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Research paper

Improving teaching, teamwork, and school organization: Collaboration networks in school teams

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ABSTRACT

Whereas previous studies on teacher collaboration have focused almost exclusively on improving teaching, this paper investigates collaboration in three highly important school improvement areas. Data for three collaboration networks were collected in four secondary schools in Switzerland in 2018 on teachers exploring new ideas on teaching (teaching improvement), teamwork (team improvement), and school organization (organizational improvement). Using social network analysis, we examined to what extent the collaboration networks overlap, how network structures differ, and what factors explain these differences. The results revealed substantial differences between collaboration in the three areas. This suggests that future research should examine collaboration from a multidimensional network perspective.

1. Introduction

Teacher collaboration is an essential condition for successful improvement processes in schools (García-Martínez, Montenegro-Rueda, Molina-Fernández, & Fernández-Batanero, 2021; Muckenthaler, Tillmann, Weiß, & Kiel, 2020; Nguyen & Ng, 2020; Weddle, Lockton, & Datnow, 2020). Schools are "loosely coupled systems" (Weick, 1976) with rather organic structures. Therefore, inquiry processes initiated to respond to discrepancies between expected and actual conditions and to improve teaching and learning take place less via a top hierarchy and more in the interactions between the actors (Butler & Schnellert, 2012). Accordingly, actors have to work and learn together discursively and through negotiation in order to achieve agreed-upon goals in teaching and learning (Mitchell & Sackney, 2011). From this perspective, the importance of collaboration for school improvement can be explained by the fact that collaboration is supposed to be effective in building personal, interpersonal, and organizational capacity (e.g., a professional culture in schools or developing teachers professionally), which in turn should lead to improved instructional quality and ultimately to better student performance (García-Martínez et al., 2021; Goddard, Goddard, & Tschannen-Moran, 2007; Mincu, 2015; Mitchell & Sackney, 2011; Nguyen & Ng, 2020; Ronfeldt, Farmer, McQueen, & Grissom, 2015).

School improvement theory distinguishes between different but interrelated areas of improvement, especially teaching improvement, team improvement, and organizational improvement (Fullan, 1992; Harris, 2002; Hopkins, 2001; Mitchell & Sackney, 2011; Rolff, 2016). However, previous studies examined teacher collaboration focusing solely on classroom practice (e.g., Stoll, Bolam, McMahon, Wallace, & Thomas, 2006; Toole & Louis, 2002; Vangrieken, Dochy, Raes, & Kyndt, 2015) and thereby on effective teaching for learning as teachers' "primary task" (James, Dunning, Connolly, & Elliott, 2007). Even if some studies had different foci or examined different types of teacher collaboration, e.g., exchange of material and mutual classroom observations (Schuster, Hartmann, & Kolleck, 2021), they were always related to classroom practice (Doppenberg, den Brok, & Bakx, 2012; Hartmann, Richter, & Gräsel, 2021; Levine & Marcus, 2010). Up to now, there seems to be a consensus in research that the focus of teacher collaboration should be on teaching and student learning (Imants, 2002; Meirink, Imants, Meijer, & Verloop, 2010; Plauborg, 2009).

However, referring to the concept of school improvement,

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which distinguishes different areas of improvement, we argue that this exclusive view of teacher collaboration as centering on classroom practice (teaching improvement) falls short of capturing and understanding the full range of collaborative improvement processes in schools. It is undisputed that the focus of collaboration on classroom practices is of great importance for the aspired 'end product' of the school improvement process, namely, students' successful learning. However, in light of school improvement theories, the context and conditions of the teaching-learning processes in schools must also be considered (Hopkins, 2005). Addressing in addition also collaboration that aims to improve teacher teamwork (team improvement) and the school as an organization (organizational improvement) broadens the view on processes of improvement and professionalization of the overall school (Maag Merki, 2008). This differentiated view will help teachers and school leaders to make more targeted improvements to their collaborative practice when improving their school. To address this gap, in this study we examine similarities and differences in collaboration on teaching improvement, team improvement, and school improvement. We investigate whether and how collaboration and its influencing factors differ in these school improvement areas by measuring and comparing three social networks among teachers in four lower secondary schools in the German-speaking part of Switzerland.

