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How Context and the Perception of Peers' Behaviors Shape Relationships in Adolescence

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Classroom ability composition and the role of academic performance and school misconduct in the formation of academic and friendship networks

This chapter is based on:

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2.1 Introduction

There is a large variability in the academic performance of high school students. Whereas some students work diligently and get good grades, others seem to be less involved in school, resulting in underachievement or even school misconduct (Bissell-Havran & Loken, 2009; Demanet & Van Houtte, 2012). Educational systems have responded in different ways to students' academic heterogeneity. One strategy that has received considerable attention is ability grouping (also known as tracking), the practice of assigning students into different classes based on their abilities, educational career goals, or curriculum standards (Belfi et al., 2012). Ability grouping seems to be a widely used practice around the world, being implemented in some form in most countries of the Organisation for Economic Co-operation and Development (OECD, 2010). In secondary education, ability grouping usually takes the form of placing higher achieving students into advanced academic classes and lower achievers in general or vocational classes.

Research has suggested that ability grouping has considerable effects on academic and socio-emotional outcomes of students, but little is known about its effects on academic and friendship relationships, referring to who studies with whom and who is best friends with whom, respectively. These two peer relations are rooted in learning environments as adolescents spend a considerable amount of time with each other doing academic tasks or hanging out in schools (Altermatt & Pomerantz, 2003).

By assigning students to different classes, ability grouping defines the social group present in classes, not only generating more homogeneous educational environments than in mixed-ability classrooms but also fostering and limiting the possible academic comparisons and social interactions among classmates (Marsh et al., 2008). Moreover, ability grouping tends to produce a process of differentiation and polarization in academically-oriented norms (Hargreaves, 1967; Lacey, 1970) with students in high-ability classrooms (or higher tracks) developing pro-school attitudes and students in low-ability classrooms displaying anti-school attitudes (Berends, 1995; Van Houtte, 2006).

We examined the link between friendship and academic networks, as well as their association with adolescents' academic performance and school misconduct, comparing classrooms with different ability composition (high-, low-, and mixed-ability classrooms). A novel contribution of this study is that the association between classroom ability composition and academic and friendship networks was examined, thus adding to the understanding of the link between school practices and adolescents' social dynamics. This paper sheds light on how academic performance and school misconduct are differently related to academic and friendship networks depending on ability grouping. Examining this topic is relevant because ability grouping tends to influence academic and friendship relationships, which, in turn, are likely to impact not only students' social development but also future educational careers.

2.1.1 Ability grouping generating distinctive educational environments

According to the differentiation-polarization theory (Hargreaves, 1967; Lacey, 1970), a process of differentiation based on an academically-oriented norm is associated with a polarization between high-track students developing pro-school attitudes, and low-track students exhibiting anti-school attitudes (Berends, 1995; Hargreaves, 1967; Van Houtte, 2006). High-track students usually have a positive school experience finding greater meaning in schoolwork, being more motivated, putting forth more effort, and holding higher expectations for themselves compared to low track students (Gamoran, 1992).

On the contrary, low-track students experience a loss of status and sense of failure because their lack of ability in terms of academic performance pushes them into lower tracks (Byrne, 1988; Ireson et al., 2001). These students will react against the tracking system and its values (e.g., academic performance and hard work). Consequently, they will reject academically-oriented norms as a frame of reference (Hargreaves, 1967; Van Houtte, 2006) and search for alternative paths to reach status, most prominently via deviant behavior (Catsambis et al., 1999; Gamoran et al., 1995; Oakes, 1985; Van Houtte, 2006). Peer interactions in lower tracks, compared with higher tracks, are often characterized by higher levels of anti-academic behaviors (e.g., school misconduct, dropping out) (Carbonaro, 2005; Gamoran & Berends, 1987; Junger-Tas et al., 2010) as well as smaller friendship networks among students (Fisher & Shogren, 2016).

2.1.2 Effects of ability grouping on school settings

Research on ability grouping has primarily focused on assessing its impact on academic and socio-emotional outcomes, such as academic performance, academic self-esteem, and academic self-efficacy (Belfi et al., 2012; Holm et al., 2013; Ireson et al., 2001; Steenbergen-Hu et al., 2016). Overall, there is evidence that ability grouping is beneficial for high-ability students in terms of their academic achievement (Hattie, 2002; Rogers, 2007; Shields, 2002) and academic attitudes (Neihart, 2007). However, ability grouping tends to be detrimental for low-ability students in areas such as general and academic self-esteem (Agirdag et al., 2013; Ireson et al., 2001; Tereshchenko et al., 2018), academic self-concept (Boaler et al., 2000; MacIntyre & Ireson, 2002), educational expectations (Walsemann & Bell, 2010), and psychological adjustment (Dupriez, 2010; Müller & Hofmann, 2016).

The effects of ability grouping on academic functioning can occur in three domains: instructional, social, and institutional (Pallas et al., 1994). First, ability grouping is associated with different learning environments by influencing the quantity, quality, and pace of instruction and learning (Oakes, 1985; Pallas et al., 1994). Learning contexts tend to be richer for high-track students, and poorer for low-track students. High-track students tend to learn more by covering a significant proportion of the curriculum, learning at a faster pace, and being taught by more qualified teachers (Gamoran et al., 1995), whereas low-track students are typically provided with inferior educational experiences and support (Darling-Hammond, 2000; Hattie, 2009), spending, for example, less time on homework (Oakes, 1985).

Second, ability grouping stratifies peer contexts, which influences students' expectations of their performance and their self-concepts. Ability grouping defines the social group that students use to compare their abilities and to develop their academic identities (Marsh et al., 2008). Moreover, ability grouping and curricular differentiation foster interaction among students with comparable levels of academic performance and engagement. For instance, lower tracks structure and promote friendships among students who are similarly alienated from school and are more likely to be involved in deviant behaviors, such as school misconduct, leading to the increase of other students' engagement in those behaviors (Crosnoe, 2002; Dishion et al., 2001). Similarly, students in low-ability classrooms are likely to have fewer learning opportunities and experience a lack of positive stimulation from other classmates (Van Houtte, 2004).

Third, ability grouping influences the expectations and perceptions of teachers and parents about student's competences, independent of their actual skills. Teachers not only tend to reduce their expectations for low-ability students (Boaler et al., 2000), but also implement less challenging instructional strategies which promote low complexity skills, such as repetition and memorization

(Clotfelter et al., 2005; Toledo Román & Valenzuela, 2015). Moreover, some teachers might consider that low-ability students have more behavioral problems than other students (Haskins et al., 1983; Van Houtte, 2006). Conversely, teachers consider teaching more prestigious in high-track classrooms (Finley, 1984).

Together, the literature stresses the importance of ability grouping in generating diverse educational settings that are associated with different school experiences. From this evidence, we expected that academic performance and school misconduct would be oppositely valued in high- and low-ability classrooms, thus, affecting the formation and maintenance of academic and friendship relationships with peers differently.

