This is, if students with a migrant background are more peripheral, in terms of interactions with their teacher, than their non-migrant peers. The results of Model 1, for each type of interaction, show that, after the dependencies in the data (given its nested structure) are considered, there are no statistically significant differences in the average number of teacher-initiated interactions by student immigrant background. Furthermore, after we control for individual characteristics, in Model 2, student immigrant background remains as a non-significant predictor of teacher-initiated interactions.[11] Thus, there is no evidence to support Hypothesis 1a, in the case of teacher-initiated interactions.

However, when we introduce the country of origin dummy variables to evaluate the Hypothesis 1 b, in Model 3, and control for the other variables in the model, interesting patterns appear. In particular, we observe that Peruvian students are significantly less frequently included in the teacher-initiated interactions assessed, with 27% fewer behavior-management interactions ($p < .05$), 16% fewer administrative interactions ($p < .10$), 46% fewer task-instruction interactions ($p < .05$) and 29% fewer pedagogical interactions ($p < .05$) than their non-immigrant peers. Haitian students, in turn, are approached by their teacher 89% more frequently in administrative interactions than their non-immigrant peers ($p < .01$). Similarly, Ecuadorian students are approached by their teacher 114% more frequently in administrative interactions ($p < .05$), and 406% more frequently in task-instruction interactions ($p < .001$). Finally, students from Venezuela show 36% fewer teacher-initiated behavior-management interactions ($p < .10$) and 54% more pedagogical interactions ($p < .05$) than their non-immigrant peers. Furthermore, model fit improves significantly with the addition of Country of Origin dummy variables, in comparison to Model 2, for all the teacher-initiated interactions analyzed. Thus, we can confirm Hypothesis 1b, when analyzing teacher-initiated interactions; students differ significantly in their centrality, based on their country of origin.

6.1.2. Student-initiated interactions

As shown in Table 3, the average frequency of total student-initiated interactions does not vary by student immigrant background. However, when looking specifically at *Country of Origin,* we find that, on average, students from Chile tend to initiate 0.78 more interactions with their mathematics teacher that students from Peru ($U = 46{,}472$, $p < .05$). On the other hand, students from

[9] The correlations between these classroom-level variables do not suggest problems of collinearity (see Table A4 in the Appendix).

[10] A random sub-sample of classrooms is depicted in Fig. 3 to allow a clearer and detailed visualization, while still providing a representative image of the network configurations in the study.

[11] As shown in the results for Model 2, applied to teacher-initiated interactions, in Tables 4 and 5, other student-level factors positively associated with more frequent pedagogical teacher-initiated interactions are speaking a language other than Spanish at home ($p < .10$), being male ($p < .05$) and having at least one parent with university studies ($p < .05$). Student-level factors positively associated with more frequent teacher-initiated behavior-management interactions are having a lower mathematics achievement level within the class ($p < .10$), being male ($p < .001$), having at least one parent with university studies ($p < .001$) and sitting in rows closer to the front of the classroom ($p < .01$). In administrative teacher-initiated interactions, the only significant student-level predictors found was sitting in rows closer to the front of the classroom ($p < .01$). Finally, significant predictors of more frequent teacher-initiated task-instruction interactions with the teacher are being male ($p < .10$) and sitting in rows closer to the front of the classroom ($p < .10$).