1.1. Teacher collaboration on school improvement

The working together of teachers is described and researched in the international literature using a variety of terminologies and conceptualizations (Vangrieken et al., 2015, 2017). For this paper, we are guided by the concept of collaboration. Collaboration in general is defined as "joint interaction in the group in all activities that are needed to perform a shared task" (Vangrieken et al., 2015, p. 23). It refers to teachers actually "doing things together" (Kelchtermans, 2006, p. 220) for job-related tasks that include all activities necessary for fulfillment of a common task or profession-related goal. When doing things together, it is important to jointly negotiate, discuss, and consider different views. The concept of collaboration is often distinguished from cooperation, in which teachers divide their work and then combine it back into a whole to accomplish a shared goal (McInnerney & Robert, 2004; Panitz, 1996). It is further distinguished from collegiality, in which the focus is more on the quality of teachers' relationships (Bovbjerg, 2006).

Several studies have further differentiated collaboration. One strand of research describes quality standards of collaboration; Kruse, Louis, and Bryk (1995), for instance, discuss characteristics like "reflective dialogue" and "deprivatization of practice." Another strand describes a continuum of different types of collaboration; Little (1990), for example, describes a continuum from independence to interdependence, ranging from "storytelling and scanning" to "joint work." Still another strand distinguishes forms of collaboration; Gräsel, Fußangel, and Pröbstel (2006) distinguish between exchange of information and materials, synchronization, and co-construction, and the Teaching and Learning International Survey (OECD, 2020) distinguishes exchange and coordination from professional collaboration. In our study, we examine collaboration on school improvement and ask school team members about with whom they explore new ideas. We believe that this kind of collaboration between school actors has the potential to be of higher quality, more on the interdependence side of the continuum or more co-constructive in nature.

This paper bases on a social network perspective on teacher collaboration (Daly, 2010; Moolenaar, 2012). To explain why a social network perspective facilitates the understanding of interactions as a basis of collaboration, the literature draws heavily on social capital theories. According to Bourdieu (1986) and Lin (2002), social capital refers to relationships with other people that provide indirect access to the other persons' capital. Through this access, resources can be shared, borrowed, and leveraged to achieve goals. Applied to education, the theory focuses on the resources and expertise of teachers that are available to them through social interactions with professional colleagues. In doing so, it assumes that there are certain network-related features that provide access to appropriate resources to further develop the school and the classroom more effectively (Coburn & Russell, 2008; Penuel, Riel, Krause, & Frank, 2009). From the perspective of social network research, interactions concerning work-related information, knowledge, ideas, experience, or expertise form the core of collaboration, as they provide access to other actors' capital (Moolenaar, Daly, & Sleegers, 2012; Moolenaar, Sleegers, & Daly, 2012; Moolenaar et al., 2014). Following these argumentations, we consider interactions between teachers to be highly relevant to individual and collective professional development in schools.

In this context, collaboration has the function to build personal (e.g., values, beliefs, knowledge), interpersonal (e.g., affective and cognitive climate), and organizational (e.g., structures and processes) capacities to competently manage change with the final goal of improving teaching and learning (Hopkins, 2005; Mitchell & Sackney, 2011; Spillane & Louis, 2002; Stoll et al., 2006). This can occur by changing routines and thus rather in smaller steps (Maag Merki, Wullschleger, & Rechsteiner, 2022), or by implementing larger innovations, such as digitization efforts in connection with COVID-19. Building these capacities by actively changing cognition and behavior is achieved through collaborative efforts in all school improvement areas (Fullan, 1992; Harris, 2002; Hopkins, 2001; Rolff, 2016):

(1) in the area of teaching improvement, where the focus is on classroom practice (e.g., making changes to improve test materials)
(2) in the area of team improvement, where the focus is on working together in the school team or in smaller teams such as grade-level teams (e.g., making changes to improve collaboration within the team)
(3) in the area of organizational improvement, where the focus is on structures and processes in the school as an organization (e.g., making changes to improve evaluation processes)

Although these areas describe different contents of teacher collaboration for school improvement, they are interrelated in the school system, as the areas of the collaboration cannot develop in isolation from the others (Rolff, 2016). Further, collaboration in all areas of school improvement supports capacity building in all fields (Fig. 1).

Summing up, for our research we define collaboration as social interactions between two or more actors in a school's social network with the common task and goal of exploring new ideas for school improvement. Because such collaboration involves joint discussion and negotiation, it is close to interdependent and co-constructive forms of collaboration. The aim of this study is to investigate teacher collaboration in different school improvement areas (teaching, team, and organizational improvement) by means of social network analysis. The focus is on analyzing to what extent the social networks across the three areas overlap, how they differ in their network structure, and what characteristics of the team members and schools explain their structure.