2.1.3 Academic and friendship networks in school settings

Peers in school, particularly friends, play an important role in adolescents' academic behaviors (Altermatt & Pomerantz, 2003). On the one hand, peers can influence their classmates' academic functioning by promoting or discouraging academic behaviors including school engagement, academic achievement, homework activity, paying attention in class, academic mastery goals, and truancy (Flashman, 2012; Geven, Weesie, & van Tubergen, 2013; Gremmen, Dijkstra, Steglich, & Veenstra, 2017; Lomi, Snijders, Steglich, & Torló, 2011; Rambaran et al., 2017; Shin & Ryan, 2014b). On the other hand, attraction to peers is partially driven by academic performance with high-achieving students receiving more friendships nominations over time than low achievers (Gremmen et al., 2017; Palacios & Berger, 2016; Shin & Ryan, 2014a; Stark, Leszczensky, & Pink, 2017).

Previous studies in school settings have, however, focused almost exclusively on understanding the role of friendship, typically ignoring more specific academic relationships. Only a few studies have examined comparable positive networks, such as helping or advice relationships. For example, one study examined friendship and advice relationships (i.e., peers to whom university students recurrently referred for information and advice on course-related matters) showing that both friendship and advice networks positively influenced each other and that academic performance was positively related to being nominated as advisor (Snijders et al., 2013). Another study examined prosocial relationships in secondary education, showing that adolescents are likely to reciprocate helping relationships as well as cooperate with peers with whom they already established a friendship (Van Rijsewijk et al., 2016).

Finally, there is evidence that academic networks (with whom do you study at the school?), like friendship networks, are shaped by reciprocity and transitivity mechanisms in high school students (Palacios & Villalobos, 2016).

2.1.4 Present study

This paper investigated the association between academic and friendship networks with academic performance and school misconduct comparing different classrooms in terms of ability composition¹. Three types of classrooms were investigated: high-ability classrooms, low-ability classrooms, and mixed-ability classrooms. We included the latter group of classrooms to compare how academic and friendship relationships unfold in contexts without clear ability grouping

¹ Although grouping might not be actually based on ability but on academic performance, the underlying assumption for this grouping is that students have different abilities which are expressed in their achievement. Because the term ability grouping is commonly used (Dupriez, 2010), we decided to keep this nomenclature.

strategies. In the current study, we focused on permanent route ability grouping (which also has been called streaming, tracking, or program differentiation), in which students are assigned to classes according to their academic abilities as measured using a prior evaluation or test.

In the permanent route, students remain in the same ability group for all of the classes during secondary education (Treviño et al., 2018). We expected that each type of classroom signals and promotes distinct educational environments: pro-school norms in high-ability classrooms; anti-school norms in low-ability classrooms; and moderate pro-school norms in mixed-ability classrooms. As a result, the importance and prominence of academic performance and school misconduct on the formation and maintenance of academic and friendship networks are expected to differ in each type of classroom.

High-ability classrooms would signal academically-oriented environments, resulting in the prominence of academic performance (Oakes, 1986) and the rejection of school misconduct. We hypothesized that compared to low-ability classrooms, in high-ability classrooms students with higher academic performance are more likely to attract academic nominations from their peers (*hypothesis 1*). Also, students who engage in school misconduct are expected to be unattractive as academic partners. Consequently, we hypothesized that compared to low-ability classrooms, in high-ability classrooms students with higher levels of school misconduct are less likely to attract academic nominations (*hypothesis 2*).

High-track students exhibit positive attitudes toward homework (Van de Gaer, Pustjens, Van Damme, & De Munter, 2006), and are also expected to spend a considerable amount of class time doing academics tasks, such as homework (Ireson & Hallam, 2001; Oakes, 1986). As a consequence, high-track students dedicate more time to academic duties and, therefore, to more academic interactions with other students, increasing opportunities for academic partners to become friends. Hence, we expected that, compared to low-ability classrooms, in high-ability classrooms, the existence of academic relationships is likely to promote the creation or maintenance of friendship relationships (*hypothesis 3a*).

Conversely, because friends tend to be a source of support in other positive relationships such as advice and helping networks (Snijders et al., 2013; Van Rijsewijk et al., 2016), we expected that the same occurs for academic networks. Hence, we hypothesized that the existence of friendships was likely to promote the creation or maintenance of academic relationships in both types of classrooms (*hypothesis 3b*).

Regarding low-ability tracks, these classrooms seem to generate anti-academic oriented settings, with students exhibiting poorer attitudes toward school as well as experiencing feelings of incompetence, dropping out of school, and displaying problem behaviors (Oakes, 1985; Page, 1991). This might also affect how peer relations are formed, specifically the prominence of school misconduct for friendship selection. Hence, we expected that, compared to high-ability classrooms, in low-ability classrooms, students with higher levels of school misconduct are likely to attract more friendship nominations (*hypothesis 4*).

Regarding the mixed-ability classrooms, we expected a moderate academically-oriented environment in which academic performance would play an important role in influencing both academic and friendship networks. Mixed-ability classrooms seem to foster higher self-esteem and positive attitudes toward school among students (Ireson et al., 2001). Moreover, these classrooms usually present a wider variability of students' academic engagement compared to high- and low-ability classrooms. For that reason, these classrooms could be more polarized in terms of academic engagement, leading to similarity selection effects for both academic performance and school

misconduct. Therefore, we hypothesized that in mixed-ability classrooms, students with similar academic performance and school misconduct are likely to be academic partners (*hypothesis 5a*) and friends (*hypothesis 5b*).

To test these hypotheses, we used longitudinal social network models, specifically the stochastic actor oriented-models (SAOM) implemented in RSiena (Ripley et al., 2018). In the analyses, we also controlled for two demographic variables: sex and socioeconomic status as both seem to be important factors in the formation of academic and friendship relationships. Friendship and academic relationships are commonly formed between same-sex peers (Palacios & Villalobos, 2016; Shin, 2017; Sijtsema, Ojanen, et al., 2010; Simpkins et al., 2013). Studies have also shown sex differences in several academic dimensions, such as academic performance, motivation, and self-esteem (e.g., Bugler, McGeown, & St Clair-Thompson, 2015; Diseth, Meland, & Breidablik, 2014; Voyer & Voyer, 2014). Socioeconomic status plays a crucial role in Chilean schools because it is related to academic outcomes and trajectories of students from different social backgrounds (Mizala & Torche, 2012).

2.2 Method

Participants were 1,474 seventh to ninth graders from 35 classrooms from nine schools in four regions in Chile. According to the Chilean national socioeconomic classification, schools come from middle to low socioeconomic backgrounds (see Table 2.A in Appendix 2.A). These schools offered education from 7th, 8th grade (last years of primary education) or 9th (first year of secondary education) throughout 12th grade (see Table 2.1). We studied the first grade of education offered in each selected school. The case of Chilean schools is relevant because ability grouping is a fairly common practice, especially in the beginning of secondary education, being applied by around 80% of the schools with two or more classrooms per grade level (Treviño et al., 2018).

The participating schools are part of a broader Chilean research project that aims to examine and understand the grouping processes carried out by effective-inclusive Chilean schools by describing their institutional arrangements and pedagogies (see Appendix 2B for additional information on the sample). These types of schools are characterized by shared commitment, high educational expectations, shared values and beliefs, clear school-wide goals, high-quality instruction in all classrooms, and learner-centered professional development (Hehir & Katzman, 2012; Intxausti et al., 2017; McLeskey et al., 2014). All classrooms in these nine schools were eligible for the present study.