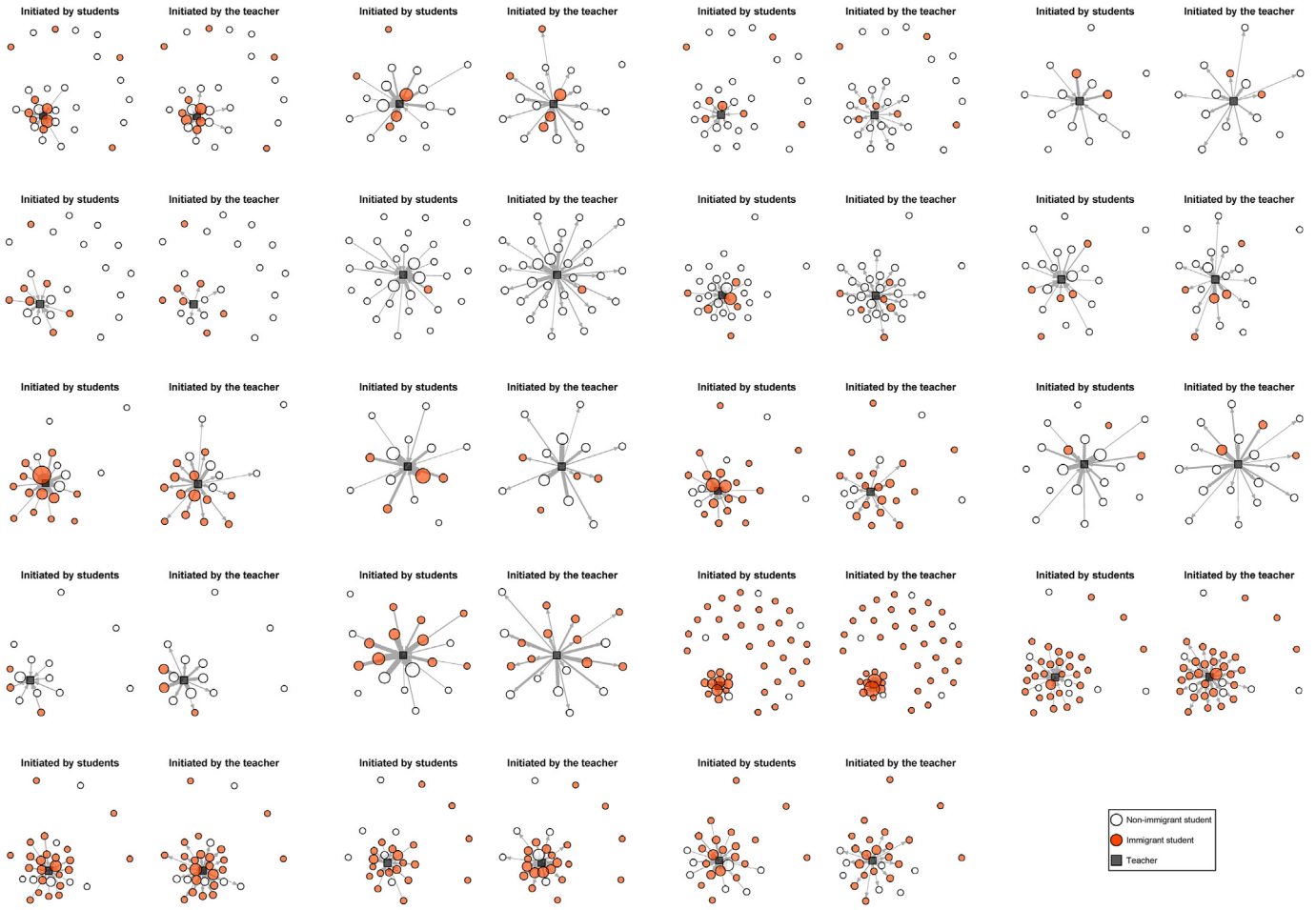

Fig. 3. Teacher- and student-initiated interaction networks in 19 of the participant classes by students' immigrant background (node size and arrow width weighted by in- and out-degree centrality of the student, respectively).

Colombia initiate, on average, 1.85 more interactions in with the teacher than students from Chile ($U = 10{,}662$, $p < .05$), as well as students from Venezuela, who initiate, on average, 1.61 more interactions in with the teacher than students from Chile ($U = 13{,}265$, $p < .01$).

The results of Model 1 in Tables 6 and 7, for student-initiated interactions, show that immigrant origin predicts 29% more pedagogical interactions ($p < .05$), but is not associated with differential administrative or task-instructions student-initiated interactions. The significant effect of immigrant origin for student-initiated pedagogical interactions disappears after controlling for the individual-level variables in Model 2. Thus, we cannot confirm Hypothesis 1a in the case of student-initiated interactions.[12]

Model 3 evaluates Hypothesis 1 b that looks for differences by students' country of origin, while still controlling for relevant student-level variables. As shown in Table 6, the results coincide with those for teacher-initiated interactions, as they indicate that Peruvian students are more peripheral in all the student-initiated interactions studied. This is, they are significantly less likely to approach the teacher, with 38% fewer administrative interactions ($p < .10$), 61% fewer task-instruction interactions ($p < .01$) and 23% fewer pedagogical interactions ($p < .10$) initiated by them than by their non-immigrant peers. Also, while Colombian students show 136% more student-initiated task-instruction interactions than non-immigrant students ($p < .05$), the opposite is true for Haitian students, who show 44% fewer student-initiated task-instruction interactions than students from Chile ($p < .001$). With regard to student-initiated pedagogical interactions, students from Colombia, Venezuela and Dominican Republic approach the teacher significantly more frequently, with 143% ($p < .001$), 110% ($p < .01$) and 68% ($p < .10$) more interactions, respectively, that their non-immigrant peers. Finally, Model 3 fits the data significantly better than Model 2 for the three student-initiated interactions analyzed, indicating that students' country of origin is a relevant predictor of frequency of interactions with the teacher. Therefore, we can also confirm Hypothesis 1b for student-initiated interactions.

[12] As shown in the results for Model 2, applied to student-initiated interactions, in Tables 6 and 7, other student-level factors positively associated with more frequent student-initiated pedagogical interactions with the teacher are having a higher mathematics achievement level within the class ($p < .001$) and sitting in rows closer to the front of the classroom ($p < .001$). In student-initiated administrative interactions with the teacher, significant student-level predictors are having at least one parent with university studies ($p < .10$), being newer to the school ($p < .10$) and sitting in rows closer to the front of the classroom ($p < .001$). Finally, significant predictors of more frequent student-initiated task-instruction interactions with the teacher are having a higher mathematics achievement level within the class ($p < .10$), being male ($p < .01$) and sitting in rows closer to the front of the classroom ($p < .001$).