1.2. Social network approach to studying teacher collaboration

To address this aim, we examine collaboration on improvement

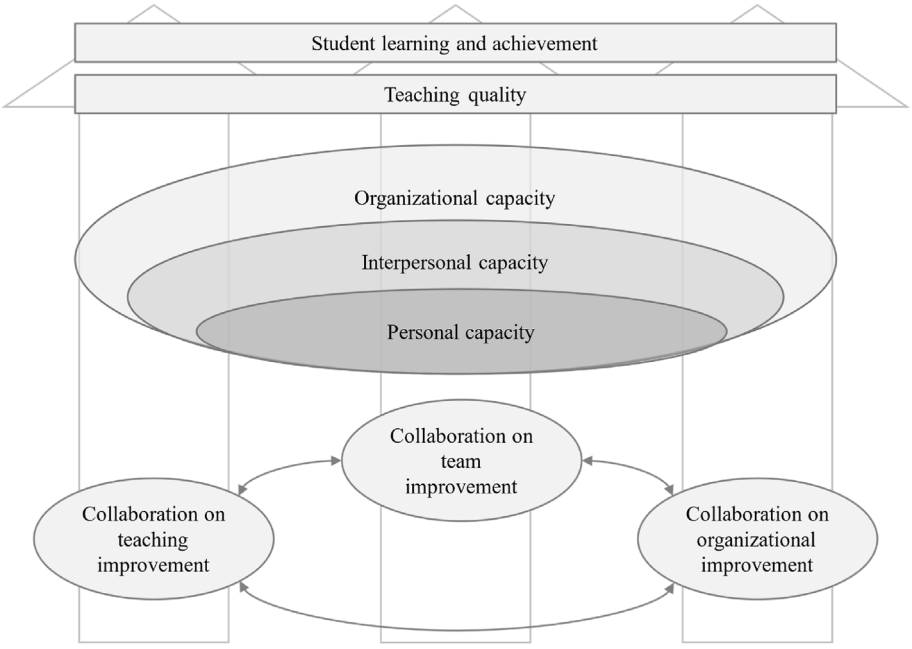


Fig. 1. Function of collaboration on school improvement areas for capacity building.

practices of school teams using a social network approach (Wasserman & Faust, 1994). Previous studies have used different methodological approaches to investigate collaboration in schools. Quantitative, mixed-methods, or qualitative approaches use interviews, focus group discussions, surveys, or observations. Weddle's (2020) literature review of approaches to examining collaboration for instructional improvement revealed that social network analysis is not yet widely used in the field. Only three of the 43 studies reviewed integrated social networks in their studies. In quantitative approaches, collaborative practices are often captured using quite general questions in survey data and do not capture direct interactions between actors (Wullschleger, Maag Merki, Rechsteiner, & Rickenbacher, 2019). By analyzing social networks in school teams, collaboration can be captured in a more straightforward way "by focusing on the patterns of social relationships among teachers that result from their interactions in practice" (Moolenaar, 2012, p. 8).

Previous research on collaboration among teachers using social networks has focused in particular on characteristics of individuals, subgroups, or schools that influence collaboration.

1.2.1. Individual characteristics of school staff influencing collaboration

Gender seems to be relevant for the probability to seek out or to be sought out for work-related discussions, in the way that women send more relationship ties than men but men receive more ties than women (Moolenaar et al., 2014). However, this effect is not seen in advice networks related to supporting vulnerable children (Ortega, Boda, Ghompson, & Daniels, 2020). *Age* had a negative receiver effect in Moolenaar et al. (2014), suggesting that older teachers are less likely to be addressed. This contrasts with Geeraerts, Van de Bossche, Vanhoof, and Moolenaar (2017), which examined the more general generational cohort (young, middle, old). *Working full time* shows a lower probability of having social ties with colleagues than working part time, which Moolenaar et al. (2014) assume to be related to higher coordination needs of part-time teachers. But *experience* (seniority) results in a higher probability to be sought out for work-related discussions and advice (Moolenaar et al., 2014; Ortega et al., 2020). *Attitude* towards collaboration is important for collaboration on the exchange of materials, as a positive attitude leads to an increased probability of exchanging instructional material (Schuster et al., 2021). Another element is *trust*. Trust is key to collaboration, as the willingness to implement innovations is low if people do not trust each other (Louis, 2007; Moolenaar et al., 2014; Moolenaar & Sleegers, 2010; Tschannen-Moran, 2001). A high level of trust leads to more effective forms of collaboration for improvement (Brown, Daly, & Liou, 2015; Cerna, 2014). *Principals* have no higher probability for work-related discussions in Moolenaar et al. (2014). However, studies focusing not only on principals but also on other formal leaders (e.g., assistant principals) found that leaders are important sources of advice and information and prove to be prominent brokers in this regard (Bryant, Yiu Lun, & Adams, 2020; Ortega et al., 2020; Schuster et al., 2021; Spillane & Kim, 2012). Additionally, leaders are central when it comes to the diffusion of reforms (Daly, Moolenaar, Bolivar, & Burke, 2010).