2.2.1 Sample selection

We analyzed the first two waves of a 3-wave study, with six months as a period between the first two waves. This interval seems to be adequate to assess potential changes in the friendship networks (see suggestions by Ripley et al., 2018; Snijders, van de Bunt, & Steglich, 2010), whereas the interval between the second and third waves was considerably larger (approximately a year). As a consequence, we removed six classrooms that only participated in the second and third waves. Additionally, we excluded one classroom that left the study before the second wave as well as a notably small classroom with only seven students. Our sample contained 27 classrooms.

In view of the requirements for longitudinal social networks analysis (referring to model convergence), the final sample of classrooms was selected based on networks' stability and the proportion of missing data. We excluded fifteen classrooms with low levels of stability (a Jaccard

Table 2.1 Descriptive information about the selected classroom networks for time 1 and 2

Class	Grade	Type	Size	Girls %	SES	Acad		Miss t1	Miss t2	Dist		Jac AC	Jac FR	AvD		AvD AC t1	AvD AC t2	AvD FR t1	AvD FR t2	Jn	Lv
						Perf	Misc			FR	AC			FR	AC						
1	7 ^o	M	49	71.4	2.81	6.34	1.67	.13	.05	200	264	.05	.33	3.02	2.95	7.63	10.27	4	5		
2	7 ^o	M	48	51.2	3.03	6.04	2.58	.15	.14	84	186	.31	.32	2.93	3.51	8.19	10.21	8	2		
3	8 ^o	M	73	62.2	3.84	5.68	3.03	.05	.05	64	89	.07	.03	2.07	2.11	5.14	7.46	28	26		
4	9 ^o	M	52	95.3	3.37	5.31	4.32	.19	.04	100	167	.30	.27	3.67	2.84	6.67	3.84	3	11		
5	9 ^o	H	41	62.8	2.71	6.43	0.16	.10	.08	142	201	.26	.42	3.71	6.10	11.30	10.80	5	5		
6	9 ^o	H	43	40.0	2.31	6.03	0.58	.32	.05	65	80	.09	.19	2.08	3.38	5.09	5.96	7	10		
7	9 ^o	H	41	61.5	3.08	6.21	0.74	.18	.09	76	145	.38	.36	2.94	4.11	9.07	7.44	3	2		
8	9 ^o	H	40	60.0	2.77	5.79	1.80	.25	.07	108	133	.31	.44	3.85	4.09	6.26	8.15	3	2		
9	9 ^o	L	44	62.8	2.20	5.42	0.93	.31	.11	88	137	.21	.33	3.17	4.07	9.55	11.85	6	7		
10	9 ^o	L	44	50.0	2.60	5.06	4.48	.15	.07	49	125	.36	.37	2.07	3.02	11.34	7.65	6	7		
11	9 ^o	L	23	88.2	1.82	5.41	3.90	.20	.10	22	29	.31	.39	1.57	2.27	3.81	3.82	5	5		
12	9 ^o	L	30	70.8	1.87	5.46	3.79	.22	.11	59	116	.12	.30	2.06	2.06	5.72	5.88	1	5		
Av/Tot	-	-	528	71.4	2.70	5.77	2.33	.19	.08	88.1	139.3	.23	.31	2.76	3.38	7.48	2.76	79	87		

Notes. Type: Type of class (M: Mixed-ability classes; H: High-ability classes; L: Low-ability classes); SES: Average of socio-economic background; Acad Perf: Academic performance; Acad Misc: Academic misconduct; Miss: % of missing data; Dist.: Hamming distance; Jac: Jaccard index; AvD: Average degree; Jn: Number of students who joined the study between assessments; Lv: Number of students who left the study between assessments

index lower than .20, see Table 2.C in Appendix 2.C) or high levels of missing data (referring to 20% or higher), which are too high for estimating SAOM, as simulations on which estimations are based become unstable (Ripley et al., 2018). The excluded classrooms were low- and mixed-ability classrooms. Compared to students from excluded classrooms, students from the included low- and mixed-ability classrooms showed higher academic performance ($t(225) = -3.62, p < .001$; $t(605) = -5.83, p < .001$) and lower school misconduct ($t(121) = 3.65, p < .001$; $t(332.32) = 4.22, p < .001$). The final sample consisted of 528 seventh to ninth graders ($N_{t1} = 449, N_{t2} = 441; M_{age t1} = 15; 64.1\%$ girls) from 12 classrooms (four in each category of ability grouping) from 5 schools (see Table 2.1).

2.2.2 Missing data and classrooms' composition change

For academic and friendships nominations, ordinary missing data were handled through the RSiena default missing data procedure (Ripley et al., 2018). For each missing tie variable, the preceding non-missing value (if any) was imputed; if the previous values were missing as well, the value 0 (referring to no friendship tie) was assigned. Whenever imputed values were used, parameter estimate updates were based on the non-imputed parts of the data. This approach tries to minimize the impact of imputations on the results (Huisman & Steglich, 2008; Ripley et al., 2018).

In the case of students who joined ($n=79$) and left ($n=89$) the study between the two assessments, we used the method of joiners and leavers (see Huisman & Snijders, 2003). In this procedure, it is possible to indicate the intervals during which joiners and leavers were present in the study. In this way, joiners and leavers only participate in the simulations at the observation moments in which they were present. Compared to the students who remained in the study over the two assessments, students who left the study before the second assessment exhibited lower academic performance in low- and mixed-ability classrooms ($t(127) = -2.03, p = .04$; $t(156) = -3.97, p < .001$). Also, participants who left the study presented higher levels of school misconduct in mixed-ability classrooms ($t(138) = 2.05, p = .04$).

2.2.3 Measures

Academic networks (T1-T2). Participants were asked to identify their classmates with whom they study at the school. Adjacency matrices were created for each classroom on each assessment representing the academic network, where nominations were coded 1 and non-nominations were code 0. On average, the number of academic partners (outdegree) was 2.76 ($SD = 0.77$) for the first wave and 3.37 ($SD = 1.13$) for the second wave.

Friendship networks (T1-T2). Participants were asked to identify their classmates with whom they hang out at school (Espelage & Swearer, 2003; Schacter et al., 2014). Adjacency matrices were created for each classroom on each assessment representing the friendship network with, friendship nominations coded as 1 and non-nominations coded as 0. On average, the number of friends (outdegree) was 7.48 ($SD = 2.46$) for the first wave and 7.77 ($SD = 2.63$) for the second wave.

Classroom grouping strategy. A widespread school practice in Chilean schools is that school principals group students at the beginning of secondary education (Treviño et al., 2018). Based on a principals' report, we categorized classrooms as high-, low-, or mixed-ability classrooms. Additionally, we performed statistical comparisons (Mann-Whitney-Wilcoxon Tests) on standardized tests and GPA officially reported by schools to the Ministry of Education before students started high school to confirm differences in academic outcomes for these types of

classrooms. Results showed that the academic distribution was different among the three categories (see Appendix 2.D for more information on the distribution of each group of classrooms).