Table 4
Results from multilevel Poisson models for teacher-initiated behavior management and administrative interactions ($n_{classes} = 38$; $n_{students} = 933$).

	Behavior Management Interactions					Administrative Interactions				
	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)
FIXED EFFECTS										
Intercept	.529 (.094)***	.939 (.304)	.995 (322)	1.008 (.334)	.717 (.565)	.807 (.128)	1.060 (.225)	.992 (.216)	.971 (.244)	1.117 (.635)
Student-Level Variables										
Immigrant	.858 (.098)	.835 (.098)		.721 (.116)*	.732 (.153)	1.046 (.101)	1.022 (.094)		1.151 (.178)	1.346 (.295)
Language Spoken at Home		1.257 (.250)	1.188 (.314)	1.172 (.266)	1.157 (.279)		1.292 (.309)	.970 (.226)	1.242 (.294)	1.241 (.294)
Math Achievement		.901 (.054)†	.902 (.055)†	.905 (.053)†	.902 (.054)†		1.015 (.047)	1.026 (.049)	1.014 (.048)	1.013 (.048)
Female		.494 (.081)***	.501 (.084)***	.491 (.081)***	.490 (.080)***		.882 (.085)	.910 (.081)	.891 (.088)	.891 (.088)
Parents' University Education		1.173 (.026)***	1.193 (.028)***	1.163 (.027)***	1.173 (.034)***		1.072 (.056)	1.060 (.059)	1.067 (.054)	1.071 (.054)
Years in the School		1.009 (.036)	.997 (.036)	1.007 (.035)	1.008 (.036)		1.001 (.019)	1.011 (.020)	1.002 (.020)	1.002 (.020)
Sitting Row		.885 (.037)**	.881 (.037)**	.885 (.037)**	.884 (.038)**		.926 (.027)**	.928 (.029)*	.928 (.027)*	.927 (.027)**
Peru			.727 (.114)*					.841 (.088)†		
Bolivia			1.410 (.357)					1.170 (.354)		
Colombia			.693 (.187)					1.001 (.163)		
Haiti			.719 (.310)					1.890 (.387)**		
Ecuador			1.843 (.924)					2.143 (.735)*		
Venezuela			.638 (.151)†					1.282 (.347)		
Dominican Republic			.710 (.573)					1.395 (.359)		
Other Country			1.541 (.384)†					1.165 (.422)		
Classroom-Level Variables										
Proportion of Immigrant Students					.629 (.410)					.547 (.352)
Proportion of Immigrant Students^2					.273 (.746)					20.010 (51.333)
Immigrant X Proportion of Immigrant Students					1.674 (.966)					1.186 (.668)
Immigrant X Proportion of Immigrant Students^2					.503 (1.207)					.100 (.207)
Teacher Attitude Diversity					.998 (.152)					1.060 (.129)
Immigrant X Teacher Attitude Diversity					.962 (.104)					.889 (.097)
Class Size					1.016 (.029)					.986 (.018)
RANDOM EFFECTS										
Variance (Intercept)	.882 (.282)	.884 (.276)	.876 (.270)	.742 (.227)	.735 (.227)	.629 (.185)	.646 (.185)	.662 (.189)	.859 (.321)	.785 (.288)
Variance (Immigrant)				.044 (.056)	.051 (.062)				.130 (.124)	.089 (.105)
CORR (Intercept, Immigrant)				.420	.441				-.714*	-.759*
Log likelihood	−1149.40	−1096.82	−1086.30	−1095.42	−1094.30	−1260.84	−1249.53	−1236.68	−1247.08	−1244.94
LR chi^2	–	105.16***	21.03**	2.81	2.23	–	22.61***	25.71**	4.91†	4.28

Notes: IR: Incidence Ratio. SE: Standard Error. CORR: Correlation. †$p < .10$: *$p < .05$; **$p < .01$; ***$p < .001$.

6.2. Variation in the inclusion of immigrant students across classrooms

Hypothesis 2 states that there is significant variation in the effect of student immigrant background, on the frequency of interactions with the teacher, across classrooms. Fig. 3 provides a first indication of variation across class groups in this regard. We formally tested the significance of classroom-level variation by comparing the fit of Models 2 and 4. This is, we compare the fit of the random intercept only Poisson model with that of the random coefficient (for the *Immigrant* variable) Poisson model.

As shown in Tables 4 and 5, when considering teacher-initiated interactions, Model 4 fits the data significantly better than Model 2 only in administrative and pedagogical interactions (χ^2 (1) = 4.91, $p < .10$ and χ^2 (1) = 19.72, $p < .001$, respectively). In the case of student-initiated interactions, Model 4 fits the data significantly better than Model 2 in all the types of interactions analyzed; this is, administrative (χ^2 (1) = 14.18, $p < .001$), task-instruction (χ^2 (1) = 7.50, $p < .05$) and pedagogical (χ^2 (1) = 19.85, $p < .001$) interactions (see Tables 6 and 7). Thus, we find evidence to support Hypothesis 2; some classrooms are significantly more inclusive of immigrant students than others, particularly in terms of student-initiated interactions and teacher-initiated administrative and pedagogical interactions.