1.2.2. Characteristics of subgroups influencing collaboration

The main object of investigation here is affiliation with a grade level or a department. School team members working on the same *grade level* have more work-related relationships than other team members (Moolenaar et al., 2014; Spillane, Kim, & Frank, 2012) and share resources on learning and teaching (Downey, 2018), and if their network is dense, they are important in enacting deep-level reforms (Daly et al., 2010). Findings regarding affiliation with a *school subject department* in secondary education are similar (Schuster et al., 2021). Teachers share teaching materials within their school subject department to a great extent (Downey, 2018), and they are more likely to seek information within their department (Meredith, Van den Noortgate, Struyve, Gielen, & Kyndt, 2017). In addition to the influence of formal subgroups, informal collaboration also plays an important role in school improvement (Meredith, Moolenaar, et al., 2017; Woodland & Mazur, 2019). Related to more informal subgroups and with it to more informal preferences for working together, staff members seem to prefer relationships with *same-gender peers* (homophily effect) both when

discussing work and when seeking or receiving advice or information (Moolenaar et al., 2014; Ortega et al., 2020; Schuster et al., 2021; Spillane et al., 2012). A homophily effect is also evident for *experience* (seniority) (Ortega et al., 2020; Schuster et al., 2021).

1.2.3. School-level characteristics influencing collaboration

School-level characteristics seem to have little influence on social networks in school teams. *Overall team experience* has been found to have a positive effect on the probability of relationships, but no effects have been found *for school size, school team size*, or *socioeconomic status* (Moolenaar et al., 2014).

As this brief literature review shows, different factors at different levels influence collaboration in school teams. Building on this, this study investigates whether influencing factors differ when it comes to collaboration in different school improvement areas. We include a selection of individual and subgroup characteristics influencing collaboration. As school-level characteristics had hardly any effects in previous studies, we omit them from our study.

1.3. Research questions

The previous studies reviewed above show that the study of teacher collaboration has moved one step closer to understanding school improvement practices of school teams by analyzing them through social networks. However, the studies mentioned above focused exclusively on collaboration for teaching improvement. This, again, is in strong contrast to the theoretical concept of school improvement as a multidimensional phenomenon (Hopkins, 2001; Mitchell & Sackney, 2011; Rolff, 2016).

In this study, we venture on an empirical journey to investigate whether and how collaboration differs in three school improvement areas by measuring and comparing three social networks among teachers exploring: new ideas on teaching, on teamwork, and on school organization. The study is guided by the following research questions:

(1) To what extent do collaboration ties in each school's networks overlap across the three school improvement areas?
(2) To what extent is the structure of collaboration networks in school teams (dis)similar across the three school improvement areas?
(3) Do individual and subgroup characteristics explain structural differences in the networks for the three school improvement areas?

As the school improvement areas describe different contents of teacher collaboration but at the same time develop in an interrelated way (Rolff, 2016), we hypothesize that collaboration of teachers in the three networks on teaching, team, and organizational improvement overlaps to some extent but nonetheless has clearly individual shares (research question 1). As there is a lack of research on how the areas differ regarding network structure, this part of the study is exploratory in nature (research question 2). As previous research has found that, in particular, individual and subgroup characteristics are related to collaboration on teaching improvement (e.g., Moolenaar et al., 2014; Spillane et al., 2012), we assume that this will also be the case in the same way in our teaching network (research question 3). Additionally, we assume that different individual and subgroup characteristics may be relevant in shaping the networks of collaboration on improving teamwork and school organization.

2. Methodology

2.1. Participants and procedure

Data for this analysis were drawn from a larger study that investigated school improvement capacity at four lower secondary schools (students aged 13 to 15) in the German-speaking part of Switzerland. In Switzerland, compulsory education lasts 11 years; the lower secondary level comprises three years. At the lower secondary level, instruction usually takes place in level-separated classes (EDK, 2022a). Teachers are trained at universities of teacher education for 4.5–5 years, where they become certified to teach three to four school subjects (EDK, 2022b). Many school teams in secondary schools are organized in instructional teams by grade level or school subject.