Academic performance (T1). General grade point average (GPA) was provided by the Chilean national assessment system (SIMCE) at the end of the first academic year. GPA as a measure of academic performance has been widely used in the literature about peer selection and influence processes (e.g., Flashman, 2012; Rambaran et al., 2017; Shin & Ryan, 2014). The Chilean grading scale ranges from 1 (*poor*) to 7 (*excellent*). On average, the academic performance of the students for the first wave was 5.7 ($SD = 0.59$).

School misconduct (T1). Students reported the number of school misconduct behaviors that they have been involved in at the end of the school year of the first assessment. School misconduct refers to the behaviors that disrupt the class or engenders punishment, such as cheating on tests, skipping lessons, and arriving late at school (Demagnet & Van Houtte, 2011; Van Houtte & Stevens, 2008). The original range was between 0 and 28, with an average of 4.19 ($SD = 4.92$). We recoded the original variable, maintaining the values from 0 to 8, and adding a last category representing all the values greater or equal to 9 ($M = 3.42$, $SD = 3.17$). The distribution was the following: 1 (28.2%), 2 (31.1%), 3 (12.6%), 4 (8.7%), 5 (5.1%), 6 (2.9%), 7 (2.5%), 8 (1.6%), 9 or more (6.8%).

Socioeconomic status (T1). The socioeconomic status index was obtained from the Chilean national learning assessment system (SIMCE). This index was calculated by equally weighting information of parents' educational background and incomes with a vulnerability index associated with students' schools. The socioeconomic status index has five categories: low (20.3%), low-middle (21.5%), middle (24.5%), upper-middle (23.0%), and upper socioeconomic status (10.5%). The participating schools belong to a small group of Chilean schools that have students from different socioeconomic groups. Overall, whereas public schools usually concentrate the most socially disadvantaged students, the middle-low and middle-class students attend private-subsidized schools, and the high-class students go to private schools (García-Huidobro, 2007).

Sex. Participants were asked about their sex, which was coded 0 for girls and 1 for boys.

2.2.4 Procedure

The data used were collected in October–November 2015 (Wave 1) and May 2016 (Wave 2). At each wave, the questionnaires were applied in one day in all the participating classrooms of a school. The total period of data collection in each wave lasted, on average, two weeks. The Institutional Review Board of the local university approved all instruments and procedures to meet ethical research standards (e.g., confidentiality, parental and participants' consent, data storage). Participants were assured that their answers would be kept confidential and that they could stop participating at any time. Trained research assistants with professional degrees (education, psychology, or sociology) applied the questionnaires during regular school hours.

To facilitate academic and friendship nominations, a roster with students' names was available on the blackboard of each classroom. Once the information was collected, the questionnaires were coded in the database and anonymized, to guarantee the confidentiality of the students' answers.

2.2.5 Analytical Strategy

Analyses were conducted using longitudinal multiplex social network models implemented in RSiena ("Simulation Investigation for Empirical Network Analysis"), which allowed unraveling the development of friendship and academic networks over time (Ripley et al., 2018) while taking into account students' individual covariates (sex, socioeconomic status, academic performance, and

school misconduct). RSiena models are actor-based models (Snijders et al., 2010), which assume that actors (e.g., students) modify their relationships (e.g., friendships and academics relationships) between assessments based on their individual preferences (Snijders et al., 2010). For instance, friendships may change (referring to creating a new friendship or dropping an existing one) in response to the current network structure as well as to the structure of the academic network, reflecting a dynamic process controlling for changes in structural (e.g., reciprocity, transitivity) and individual effects (actor attributes).

We estimated the model for each type of classroom separately using the Methods of Moments estimator and specifying 10,000 iterations in phase 3 for calculating standard errors. Specifically, classrooms of each type were combined and analyzed simultaneously using the multi-group approach, which assumes that parameters are identical across classroom networks. This approach yields more statistical power compared to analyzing classrooms separately (Ripley et al., 2018). All models reached convergence, showing a good convergence of the algorithm (with overall maximum convergence ratios smaller than .15 for each model), and overall satisfactory goodness of fit (for more details see Appendix 2.E). Our model includes three sets of parameters: structural effects, individual covariates, and cross-network effects.

2.2.6 Model specification

Structural network effects. These effects were included to capture the basic tendencies of actors to form and maintain relationships within the two types of networks. *Density* describes the tendency of actors to establish relationships. *Reciprocity* is the tendency toward reciprocation of relationships (referring to mutual ties). *Transitivity* (transitive triplets) refers to the transitive closure of individuals ('friends of friends become friends'). Moreover, we included the interaction between *transitivity* and *reciprocity* (transitive reciprocated triplets), representing the tendency toward reciprocation of nominations within triads (Block, 2015). Additionally, we included two degree-related effects to differentiate between actors who received or sent many (or few) nominations in friendship and academic networks. The *indegree-popularity* effect reflects the tendency of actors who receive many nominations to attract more nominations over time, whereas the *outdegree-activity* effect reflects the tendency of actors who send many nominations to send more nominations over time. To improve the goodness of fit of the models, we included the interaction between the reciprocated degree and the *indegree-popularity* (*reciprocal degree-related popularity* effect), indicating that students with a large number of reciprocated ties will receive more additional nominations over time.

Covariates. The effect of academic performance and school misconduct on friendship and academic relationships were included, assessing whether participants, who, for instance, score higher on academic performance are more likely to send (*ego* effect) and/or receive (*alter* effect) friendships or academic nominations. We also included the similarity effect for these two covariates, indicating whether friendship nominations and academic nominations are more likely to occur between participants with similar levels of academic performance and school misconduct. Additionally, we included the effect of sharing the *same sex* and *socioeconomic status similarity* in the formation and maintenance of academic and friendship networks.

Cross-network effects. These effects were included to analyze the effect of one type of network on another type of network. For our purpose, we examined whether friendship nominations lead to academic nominations and vice versa.

2.3 Results

2.3.1 Descriptive analysis

Table 2.2 provides descriptive information about the changes in academic and friendship networks from Wave 1 to Wave 2. Regarding the academic networks, high- and low-ability classrooms shared a comparable pattern, in which the number of created ties was the largest, followed by the number of maintained ties, and the number of dissolved ties was smallest. In the case of mixed-ability classrooms, the number of dissolved ties was the largest, followed by created and maintained ties. High- and low-ability classrooms shared a comparable pattern in the friendships network dynamics. The number of maintained ties was the largest, followed by the number of created ties, and the number of dissolved ties was smallest. In the case of mixed-ability classrooms, the number of created ties was the largest, followed by maintained and dissolved ties.

Students in high-ability classrooms exhibited higher academic performance ($t(251) = 13.60$, $p < .001$) and socioeconomic status ($t(248) = 3.39$, $p < .001$) and a lower level of school misconduct ($t(94) = -6.46$, $p < .001$) compared to students in low-ability classrooms (see Table 2.2). Moreover, students in high-ability classrooms showed higher academic performance ($t(312.31) = 5.26$, $p < .001$) as well as lower school misconduct ($t(223.09) = -7.81$, $p < .001$) and socioeconomic status ($t(274.42) = -4.01$, $p < .001$) than students in mixed-ability classrooms.