Table 5
Results from multilevel Poisson models for teacher-initiated task instruction and pedagogical interactions ($n_{classes} = 38$; $n_{students} = 933$).

	Task Instruction Interactions					Pedagogical Interactions				
	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)
FIXED EFFECTS										
Intercept	.089 (.020)***	.154 (.063)***	.132 (.062)***	.147 (.066)***	.307 (.259)	.843 (.131)	.970 (.176)	.840 (.152)	.881 (.176)	1.832 (.873)
Student-Level Variables										
Immigrant	.949 (.229)	.920 (.229)		.809 (.355)	.383 (.278)	.945 (.121)	.891 (.107)		1.006 (.136)	1.080 (.212)
Language Spoken at Home		.913 (.655)	.616 (.342)	.952 (.664)	1.044 (.569)		1.437 (.272)†	1.329 (.236)	1.486 (.290)*	1.500 (.306)*
Math Achievement		.942 (.085)	.943 (.091)	.939 (.087)	.942 (.091)		1.059 (.044)	1.058 (.044)	1.068 (.043)	1.065 (.044)
Female		.716 (.140)†	.770 (.161)	.724 (.107)	.727 (.141)		.754 (.089)*	.775 (.089)*	.762 (.091)*	.757 (.090)*
Parents' University Education		1.070 (.132)	1.090 (.129)	1.080 (.139)	1.099 (.169)		1.148 (.063)*	1.142 (.051)**	1.150 (.067)*	1.158 (.068)*
Years in the School		.999 (.043)	1.023 (.050)	.995 (.043)	.997 (.042)		.992 (.017)	1.012 (.017)	.988 (.017)	.987 (.017)
Sitting Row		.878 (.058)†	.878 (.061)†	.882 (.060)†	.893 (.054)†		.991 (.030)	.994 (.030)	.996 (.030)	.997 (.030)
Peru			.541 (.154)*					.711 (.105)*		
Bolivia			1.333 (1.174)					1.101 (.254)		
Colombia			.864 (.436)					1.014 (.273)		
Haiti			1.031 (.639)					1.047 (.233)		
Ecuador			5.058 (2.115)***					1.558 (.437)		
Venezuela			1.798 (.899)					1.536 (.276)*		
Dominican Republic			1.087 (1.073)					1.416 (.420)		
Other Country			1.086 (.544)					1.130 (.333)		
Classroom-Level Variables										
Proportion of Immigrant Students					.748 (.732)					1.636 (.834)
Proportion of Immigrant Students^2					.001 (.003)†					.948 (2.375)
Immigrant X Proportion of Immigrant Students					3.020 (4.087)					1.623 (1.078)
Immigrant X Proportion of Immigrant Students^2					125,044.6 (749,059.8)*					.193 (.501)
Teacher Attitude Diversity					1.374 (.328)					1.400 (.183)*
Immigrant X Teacher Attitude Diversity					.935 (.291)					.790 (.094)†
Class Size					.983 (.032)					.970 (.017)†
RANDOM EFFECTS										
Variance (Intercept)	.854 (.352)	.882 (.355)	.904 (.376)	.897 (.387)	.609 (.305)	.603 (.147)	.575 (.144)	.577 (.141)	.818 (.226)	.595 (.231)
Variance (Immigrant)				.716 (.867)	.063 (.152)				.302 (.140)	.250 (.104)
CORR (Intercept, Immigrant)				-.253	-.130				-.657*	-.594*
Log likelihood	−355.57	−351.40	−340.09	−350.57	−344.76	−1285.44	−1286.74	−1268.96	−1276.89	−1271.04
LR chi^2	–	8.34	22.62**	1.66	11.61	–	38.35***	35.56***	19.72***	11.68

Notes: IR: Incidence Ratio. SE: Standard Error. CORR: Correlation. †$p < .10$: *$p < .05$; **$p < .01$; ***$p < .001$.

6.3. Predictors of the variation in the inclusion of immigrant students across classrooms

Hypothesis 3 states that the classroom-level variation on the effect of student immigrant background is partially explained by the immigrant composition of the classroom and the teacher's attitude towards diversity in the classroom.

As shown in Table 5, when considering teacher-initiated task-instructions interactions, a significant positive interaction effect between student *Immigrant Origin* and *Proportion of Immigrant Students*^{2} was found ($p < .05$). This suggests that there is quadratic (U-shaped) dependence of the number of teacher-initiated task-instructions interactions for an immigrant child on the proportion of migrants in the classroom. In this case, an immigrant student is approached more frequently by the teacher in task-instructions interactions when the proportion of immigrant students in the classroom is low and high, as opposed to medium.