All schools participated voluntarily in the study. Two schools were located in more urban and two in more rural regions. The schools were similar in size, and a total of 105 employees (58% women) participated in the study, working as principals, teachers, and specialist teachers. Of the employees, 25% held a leadership position, either as principal or in another formal leadership position typically referred to as middle leader (Bryant et al., 2019) (Table 1). In all cases, middle leaders belonged to the steering group of the school together with the principal, and in most cases, middle leaders were head of a grade-level team.

In September 2017, the participants filled out an online questionnaire (response rate 83%). In addition to the network questions, the questionnaire also contained items on individual characteristics of school team members.

2.2. Data collection and measures

For the social network data collection, principals, teachers, and specialist teachers were asked to indicate their interaction with other school team members regarding school improvement. The network question was similar to the question in Moolenaar et al. (2014) on teaching improvement; we adapted it to include team and organizational improvement:

(1) With whom did you explore new ideas on teaching last year?
(2) With whom did you explore new ideas on working together in your team(s) last year (e.g., grade-level team)?
(3) With whom did you explore new ideas on issues of school organization last year?

Further, participants provided information on their trust relations with other team members based on the following network question: Imagine you need support with an emotional-motivational problem at school (e.g., stress, dissatisfaction): To whom would you turn?

Study participants at each school received a name roster with their school team members in rows, so that they could indicate with whom they had explored ideas on school improvement.

2.3. Analytic approach

First, to investigate to what extent collaboration ties in the three school improvement areas overlap, we created Venn diagrams (Vörös & Snijders, 2017) and tested correlations using the quadratic assignment procedure (QAP) (Krackhardt, 1987). We performed the analyses in R using the venneuler (Wilkinson, 2011; version 1.1–0) and sna (Butts, 2008; version 2.5) packages.

Second, to explore the extent to which the structure of collaboration varies across school improvement areas, we calculated statistics that describe the structure of networks (e.g., de Lima,

Table 1
Overview of the characteristics of the participating schools ($N_{school} = 4$, $N_{staff} = 105$).

	N_{staff}	f	Response rate	Seniority at school (years)			Percentage of full-time employment (full-time employment = 100%)		Leadership position
School				0–3	4–9	≥10	<80%	80–100%	
1	24	14 (58%)	19 (79%)	4 (21%)	8 (42%)	7 (37%)	9 (47%)	10 (53%)	6 (32%)
2	23	15 (65%)	19 (83%)	4 (21%)	7 (37%)	8 (42%)	9 (47%)	10 (53%)	5 (26%)
3	30	14 (47%)	25 (83%)	5 (20%)	4 (16%)	16 (64%)	9 (36%)	16 (64%)	8 (32%)
4	28	18 (64%)	24 (86%)	7 (29%)	6 (25%)	11 (46%)	10 (42%)	14 (58%)	6 (25%)
Total	105	61 (58%)	87 (83%)	20 (23%)	25 (29%)	42 (48%)	37 (43%)	50 (57%)	25 (29%)

2010; Robins, 2015) in each of the schools (Table 2). We used the igraph software package in R (Csardi & Nepusz, 2006; version 1.2.5).

Third, to examine how individual and subgroup characteristics explain the structure of the three networks, we applied exponential random graph models (ERGMs) using the statnet package in R (Handcock et al., 2018; version 2019.6). The basic idea of ERGMs is that a network is generated by a stochastic process in which the presence of ties is influenced by the presence or absence of other ties (internal network patterns referred to as structural factors), actor-level attributes (individual factors), or other contextual factors (oftentimes dyadic tie covariates, e.g., other networks whose ties may predict the corresponding tie in the network of interest) (Lusher et al., 2013). As structural factors, we included reciprocity, transitivity, indegree, outdegree, and mixed indegree and outdegree (two-paths) effects (Harris, 2013). As individual factors, we included gender, seniority at school, percentage of full-time employment, and leadership position. For these individual factors, we included sender effects (likelihood of persons with a specific attribute to approach someone to explore new ideas), receiver effects (likelihood of persons with a specific attribute to be approached to explore new ideas), and homophily effects (likelihood of persons sharing the same individual attribute to be connected). As contextual factors, we included trust relations with colleagues, which were measured as a network alongside the three forms of collaboration. For the contextual factors, we considered the impact of sending, receiving, and having a mutual trust tie with a colleague on exchanging ideas about work. For the full list of ERGM terms used in our models, see Appendix A. The final models had adequate goodness of fit (Hunter, Goodreau, & Handcock, 2008); see Appendix B.