Students in low-ability classrooms had lower academic performance ($t(289) = -8.24$, $p < .001$) and socioeconomic status ($t(268) = -7.73$, $p < .001$) in comparison to students in mixed-ability classrooms. In addition, there was a significant negative correlation between academic performance and school misconduct in high-ability ($r(92) = -0.33$, $p = .001$), low-ability ($r(72) = -0.36$, $p = .001$), and mixed-ability classrooms ($r(138) = -0.55$, $p < .001$).

Table 2.2 Variables Distribution and Changes across the two observations by each type of classroom composition

	High-ability classrooms		Low-ability classrooms		Mixed-ability classrooms	
	T1	T2	T1	T2	T1	T2
N students by wave	147	146	123	117	179	178
N students total	165		141		222	
Academic networks						
Density	.08	.11	.07	.08	.06	.06
Average degree	3.15	4.42	2.22	2.86	2.92	2.85
	T1 → T2		T1 → T2		T1 → T2	
Average number of academic changes	97.75		41.25		112	
Jaccard index (stability)	.27		.24		.18	
Academics emerged	381		288		386	
Academics dissolved	170		93		395	
Academics maintained	201		106		153	
	T1	T2	T1	T2	T1	T2
Friendship networks						
Density	.20	.20	.21	.21	.14	.15
Average degree	7.93	8.09	7.61	7.30	6.91	7.95

Table 2.2 Variables Distribution and Changes across the two observations by each type of classroom composition (continued)

	High-ability classrooms	Low-ability classrooms	Mixed-ability classrooms
	T1 → T2	T1 → T2	T1 → T2
Average number of academic changes	139.75	101.75	176.50
Jaccard index (stability)	.36	.35	.26
Friendships emerged	505	421	885
Friendships dissolved	429	395	770
Friendships maintained	545	436	547
	T1	T1	T1
<i>Covariates</i>			
Academic performance	6.12 (0.46)	5.30 (0.49)	5.82 (0.54)
School misconduct	0.84 (1.40)	3.45 (3.25)	2.89 (2.59)
Socioeconomic background (SES)	2.74 (1.29)	2.20 (1.20)	3.31 (1.12)
Sex (% girls)	56%	64%	70%

Notes. Standard errors in parentheses

2.3.2 Longitudinal social networks analysis

Results of the RSiena analyses for the different types of classrooms are presented in Table 2.3. To facilitate the interpretation of the effects, we calculated the odds ratios representing the odds that an outcome will occur given a particular situation, compared with the odds of the outcome occurring in the absence of that situation. For instance, the odds of 3 for the friends' similarity effect means that a student was three times as likely to nominate a similar peer as a friend than not to, all else being equal.

Structural network effects. Across the three type of classrooms, we found that students were likely to reciprocate academics relationships (*reciprocity* Est. _{high} = 2.35, $p_{\text{high}} < .001$, OR = 10.46; Est. _{low} = 2.13, $p_{\text{low}} < .001$, OR = 8.43; Est. _{mixed} = 2.70, $p_{\text{mixed}} < .001$, OR = 14.81). Also, participants nominated academic partners of academic partners as academic partners (*transitivity* Est. _{high} = 0.50, $p_{\text{high}} < .001$, OR = 1.65; Est. _{low} = 0.73, $p_{\text{low}} < .001$, OR = 2.08; Est. _{mixed} = 0.89, $p_{\text{mixed}} < .001$, OR = 2.44), but academic relationships within triadic structures were not reciprocated (*transitivity × reciprocity* Est. _{high} = -0.78; $p_{\text{high}} < .001$, OR = 0.46; Est. _{low} = -0.45, $p_{\text{low}} = .01$, OR = 0.64; Est. _{mixed} = -0.63, $p_{\text{mixed}} < .001$, OR = 0.53).

Participants who had many academic relationships in low-ability classrooms were less likely to attract new academic partners (*indegree-popularity* Est. _{low} = -0.88, $p_{\text{low}} = .03$, OR = 0.41) resulting in a lower dispersion in academic indegrees. An interpretation is that for students in low-ability classrooms, which are usually not focused on academic achievement, there would be less incentive to increase their number of academic partners over time. Likewise, the negative outdegree-activity effect in mixed-ability classrooms indicates that participants who send more academic nominations, send less additional academic nominations over time (*outdegree-activity* Est. _{mixed} = -0.53, $p_{\text{mixed}} < .001$, OR = 0.59). Consistent with the indegree-popularity effect, for students who already indicate having many academic partners there would be less incentive to find more academic partners in mixed-ability classrooms. Last, in high- and mixed-ability classrooms, students who have many

reciprocated academic ties received fewer additional academic nominations over time (*reciprocal-degree popularity* Est. $_{high} = -0.67$, $p_{high} < .001$, OR = 0.51; Est. $_{mixed} = -0.92$, $p_{mixed} < .001$, OR = 0.40). An interpretation is that students with a large number of reciprocated academic ties are perceived as less available for other classmates to be an academic partner.

In the case of friendship networks, across the three types of classrooms, friendship nominations tended to be reciprocated (*reciprocity* Est. $_{high} = 2.39$, $p_{high} < .001$, OR = 10.95; Est. $_{low} = 2.31$, $p_{low} < .001$, OR = 10.02; Est. $_{mixed} = 3.23$, $p_{mixed} < .001$, OR = 25.20). Participants tended to nominate friends of friends as friends (*transitivity* Est. $_{high} = 0.30$, $p_{high} < .001$, OR = 1.34; Est. $_{low} = 0.29$, $p_{low} < .001$, OR = 1.34; Est. $_{mixed} = 0.46$, $p_{mixed} < .001$, OR = 1.59), but they were less likely to reciprocated friendships within triads (*transitivity \times reciprocity* Est. $_{high} = -0.26$, $p_{high} < .001$, OR = 0.77; Est. $_{low} = -0.27$, $p_{low} < .001$, OR = 0.76; Est. $_{mixed} = -0.46$, $p_{mixed} < .001$, OR = 0.63). Students who received many friendship nominations were less likely to attract new friends over time in low and mixed-ability classrooms (*indegree-popularity* Est. $_{low} = -0.40$, $p_{low} = .05$, OR = 0.67; Est. $_{mixed} = -0.54$, $p_{mixed} < .001$, OR = 0.58), resulting in a lower dispersion in friendship indegrees.

In addition, in both high- and mixed-ability classrooms participants who send many friendship nominations were less likely to give new friendship nominations over time (*outdegree-activity* Est. $_{high} = -0.30$, $p_{high} < .001$, OR = 0.74; Est. $_{mixed} = -0.21$, $p_{mixed} < .001$, OR = 0.81). Results of the two degree-related effects suggest that, particularly in mixed-ability classrooms, there exists a less hierarchical structure in terms of the incoming and outgoing friendship nominations. Last, in low- and mixed-ability classrooms the interaction between the friendship reciprocated degree and indegree-popularity was negative (*reciprocal-degree popularity* Est. $_{low} = -0.40$, $p_{low} = .03$, OR = 0.67; Est. $_{mixed} = -0.57$, $p_{mixed} < .001$, OR = 0.57). A possible interpretation is that students with more mutual friendships are perceived as less available for other classmates to be friends.