Also, when considering pedagogical teacher-initiated interactions, we find a significant interaction effect between student *Immigrant Origin* and *Teacher's Attitude towards Diversity in the*

Table 6
Results from multilevel Poisson models for student-initiated administrative and task-instruction interactions ($n_{classes} = 38$; $n_{students} = 933$).

	Administrative Interactions					Task-Instruction Interactions				
	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)	IR (SE)
FIXED EFFECTS										
Intercept	.689 (.079)**	1.906 (.524)*	1.832 (.511)*	1.905 (.528)*	2.750 (1.035)*	.088 (.021)***	.326 (.143)*	.315 (.127)**	.392 (.153)*	.532 (.391)
Student-Level Variables										
Immigrant	.932 (.150)	.801 (.116)		.779 (.113)†	.989 (.189)	1.071 (.311)	1.114 (.396)		.662 (.237)	1.010 (.472)
Language Spoken at Home		1.084 (.309)	1.130 (.348)	.996 (.299)	.968 (.218)		.932 (.741)	1.484 (.915)	1.002 (.830)	.967 (.820)
Math Achievement		1.068 (.060)	1.063 (.060)	1.066 (.060)	1.065 (.042)		1.237 (.140)†	1.207 (.132)†	1.225 (.142)†	1.216 (.144)†
Female		.882 (.163)	.895 (.159)	.875 (.161)	.874 (.073)		.444 (.122)**	.495 (.120)**	.439 (.122)**	.436 (.120)**
Parents' University Education		1.083 (.045)†	1.085 (.042)*	1.083 (.047)†	1.083 (.042)*		.659 (.198)	.640 (.179)	.614 (.218)	.614 (.218)
Years in the School		.931 (.034)†	.937 (.035)†	.930 (.035)†	.929 (.035)†		.994 (.061)	1.018 (.060)	.994 (.060)	.992 (.062)
Sitting Row		.801 (.036)***	.800 (.036)***	.805 (.036)***	.807 (.021)***		.729 (.049)***	.733 (.047)***	.728 (.050)***	.726 (.050)***
Peru			.617 (.161)†					.386 (.107)**		
Bolivia			.843 (.209)					.664 (.761)		
Colombia			1.144 (.265)					2.362 (.852)*		
Haiti			.555 (.232)					.463 (.128)***		
Ecuador			1.050 (.697)					1.919 (1.111)		
Venezuela			.956 (.302)					1.761 (.995)		
Dominican Republic			1.405 (.456)					1.056 (.822)		
Other Country			1.079 (.433)					.540 (.460)		
Classroom-Level Variables										
Proportion of Immigrant Students					.863 (.387)					1.029 (.844)
Proportion of Immigrant Students^2					1.262 (2.527)					30.275 (90.086)
Immigrant X Proportion of Immigrant Students					.873 (.512)					3.717 (4.666)
Immigrant X Proportion of Immigrant Students^2					.063 (.152)					.001 (.003)
Teacher Attitude Diversity					.983 (.100)					1.098 (.233)
Immigrant X Teacher Attitude Diversity					1.138 (.129)					1.019 (.338)
Class Size					.988 (.015)					.979 (.029)
RANDOM EFFECTS										
Variance (Intercept)	.312 (.074)	.290 (.071)	.304 (.073)	.282 (.082)	.274 (.093)	.918 (.315)	1.077 (.426)	.893 (.281)	.665 (.291)	.622 (.277)
Variance (Immigrant)				.316 (.156)	.206 (.121)				.714 (.547)	.621 (.512)
CORR (Intercept, Immigrant)				-.275	-.441				.474	.388
Log likelihood	−1233.98	−1175.12	−1165.57	−1169.03	−1165.03	−380.81	−354.04	−339.31	−350.29	−348.93
LR chi^2	–	115.72***	21.10**	14.18***	8.00	–	53.54***	29.46***	7.50*	2.72

Notes: IR: Incidence Ratio. SE: Standard Error. CORR: Correlation. †$p < .10$: *$p < .05$; **$p < .01$; ***$p < .001$.

Classroom ($p < .10$), indicating that teachers with more negative attitudes towards diversity in the classroom approach immigrant students less frequently for pedagogical purposes than teachers who report more positive attitudes towards diversity. However, when we consider behavior management and administrative teacher-initiated interactions, none of the interaction effects between student immigrant origin and the classroom-level variables are statistically significant (see Table 4). Furthermore, the inclusion of the classroom-level variables and cross-level interaction effects does not significantly improve model fit for any of the teacher-initiated interactions studied.

The results of Model 5 for student-initiated interactions, in Tables 6 and 7, show that none of the cross-level interactions are statistically significant after controlling for the rest of the variables in the model. Also, Model 5 does not fit the data better than Model 4 in any of the student-initiated interactions analyzed. Thus, we find little support for Hypothesis 3.

7. Discussion

This study investigated the inclusion of immigrant students in 38 classrooms in Chilean public schools, following a relational approach that consisted in analyzing the relative centrality of immigrant students in teacher-student interaction networks. Overall, immigrant background was not a significant predictor of frequency of teacher-student interactions. However, our detailed analysis suggests that the situation of immigrant students depends heavily on their country of origin.