The individual and subgroup characteristics in our research question are reflected in several places in the ERGM model. The individual characteristics refer to the sender and receiver effects of gender, seniority at school, percentage of full-time employment, leadership position, and trust. The subgroup characteristics refer to the structural factors, the homophily effects of gender, seniority at school, percentage of full-time employment, and leadership position, and the mutual tie effect of trust.

For the ERGM analyses, we first imputed missing data regarding explanatory factors. We applied multiple imputations including auxiliary variables and created 100 imputed datasets. To take the multilevel structure of the data into account (teachers nested in schools), we worked with multilevel regression using the pan and mitml packages in R (Grund, Lüdtke, & Robitzsch, 2016). We subsequently ran the ERGM analyses on all 100 datasets and combined the resulting estimates with meta-analysis techniques using weighted least squares estimates (Schwarzer, Carpenter, & Rücker, 2015). See Appendix C for further details.

3. Results

3.1. Overlap of collaboration across the three school improvement areas (RQ 1)

Table 3 presents the overlap of ties in the three collaboration networks in the four schools. The Venn diagrams revealed that the networks were related, but the proportion of ties without overlap was close to or over 50% in all four schools. This means that in about half of the collaboration ties, teachers explored ideas on only one of the three school improvement areas. The QAP results indicated a medium correlation between most network pairs in all four schools. All observed correlations were significantly larger than what would be expected given the structure of the networks. In other words, teachers talked to the same colleagues about various issues more often than would be expected by chance.

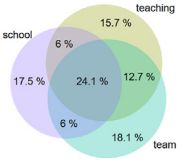
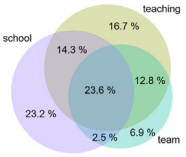
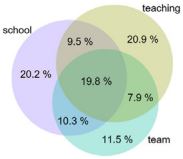
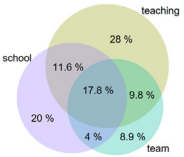
3.2. Differences in school improvement areas regarding the collaboration structure (RQ 2)

To illustrate the main findings on the structural differences between the three networks, network plots of school 2 are presented as an example (Fig. 2) and related to the findings of all schools (Table 4).

Table 2
Description of network statistics.

Network statistic	Description
Density	Proportion of actual relationships to possible relationships in the network. Indicator of how actively school teams exchange new ideas.
Centrality and centralization	Importance of persons in the network. Centrality is about single actors. Centralization is a measure of the dispersion of centrality values across all actors. It summarizes the centrality of all persons in the network on a continuum between "all actors are equally central" and "one actor is maximally central."
Actors can be central with regard to the following aspects:	
Degree	Total number of relationships
Indegree	Number of incoming relationships; indicator for the prestige of a person
Outdegree	Number of outgoing relationships; indicator for the activity of a person
Reciprocity	Tendency for relationships to be mutual; proportion of reciprocal ties to non-empty ties; indicator of mutual exchange between team members
Clustering (transitivity)	Relationships between three actors in the network (triads); proportion of closed triads to open triads; indicator for subgroups or cliques in the network

Table 3
Venn diagrams and QAP correlations of the networks for new ideas on teaching, teamwork, and school organization ($N_{school} = 4$).

School	1	2	3	4
Venn diagrams				
Correlations between networks	QAP correlations			
Teaching and teamwork	.504	.533	.406	.433
Teaching and school organization	.414	.383	.367	.364
Teamwork and school organization	.397	.303	.449	.372

Note. $P_{large} = 0$ and $p_{small} = 1$ for all correlations.