Covariates. In line with our first hypothesis, we found that students with higher academic performance received more academic nominations in high- and mixed-ability classrooms but not in low-ability classrooms (*academic performance alter* Est. $_{high} = 0.47$, $p_{high} = .05$, OR = 1.61; Est. $_{mixed} = 0.36$, $p_{mixed} < .001$, OR = 1.44; Est. $_{low} = 0.14$, $p_{low} = 0.40$, OR = 1.15). However, the effect of academic performance on the incoming academic nominations did not differ between high- and low-ability classrooms ($z = 1.45$, $p = .07$). In line with the second hypothesis, students who engaged in school misconduct attracted fewer academic nominations in high-ability, but not in low-ability classrooms (*school misconduct alter* Est. $_{high} = -0.16$, $p_{high} = .03$, OR = 0.85; Est. $_{low} = 0.00$, $p_{low} = .92$, OR = 1.00). This difference was statistically significant ($z = -2.13$, $p = .01$), and consistent with the second hypothesis.

Moreover, students with higher levels of school misconduct did not attract many friendship nominations in either high- or low-ability classrooms (*school misconduct alter* Est. $_{high} = -0.10$, $p_{high} = .46$, OR = 0.91; Est. $_{low} = -0.03$, $p_{low} = .17$, OR = 0.97), rejecting the fourth hypothesis. Also, similarity in academic performance and school misconduct was not associated with selecting academic partners in mixed-ability classrooms (*academic performance similarity* Est. $_{mixed} = -0.35$, $p_{mixed} = .35$, OR = 0.70; *school misconduct similarity* Est. $_{mixed} = -0.17$, $p_{mixed} = .35$, OR = 0.85), rejecting the first part of our fifth hypothesis. Furthermore, school misconduct and academic performance were not associated with selecting friends (*school misconduct similarity* Est. $_{mixed} = -0.34$, $p_{mixed} = .13$, OR = 0.71; *academic performance similarity* Est. $_{mixed} = -0.58$, $p_{mixed} = .06$, OR = 0.56). Hence, the second part of our fifth hypothesis was rejected.

Table 2.3 Academic and friendship networks: RSiena Multi-group Analyses in High-, Low-, and Mixed-ability classrooms

<u>Effects</u>	High-ability classrooms				Low-ability classrooms				Mixed-ability classrooms			
	<u>Est.</u>	<u>SE</u>	<u>p</u>	<u>OR</u>	<u>Est.</u>	<u>SE</u>	<u>p</u>	<u>OR</u>	<u>Est.</u>	<u>SE</u>	<u>p</u>	<u>OR</u>
Academic networks												
<i>Structural effects</i>												
Density	-1.64	0.46	< .001	0.19	-0.44	0.61	0.47	0.65	0.65	0.55	0.23	1.92
Reciprocity	2.35	0.28	< .001	10.46	2.13	0.35	< .001	8.43	2.70	0.24	< .001	14.81
Transitivity	0.50	0.09	< .001	1.65	0.73	0.11	< .001	2.08	0.89	0.09	< .001	2.44
Transitivity x reciprocity	-0.78	0.15	< .001	0.46	-0.45	0.18	0.01	0.64	-0.63	0.12	< .001	0.53
Indegree-popularity	0.10	0.16	0.54	1.10	-0.88	0.40	0.03	0.41	-0.35	0.24	0.14	0.70
Outdegree-activity	0.03	0.08	0.72	1.03	-0.05	0.09	0.60	0.95	-0.53	0.13	< .001	0.59
Reciprocal-degree popularity	-0.67	0.23	< .001	0.51	-0.41	0.28	0.14	0.66	-0.92	0.22	< .001	0.40
<i>Covariates effects</i>												
Same sex	-0.08	0.09	0.34	0.92	0.34	0.11	< .001	1.41	0.12	0.11	0.25	1.13
Same SES	0.01	0.10	0.91	1.01	0.15	0.11	0.18	1.16	-0.15	0.11	0.19	0.86
Academic perf. alter	0.47	0.15	< .001	1.61	0.14	0.17	0.40	1.15	0.36	0.15	0.02	1.44
Academic perf. ego	-0.30	0.13	0.02	0.74	-0.04	0.15	0.81	0.97	-0.33	0.16	0.04	0.72
Academic perf. similarity	0.09	0.44	0.83	1.10	-0.41	0.41	0.31	0.66	-0.35	0.37	0.35	0.70
School misconduct alter	-0.16	0.08	0.03	0.85	0.00	0.03	0.92	1.00	-0.03	0.04	0.35	0.97
School misconduct ego	-0.06	0.06	0.33	0.94	0.02	0.02	0.39	1.02	-0.06	0.03	0.02	0.94
School misconduct similarity	-0.85	0.61	0.16	0.43	-0.28	0.28	0.32	0.76	-0.17	0.28	0.55	0.85
<i>Cross-network effects</i>												
Friendship to Academic	0.90	0.22	< .001	2.46	0.82	0.24	< .001	2.27	0.38	0.20	0.06	1.47

Table 2.3 Academic and friendship networks: RSiena Multi-group Analyses in High-, Low-, and Mixed-ability classrooms (Continued)

Effects	High-ability classrooms			Low-ability classrooms			Mixed-ability classrooms			
	Est.	SE	p	Est.	SE	p	Est.	SE	p	
Friendship networks										
<i>Structural effects</i>										
Density	1.58	1.44	0.27	4.85	0.43	0.99	1.00	1.35	0.45	< .001
Reciprocity	2.39	0.28	< .001	10.95	2.31	< .001	10.02	3.23	0.21	< .001
Transitivity	0.30	0.05	< .001	1.34	0.29	< .001	1.34	0.46	0.03	< .001
Transitivity x reciprocity	-0.26	0.05	< .001	0.77	-0.27	< .001	0.76	-0.46	0.05	< .001
Indegree-popularity	-0.65	0.92	0.48	0.52	-0.40	0.05	0.67	-0.54	0.17	< .001
Outdegree-activity	-0.30	0.08	< .001	0.74	-0.06	0.28	0.94	-0.21	0.05	< .001
Reciprocal-degree popularity	-0.20	0.77	0.80	0.82	-0.40	0.03	0.67	-0.57	0.17	< .001
<i>Covariates effects</i>										
Same sex	-0.10	0.11	0.38	0.91	0.15	0.08	1.17	-0.30	0.08	< .001
Same SES	-0.18	0.09	0.06	0.84	0.03	0.76	1.03	-0.18	0.09	0.04
Academic perf. alter	-0.25	0.13	0.05	0.78	0.13	0.20	1.14	0.31	0.10	< .001
Academic perf. ego	0.29	0.13	0.03	1.34	0.06	0.56	1.06	-0.10	0.12	0.41
Academic perf. similarity	-0.16	0.59	0.78	0.85	0.53	0.07	1.70	-0.58	0.31	0.06
School misconduct alter	-0.10	0.13	0.46	0.91	-0.03	0.17	0.97	-0.04	0.02	0.07
School misconduct ego	0.13	0.07	0.05	1.14	0.01	0.52	1.01	0.03	0.02	0.07
School misconduct similarity	-0.72	0.69	0.30	0.49	-0.17	0.37	0.84	-0.34	0.23	0.13
<i>Cross-network effects</i>										
Academic to Friendship	1.26	0.27	< .001	3.53	1.28	0.01	3.59	0.31	0.24	0.19