Table 7
Results from multilevel Poisson models for student-initiated pedagogical interactions ($n_{classes} = 38$; $n_{students} = 933$).

	Pedagogical Interactions				
	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
	IR (SE)	**IR (SE)**	**IR (SE)**	**IR (SE)**	**IR (SE)**
FIXED EFFECTS					
Intercept	1.149 (.128)	2.190 (.402)***	1.863 (.360)**	2.163 (.415)***	4.317 (2.151)**
Student-Level Variables					
Immigrant	1.294 (.138)*	1.177 (.130)		1.057 (.140)	.958 (.208)
Language Spoken at Home		1.212 (.293)	1.440 (.392)	1.169 (.286)	1.181 (.293)
Math Achievement		1.293 (.080)***	1.304 (.085)***	1.300 (.082)***	1.299 (.082)***
Female		.930 (.106)	.958 (.114)	.932 (.105)	.924 (.103)
Parents' University Education		1.003 (.048)	.975 (.054)	1.013 (.050)	1.012 (.049)
Years in the School		.974 (.027)	1.003 (.027)	.975 (.028)	.974 (.028)
Sitting Row		.848 (.036)***	.854 (.036)***	.854 (.036)***	.856 (.036)***
Peru			.768 (.118)†		
Bolivia			.702 (.260)		
Colombia			2.429 (.522)***		
Haiti			.817 (.366)		
Ecuador			.754 (.294)		
Venezuela			2.097 (.517)**		
Dominican Republic			1.676 (.453)†		
Other Country			1.108 (.385)		
Classroom-Level Variables					
Proportion of Immigrant Students					1.021 (.465)
Proportion of Immigrant Students^2					2.089 (5.056)
Immigrant X Proportion of Immigrant Students					1.434 (.736)
Immigrant X Proportion of Immigrant Students^2					3.848 (10.157)
Teacher Attitude Diversity					1.109 (.125)
Immigrant X Teacher Attitude Diversity					1.119 (.186)
Class Size					.970 (.019)
RANDOM EFFECTS					
Variance (Intercept)	.425 (.096)	.395 (.084)	.382 (.081)	.359 (.086)	.308 (.073)
Variance (Immigrant)				.234 (.111)	.239 (.105)
CORR (Intercept, Immigrant)				-.031	-.040
Log likelihood	−1918.72	−1825.38	−1758.15	−1815.45	−1810.85
LR chi^2	–	186.69***	134.46***	19.85***	9.20

Notes: IR: Incidence Ratio. SE: Standard Error. CORR: Correlation. †$p < .10$: *$p < .05$; **$p < .01$; ***$p < .001$.

Students from Peru were consistently more peripheral to their teacher-student networks than their non-immigrant peers across all of the interactions assessed. This is in line with previous Chilean studies suggesting that Peruvian students are perceived as lower status immigrants and are discriminated against on the basis of their phenotype, skin color and way of speaking (Mondaca et al., 2018; Pavez, 2012). On the other hand, students from Caribbean countries (i.e., Venezuela, Colombia and Dominican Republic) are particularly active when it comes to initiating pedagogical interactions with their mathematics teacher. Students from Venezuela are also more frequently addressed by the teacher in pedagogical interactions and less frequently addressed in behavior-management interactions. Finally, students from Haiti and Ecuador are more frequently approached by their teacher than their non-immigrant peers, but only in administrative or task-instruction interactions. A possible explanation for the differential inclusion of immigrant students by country of origin, found in the literature, is that, as immigration grows in numbers and diversity, immigrant students are compared against each other and are perceived differently by the school community (Cerón et al., 2017). These findings are in line with previous international research highlighting that the relationship with teachers varies across student racial/ethnic groups (Cherng, 2017; Ladd et al., 1999; Peguero & Bondy, 2011).

In addition, we identified significant variation, at the classroom level, in the effect of student immigrant-background on the frequency of interactions with the teacher, for five of the seven types of interactions investigated. These include both teacher- and student-initiated pedagogical interactions, with some classrooms being significantly more inclusive of immigrant students than others. This variation was not consistently explained by the immigrant composition of the classroom, as expected from the literature. However, we explored the effect of teachers' attitudes towards diversity in the classroom and found that teachers with more negative attitudes approached immigrant students significantly less frequently for pedagogical purposes.

Educational inclusion of students with immigrant background is essential for providing them with equal opportunities in the education system. The results presented contribute to a broader, social and relational, understanding of educational inclusion (Loreman, 2009; 2014). Together with ensuring access to, and participation in, formal education, it is important to look at relational mechanisms to achieve equality within educational systems. As shown in this study, members of some immigrant groups seem to be relatively excluded from student-teacher interaction networks, which can be important for several educational outcomes. This most likely contributes to qualitative differences in students' educational experiences between groups, reinforcing existing social disadvantages (Bourdieu, 1974; Lucas, 2001).