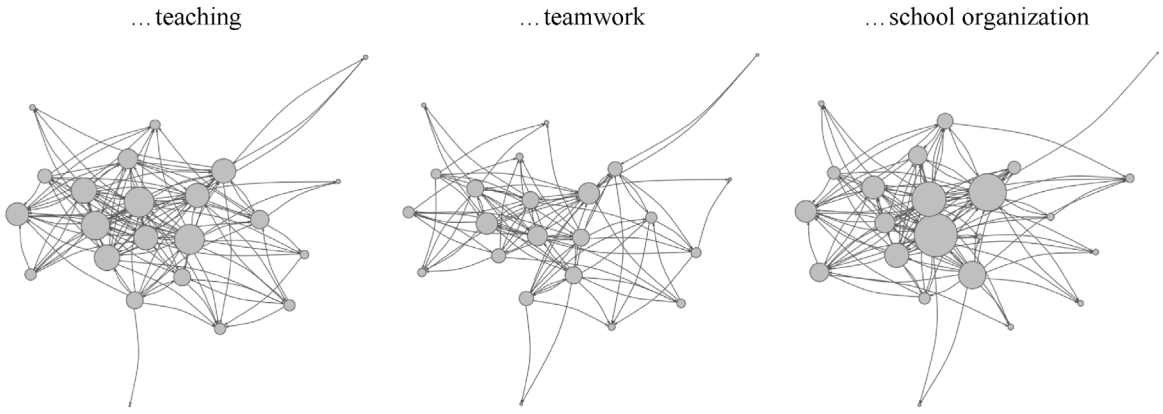


Fig. 2. Network plots of school 2. Exploring of new ideas on ….
Note. The size of the nodes (actors) refer to their total degree centrality.

Table 4
Descriptive measures of the networks for new ideas on teaching, teamwork, and school organization ($N_{school} = 4$).

School	1			2			3			4		
Network	Teaching	Teamwork	School organization	Teaching	Teamwork	School organization	Teaching	Teamwork	School organization	Teaching	Teamwork	School organization
Density	.176	.183	.161	.271	.184	.255	.180	.152	.203	.209	.131	.164
Centralization												
Degree	.202	.149	.353	.216	.164	.446	.224	.200	.271	.379	.229	.348
Indegree	.172	.165	.187	.229	.316	.427	.406	.262	.417	.310	.202	.429
Outdegree	.259	.426	.534	.547	.225	.700	.233	.366	.693	.569	.239	.429
Reciprocity	.536	.495	.472	.409	.344	.450	.471	.333	.294	.532	.404	.419
Transitivity	.389	.445	.392	.610	.455	.575	.374	.454	.509	.419	.374	.423

Note. Highlighted in gray are the main results referred to in the text.

Regarding the *density of the networks*, the plots showed that there were not as many relationships in the network concerned with new ideas on teamwork as there were in the other two areas. This means that new ideas on teamwork were explored in fewer pairs of teachers than new ideas on teaching and school organization. This pattern could be observed in this clarity in three schools (Table 4).

Regarding the *degree of centralization*, the plots showed that the exploration of new ideas on teamwork was quite equally distributed among the actors. Concerning exploration of new ideas on teaching, some teachers were more central than others (bigger nodes). This was especially true for the network concerning the exploration of new ideas on school organization, which was clearly more centralized than the other networks. As shown by the large nodes in the center of the plot, a few actors were very important when exploring new ideas on the school as an organization. In Table 4, centralization in the networks was compared based on three measures. These results reflected the described pattern in this clarity in three schools.

Regarding *reciprocity* (ranging from 0.3 to 0.6) and *transitivity* (ranging from 0.37 to 0.7), no clear patterns for the three networks was observed. All networks showed moderate to high proportions of mutual dyads and transitive triads.

3.3. Differences between school improvement areas explained by individual and subgroup characteristics (RQ 3)

The results for the third research question come from several ERGMs. The results of the individual networks are presented first and then compared to each other.

3.3.1. Factors related to the network of new ideas on teaching

In the model on exploration of new ideas on teaching (Table 5) the results revealed that *structural factors* were the most consistently significant across the schools. There was a significant and positive *reciprocity* effect in all schools. It signified that the exploration of new ideas on teaching had a higher probability to be mutual than to be unidirectional. Further, the results suggested that: (1) two teachers were more likely to discuss ideas on teaching if they also talked about teaching issues with the same colleagues (transitivity positive). This means that there were subgroups of actors who were more densely connected to each other than the rest of the school team; (2) there was a negative effect of mixed indegree and outdegree (two-paths). This means that actors who approached someone to explore new ideas on teaching tended to be less frequently approached by others and vice versa; and (3) there was a negative outdegree effect, meaning that most actors seemed to have similar levels of activity.

Looking at *individual factors* of school team members, the findings showed that there were few effects and that they were not consistently significant across schools. But, regarding *contextual factors*, the results reveal that trust was of importance when approaching someone to explore new ideas on teaching (one school) and when being chosen to explore new ideas on teaching (three schools). Beyond this, mutually trusting each other appears to further facilitate the exploration of new ideas on teaching (three schools).

3.3.2. Factors related to the network of new ideas on teamwork

In this model (Table 6), similar results as in the teaching model were observed. Regarding *structural factors*, reciprocity was significant and positive in all schools, and the patterns of transitivity (positive) and for mixed indegree and outdegree (negative two-paths) were significant across all four schools.