Notes. Each model represents a separate multi-group analysis in RSiena. Due to convergence issues, we fixed the Academic and Friendship rate parameters for one classroom in each model. Based on the average of Friendship and Academic rate parameters in the rest of the classrooms, we fixed the mentioned parameters at 20; For the indegree-popularity, outdegree-activity, and reciprocal-degree activity we use the squared version effects; OR: Odds ratio

Cross-network effects. In both high- and low-ability classrooms, academic nominations led to friendships nominations (*academic to friendship* Est. $_{high} = 1.26$, $p_{high} < .001$, $OR = 3.53$; Est. $_{low} = 1.28$, $p_{low} = .01$, $OR = 3.59$). Furthermore, no significant differences were found comparing both types of classrooms for academic nominations leading to friendship nominations ($z = -0.03$, $p = .51$), not supporting the first part of our third hypothesis (*hypothesis 3a*). Finally, as expected, friendship nominations led to academic nominations in both high- and low-ability classrooms (*friendship to academic* Est. $_{high} = 0.90$, $p_{high} < .001$, $OR = 2.46$; Est. $_{low} = 0.82$, $p_{low} < .001$, $OR = 2.27$). No significant differences were found between the two types of classrooms ($z = 0.25$, $p = .40$), consistent with the second part of our third hypothesis (*hypothesis 3b*).

2.4 Discussion

The aim of this paper was to examine the association between friendship and academic networks, and their connection with academic performance and school misconduct across three types of classroom ability compositions (high-, low-, and mixed-ability classrooms). To our knowledge, this study is the first in which the combination of friendship and academics relationships was examined using a short-term longitudinal social network analysis. Building on previous studies, we advanced current knowledge by examining the effect of academic performance and school misconduct on academic and friendship networks comparing classrooms with different types of ability composition. Three main conclusions can be drawn from the results.

First, the results indicated the existence of significant differences in the formation and maintenance of academic networks with peers between high- and low-ability classrooms. Academic nominations in high-ability classrooms were driven partially by a preference to form and maintain relationships with higher-performing students as well as by a preference to avoid academic relationships with students who were engaged in school misconduct. Academic nominations in low-ability classrooms, however, were driven by neither academic performance nor school misconduct. Together, these results partially align with the differentiation-polarization theory, suggesting that in high-ability classrooms an academically-oriented culture exists, whereas in low-ability classrooms an anti-school culture dominates (Berends, 1995; Hargreaves, 1967; Van Houtte, 2006). In high-ability classrooms, academic performance appears to be a desirable attribute for being nominated as an academic partner. These findings are in line with previous social network studies in educational settings that indicate that students with higher academic performance are asked for advice on course-related matters by a large number of classmates (Snijders et al., 2013). On the contrary, school misconduct seems to be detrimental to receiving academic nominations. This supports the idea that risk and deviant behavior (e.g., school misconduct) are negatively associated with academic performance (Hinshaw, 1992; McEvoy & Welker, 2000). The association between academic performance and school misconduct seems to be important in defining the formation and maintenance of academic and friendship networks because both behaviors affect adolescents' attraction to and avoidance of certain peers. For example, a study in Dutch secondary education showed that seventh graders who drank alcohol were more likely to select low-achieving peers as friends, whereas students who did not drink alcohol were more likely to choose high-achieving peers as friends (Gremmen et al., 2018).

Second, we found similarities in the link between academic and friendship relationships comparing high- and low-ability classrooms. As expected, friends tended to study together in both high- and low-ability classrooms. Unexpectedly, we did not find that academic partners form or maintain friendships more often in high-ability than in low-ability classrooms. Academic

relationships, however, often take place outside the school, for instance, when doing homework and preparing for exams. Therefore, asking students with whom they study at school might underestimate these interactions. Future studies should incorporate this consideration to gain better knowledge about academic relationships.

Together, the results of this paper are relevant to enhance educational policies. Regarding school practices, results show how ability grouping can affect peer relations, a key aspect of any educational management (Leithwood et al., 2004). For this reason, principals should know and consider the importance of ability grouping strategies in affecting academic and friendship networks. Regarding teaching, the results show the need for teachers to consider academic and friendship relationships as learning resources that can promote the development of equitable social networks (Hamre et al., 2013), where all children interact daily with classmates with different academic performance. Moreover, the overlap between academic and friendship relationships suggest that the modification of one type of network may affect the other type of relationships.

2.4.1 Limitations and future directions

This study has some limitations to be acknowledged. The sample is relatively small and comes from a specific group of schools. The effective-inclusive schools combine school effectiveness and inclusion (Intxausti et al., 2017), showing in general better performance on standardized tests and higher levels of inclusion in terms of academic achievement in comparison to schools with similar socioeconomic backgrounds. Therefore, it is likely that the differences between high- and low-ability classrooms found in this study will be stronger in schools with lower levels of academic performance and inclusion. Future studies could replicate these hypotheses in schools with different levels of academic orientation and inclusion.

Moreover, future studies on academic networks can also analyze the role of factors such as the meeting opportunities via the seating arrangement in the classroom as well as other school-related factors such as school engagement and truancy (Gremmen, van den Berg, Segers, & Cillessen, 2016). Finally, in this study, we assumed that different ability classrooms reflect different norms of schoolwork. However, we did not directly measure the level of academic norms present in the different types of classrooms. Therefore, future studies could examine this aspect through peer norms, which reflect the expected and accepted behavior in social groups and how this might impact peer relations (Dijkstra & Gest, 2015).

Despite these limitations, featuring a sample of students from secondary education in an understudied context constitutes a clear strength of this study. Evidence from previous studies in ability grouping mainly comes from students in the United States or Europe. Furthermore, we took advantage of multiplex longitudinal social network analysis to model academic and friendship networks simultaneously.

Overall, this study contributes to the literature by testing the effects of academic performance and school misconduct on academic and friendship networks in classrooms with different types of ability composition. We found that only in high-ability classrooms did students choose high-achieving peers as academic partners and avoid choosing peers who engaged in school misconduct as academic partners. Furthermore, in both high- and low-ability classrooms, academic relationships led to friendship relationships, and vice versa. This study, thus, opens a promising research area that links school practices with adolescent peer relationships.