8. Conclusions

Worldwide, increased diversity in student population is becoming an enormous challenge for teachers, schools and education systems. Recent influxes of immigration in different regions of the world are putting pressure on both school systems and research communities to better understand how to pedagogically deal with this diversity in effective and inclusive ways. Ensuring

access to quality education, regardless of student immigrant background, is extremely important to promote inclusion in education systems. This study proposes a complementary way of looking at educational inclusion by exploring teacher-student interaction networks within school classes. The study advances the field by (1) focusing on, and expanding, the understanding of educational inclusion as a social phenomenon by applying a social-network approach, (2) exploring the educational experiences of immigrant students in an emerging country with an accelerated and unprecedented trend of immigration, and (2) demonstrating the combined use of systematic classroom observation, descriptive social network analysis and multilevel models for investigating the within- and between-classroom inclusion of immigrant students, and their predictors. Thus, the study is significant in presenting a complementary and fertile approach to important questions about inclusion in the classroom and teacher-student interactions, which stand in need of better research.

The growing immigration trends around the world will require schools and teachers to work in diverse classrooms. In this context, teachers face a significant challenge: to promote the educational inclusion of all students regardless of their background. The international community states that immigrant inclusion should be at the centre of education policies and systems (UNESCO, 2018). The results presented suggest that emphasis should be put on initiatives that support immigrant groups that are at high risk of educational exclusion (e.g., Peruvian students in Chile).

Previous evidence shows that Chilean teachers are not well equipped to work with diversity. Our study also suggests that teachers differ in the extent to which they include immigrant students: due to the lack of formal training in this direction, their personal attitudes seem to matter. It is important to develop tools that help teachers better understand how they can improve the quality of their interactions and their distribution among students in the classroom. There is also need for interventions that improve teachers' attitudes towards diversity; help them to become aware of, and overcome, their biases; and develop skills and strategies for working in diverse classrooms. The results are highly relevant for advancing our understanding of educational inclusion in classrooms, fostering school equity policies and teacher development programs, both in Chile and abroad.

As with any piece of research, this study has limitations. Firstly, these conclusions cannot be generalized to all types of classrooms/schools in (or outside of) Chile nor to all types of teacher-student interactions. Indeed, as the majority of studies on teacher-student interactions, we worked with volunteer schools and teachers, which may lead to a selection of schools more open to evaluation and research, and to classrooms in which teacher-student relationships are more positive and less biased toward certain groups of students (den Brok & Levy, 2005). If so, the estimated differences in the inclusion of students by country of origin are conservative in relation to those that could be found in a representative sample of Chilean classrooms. Furthermore, this study focuses on mathematics classrooms and, according to previous studies conducted in Chile, subject areas can differ in the extent that they tend to feature teacher-centered instruction and promote student participation (Martinic, Vergara, & Huepe, 2013; Sun, Correa, Zapata, & Carrasco, 2011). Thus, these results cannot be extrapolated to other school subjects, neither in terms of bias in teacher-student interactions by student immigrant origin, nor in relation to overall patterns of interactions.

Secondly, we analyzed differential patterns of teacher-student interactions by immigrant background but did not look at culturally responsive teaching, another important approach to assess immigrant educational inclusion (e.g., Civitillo, Juang, Badra, & Schachner, 2019; Jensen, Grajeda, & Haertel, 2018). Importantly, Chilean scholars have also called for intercultural education approaches and programs to address the needs of immigrant children and promote their social and educational inclusion (Riedemann & Stefoni, 2015; Stefoni, Stang, & Riedemann, 2016).

Thirdly, while our study considers dependencies in the data that are related to its nested structure (i.e., students nested within classrooms) by using appropriate multilevel models, we assume that, within each classroom, interactions happen independent of each other. This is most likely not the case. For example, those students approached by the teacher may be more likely to initiate interactions themselves in the future, teachers may specifically approach those students who seem passive in the classroom, etc. These and similar tendencies could be modeled using statistical techniques that take the timing of events into account and model them based on patterns of past events (e.g., DuBois, Butts, McFarland, & Smyth, 2013). Unfortunately, existing methods, such as relational event models or dynamic network actor models cannot be applied to our data in their current forms.

Despite the limitations mentioned above, the study presents important methodological strengths. As teachers' cultural competence self-assessment is prone to bias (Larson & Bradshaw, 2017), a more direct measure was preferred to investigate differences in teacher-student interactions by immigrant background. The classroom interaction data collected in this study meets the quality standards used to assess teaching practices via classroom observations methods (Ho & Kane, 2013; Martínez, Taut, & Schaafa, 2016), which include double-coding processes and criteria to assess inter-rater reliability. Also, the high volume of detailed subject-level classroom processes data generated in this study is not usually found in the field, and allows an in-depth analysis of teacher-student interactions.