Appendixes

Appendix 2.A

Schools information

Table 2.A Schools information

School number	N° classrooms	First grade	School type	Region	SES
1	2	8°	Public	Metropolitan	Middle
2	5	9°	Public	Coquimbo	Low
3	2	8°	Private subsidized	Metropolitan	Lower-middle
4	2	8°	Private subsidized	Metropolitan	Middle
5	8	9°	Public	O'Higgins	Low
6	5	9°	Public	Maule	Lower-middle
7	5	8°	Public	Coquimbo	Lower-middle
8	3	9°	Private subsidized	Metropolitan	Lower-middle
9	3	7°	Public	Metropolitan	Middle

Notes. First grade: First grade of education offered by the school; SES: The school vulnerability index measured the percentage of students in a school that is considered vulnerable based on family income, medical needs, birth weight, and residential conditions; The Chilean school system includes three types of schools: public, private subsidized, and private.

Appendix 2.B
Sample Information

The participating schools were selected according to their trajectories of school effectiveness and educational inclusion between 2010 and 2015. Regarding school effectiveness, schools were selected when the progress of the majority of the students was better than expected, given the socioeconomic conditions of the families (Hopkins & Reynolds, 2001; Mitchell et al., 2002). Selected schools showed a higher average in the Chilean national standardized tests (SIMCE) in Mathematics and Language in 4th and 10th grade, compared to schools with a similar socioeconomic level. Moreover, the selected schools did not apply selection processes for enrolling students and exhibited lower rates of repetition and dropout. Regarding educational inclusion, this was measured through schools' ability to close learning gaps, understanding that schools that reduce differences in academic outcomes among their students are closer to offering more equitable learning opportunities (Breen & Jonsson, 2005). Specifically, we chose schools that decreased their variance in both SIMCE standardized tests (Mathematics and Language) and Grade Point Average (GPA) throughout the secondary education cycle (from 9th to 12th grade in Chile).

Appendix 2.C
Non-selected classroom networks

Table 2.C Descriptive information about the non-selected classroom networks for time 1 and 2

Class	Grade	Type	Size	Girls %	SES	Acad		Miss		Dist		Jac		AvD		AvD		Jn	Lv
						Perf	Misc	t1	t2	AC	FR	AC	FR	AC t1	AC t2	FR t1	FR t2		
1	7°	M	42	48.78	3.07	5.76	5.00	.21	.00	.74	102	.26	.32	2.77	3.42	5.58	9.52	8	2
2	8°	M	67	50.98	3.88	5.84	2.74	.04	.04	.64	89	.05	.11	2.56	2.40	6.70	6.24	21	22
3	8°	M	69	56.14	3.02	5.52	4.79	.09	.00	.3	2	.00	.00	1.59	2.30	6.17	3.69	29	34
4	8°	M	38	5.40	2.86	5.21	4.73	.06	.15	.39	60	.03	.12	1.43	2.34	9.30	8.90	7	9
5	8°	M	38	0.00	3.30	5.12	4.73	.25	.04	.47	84	.20	.25	2.44	2.91	9.01	9.48	4	7
6	9°	M	52	54.83	2.68	5.61	4.44	.21	.10	.43	62	.15	.16	3.90	2.17	5.20	4.40	15	19
7	9°	M	43	46.42	2.82	5.86	3.79	.23	.12	.60	50	.23	.31	2.63	2.81	5.66	4.69	7	14
8	9°	M	40	44.82	2.45	5.33	3.28	.21	.06	.46	76	.20	.18	2.62	2.27	5.46	4.42	5	13
9	9°	M	45	58.62	2.50	5.42	3.92	.21	.02	.47	66	.15	.16	2.22	1.86	5.19	3.71	9	19
10	9°	M	55	100	3.29	5.22	6.41	.16	.03	1.00	167	.17	.18	2.35	3.06	5.28	4.30	8	17
11	9°	M	49	97.61	3.60	5.83	2.42	.22	.08	.92	92	.40	.50	4.21	3.84	6.27	5.74	1	7
12	9°	L	34	30.76	1.96	5.05	5.67	.33	.02	.23	70	.11	.19	1.68	1.59	6.52	8.36	6	8
13	9°	L	56	32.25	2.21	5.20	6.47	.31	.07	.11	24	.00	.04	.80	1.08	2.23	3.27	18	25
14	9°	L	50	58.06	2.69	4.86	4.46	.20	.05	.12	15	.02	.07	1.20	1.59	2.15	3.86	18	20
15	9°	L	44	100	1.76	5.15	5.73	.42	.10	.88	41	.14	.13	2.37	6.47	3.20	6.47	8	11
Av/Tot.	-	-	722	45.71	2.80	5.40	4.57	.21	.06	49.93	66.67	.14	.18	2.32	2.67	5.59	5.80	164	227

Notes. Type of class (M: Mixed-ability classes; H: High-ability classes; L: Low-ability classes); SES: Average of socio-economic background; Acad Perf: Academic performance; Acad Misc: Academic misconduct; Miss: % of missing data; Dist.: Hamming distance; Jac: Jaccard index; AvD: Average degree; Jn: Number of students who joined the study between assessments; Lv: Number of students who left the study between assessments

Appendix 2.D

Distribution difference among the three types of classrooms

First, we conducted three Shapiro-Wilk tests in R to examine whether each sample comes from a normally distributed population. We compared the academic performance (general GPA) of the students from each type of classroom at the first assessment, finding that the three samples (referring to high-, low-, and mixed-ability classrooms) were not normally distributed ($W_{\text{high}} = 0.95$, $p_{\text{high}} < .001$; $W_{\text{low}} = 0.96$, $p_{\text{low}} < .001$; $W_{\text{mixed}} = 0.97$, $p_{\text{mixed}} < .001$).

Second, we tested whether the samples of students from each type of classrooms come from distinct populations. Using the Mann-Whitney-Wilcoxon Test in R, we found that high-, low-, and mixed-ability classrooms come from different populations ($W_{\text{high-low}} = 38,917$, $p_{\text{high-low}} < .001$; $W_{\text{high-mixed}} = 53,266$, $p_{\text{high-mixed}} < .001$; $W_{\text{low-mixed}} = 54,424$, $p_{\text{low-mixed}} < .001$).

Appendix 2.E
Goodness of fit

Once convergence was reached for all three models, we assessed the goodness of fit of the models by examining the extent to which the models explained additional features of the academic and friendship networks that were not explicitly included in the model specification. Specifically, we examined the distribution of academic and friendship outdegree, indegree, geodesic distance, and triad census. The goodness of fit was assessed by comparing the Mahalanobis distance of the observations to the mean of the simulated values and computing the associated p -value (for more details, see Ripley et al., 2018). To combine the results for the multiple classrooms we use the inverse normal method (for more details see Hedges & Olkin, 1985). For the four statistics, the vast majority of the combined p -values for each type of classroom were between .10 and .90, indicating a good fit. The only cases of unsatisfactory fit were the triad census for friendship networks in high- and mixed-ability classrooms, as well as the triad census for academic networks in high-ability classrooms, and the outdegree distribution for academic networks in mixed-ability classrooms. For the triadic census cases, the triadic configuration with the poorest fit was the 021U ($i \rightarrow b; j \rightarrow b$), which number was underestimated for the model. In the case of the outdegree distribution for academic networks in mixed-ability classrooms, the number of students with none outgoing academic nominations was also underestimated.