The study also provides important implications for research. It supports the importance of using a disaggregated perspective to the study of educational processes. It also highlights the relevance of distinguishing by initiator (directionality) and content of interaction when studying teacher-student relations. Furthermore, it shows that studying the inclusion of immigrant students by treating this group as a whole can hide important differences, and it is necessary to distinguish by country of origin, as well as controlling for important student-level and contextual characteristics.

At a more conceptual level, this piece offers insights on how educating immigrant students entails different challenges according to the context. The evidence from Chile shows that, while most immigrants in Chile speak Spanish, there are relational patterns that put some of them at disadvantage. As suggested in previous studies, this may be related to stereotypes about culture, race and ethnicity of immigrant students (Cherng, 2017; Preiss et al., 2015; Tijoux, 2013b). Specifically, in the case of Peruvian students, a history of military confrontations between Chile and Peru, as well as the negative stereotypes associated to the indigenous descent of Peruvian immigrants, may play a role in the unequal patterns of interactions found in this study. This contrast, to some extent, with the challenges found in other national contexts, in which educating immigrant students also involves the challenge of dealing with native languages that are different from the official languages of the host countries (Alba, Sloan, & Sperling, 2011; Oecd The Organization for Economic Cooperation and Development, 2018). In consequence, it seems that being an immigrant entails educational exclusions associated to symbolic markers related to ethnicity, race and culture, which in other contexts also interact with language barriers.

In the future, the approach presented in this study could be extended to assess the inclusion of other traditionally excluded or underperforming student groups (e.g., students with special educational needs, indigenous students, etc.), investigate potential

biases in teacher-student interactions at other educational levels (e.g., pre-school education, higher education, etc.), explore education inclusion in other school subjects (e.g., language, history, science, etc.), and study the association between differential patterns of teacher-student interactions for certain groups of students and their progress in educational outcomes, using longitudinal data.

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CRediT authorship contribution statement

Lorena Ortega: Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft, Writing - review & editing, Supervision, Project administration, Funding acquisition. **Zsófia Boda:** Conceptualization, Methodology, Formal analysis, Writing - review & editing, Visualization. **Ernesto Treviño:** Conceptualization, Investigation, Writing - review & editing, Supervision, Funding acquisition. **Verónica Arriagada:** Writing - original draft. **Denisse Gelber:** Conceptualization, Investigation, Writing - review & editing, Project administration. **María del Rosario Escribano:** Methodology, Writing - review & editing.

Appendix A

Table A1
Frequency and percentage of student immigrant generation by country of origin.

	Peru	Bolivia	Colombia	Haiti	Ecuador	Venezuela	Dominican Republic	Other Countries	Total
First generation	139	8	47	20	10	63	17	9	340
	40.9%	2.4%	13.8%	5.9%	2.9%	18.5%	5.0%	2.6%	100.0%
Second generation	57	3	4	1	3	1	0	11	80
	71.3%	3.8%	5.0%	1.3%	3.8%	1.3%	0.0%	13.8%	100.0%
Total	196	11	51	21	13	64	17	20	933
	21.0%	1.2%	5.5%	2.3%	1.4%	6.9%	1.8%	2.1%	100.0%

Table A2
Intra-class correlation (ICC) by initiator and type of interaction ($n_{classrooms} = 9$. $n_{students} = 218$).

	Teacher-initiated interactions Behavior Management	Instructions	Administrative	Pedagogical	Total
ICC	0.73 (0.66–0.78)	0.55 (0.45–0.64)	0.71 (0.64–0.77)	0.67 (0.58–0.73)	0.82 (0.77–0.86)
	Student-initiated interactions *Behavior Management*	*Instructions*	*Administrative*	*Pedagogical*	*Total*
ICC	–	0.59 (0.50–0.67)	0.53 (0.43–0.62)	0.79 (0.73–0.83)	0.74 (0.67–0.79)

Notes: Lower and upper limits of 95% confidence interval are shown in parentheses. The ICC for student-initiated interactions of type Behavior Management was not be estimated due to its low frequency of occurrence.

Table A3
Items and factor loadings of the scale Teacher's Attitude towards Diversity in the Classroom.

Scale/Item	Factor loading
Teacher's Attitude towards Diversity in the Classroom (Cronbach's $\alpha = .88$)	
How much do you agree with the following statement? "A class with a high proportion of immigrant students, indigenous students and students with Special Educational Needs (SEN) …	
1. Hinders the progression of the class".	.89
2. Makes the work of the teacher harder"	.78
3. Harms the average academic level".	.89
4. Generates discipline problems".	.89

Table A4
Correlations between classroom-level variables ($n_{classrooms} = 38$).

	Proportion of Immigrant Students	Proportion of Immigrant Students^2	Teacher Attitude towards Diversity in the Classroom	Class Size
Proportion of Immigrant Students	1			
Proportion of Immigrant Students^2	.390*	1		
Teacher Attitude towards Diversity in the Classroom	-.269	-.232	1	
Class Size	.396*	.381*	-.420**	1

Notes: Pearson correlation coefficients. †$p < .10$: *$p < .05$; **$p < .01$; ***$p < .001$.

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