Looking at *individual factors* of school team members, there were no effects at all for gender and seniority at the school and nearly no effects for percentage of full-time employment. But for exploring new ideas on teamwork, a leadership position seemed to have some importance. There were positive and significant effects on receiver covariates in three schools. This means that team members with a leadership position were more likely to be approached for new ideas

Table 5
ERGM results of the network for new ideas on teaching ($N_{school} = 4$).

Network	Teaching							
School	1		2		3		4	
	Meta-estimate	*Pr* ($p < 0.05$)	Meta-estimate	*Pr* ($p < 0.05$)	Meta-estimate	*Pr* ($p < 0.05$)	Meta-estimate	*Pr* ($p < 0.05$)
Structural terms								
Density	-2.614	100/100	-2.219	100/100	-1.772	100/100	-1.741	100/100
Reciprocity	2.386	100/100	0.942	100/100	2.173	100/100	1.517	100/100
Transitivity (α=0.69)	0.557	100/100	0.139	0/100	0.487	100/100	0.493	100/100
Two-paths	-0.141	100/100	-0.035	0/100	-0.195	100/100	-0.109	100/100
Indegree (α=0.69)	-0.174	0/100	-0.505	0/100	-0.331	0/100	-0.872	0/100
Outdegree (α=0.69)	-1.678	100/100	-3.968	100/100	-2.608	100/100	-1.243	0/100
Gender								
Sender covariate	0.059	0/100	0.144	0/100	0.095	0/100	0.287	0/100
Receiver covariate	0.038	0/100	-0.373	0/100	-0.529	100/100	0.260	0/100
Homophily	0.213	0/100	0.382	0/100	0.502	100/100	0.331	92/100
Seniority at school								
Sender covariate	-0.238	0/100	-0.234	100/100	-0.051	0/100	-0.323	100/100
Receiver covariate	0.218	0/100	0.219	0/100	0.017	0/100	0.128	0/100
Homophily	-0.213	0/100	0.249	0/100	0.040	0/100	0.292	0/100
Percentage of full-time employment								
Sender covariate	0.083	0/100	0.126	0/100	0.248	0/100	-0.051	0/100
Receiver covariate	0.031	0/100	0.700	100/100	0.189	0/100	0.106	0/100
Homophily	0.587	100/100	0.369	0/100	0.240	0/100	0.047	0/100
Leadership position								
Sender covariate	0.656	100/100	0.174	0/100	0.201	0/100	0.287	0/100
Receiver covariate	0.260	0/100	1.065	100/100	1.163	100/100	0.226	0/100
Homophily	0.183	0/100	0.337	0/100	-0.009	0/100	-0.186	0/100
Trust								
Tie sent	0.484	0/100	1.756	100/100	0.922	1/100	-0.352	0/100
Tie received	1.330	100/100	1.802	100/100	1.053	100/100	0.840	0/100
Mutual tie	0.876	0/100	1.968	100/100	2.146	100/100	2.882	100/100

Note. Pr is the proportion of imputed datasets in which the term is significant ($p < 0.05$). Highlighted in gray are the results that are significant at 0.05 in at least 95 imputed datasets.

on teamwork than team members without a leadership position. And, similar to the teaching network, the *contextual factor* trust was of great importance in this area as well, especially when being chosen to explore new ideas on teamwork.

3.3.3. Factors related to the network of new ideas on school organization

Looking at *structural factors*, in this model (Table 7) there was a significant and positive reciprocity effect in only one school. Other structural terms were particularly relevant in one school, whereas they seemed to be less important in the other schools.

Looking at *individual factors* of school team members, a leadership position was the most relevant. There were positive and significant effects on receiver covariates in three schools (team members with a leadership position were more likely to be approached to explore new ideas on school organization), positive and significant effects on sender covariates in two schools (team members with a leadership position were more likely to actively approach others), and a positive and significant homophily effect in one school (team members with a leadership position explored new ideas on school organization with each other). Further, the *contextual factor* trust was important in all schools, especially if there was mutual trust.

3.3.4. Comparison of the three networks

Focusing on *structural factors*, there were clearly more mutual relationships on improving teaching and teamwork than on improving school organization. Further, new ideas were explored more in subgroups in the teaching and teamwork improvement networks than in the organizational improvement network. These results supported the conclusion that subgroup processes were decisive for exploration on teaching and teamwork and that they remained important even though we accounted for homophily in a number of variables.

For *individual factors* of team members, there were few to no effects regarding gender, seniority at the school, and percentage of full-time employment in all networks. But a leadership position was the most important when exploring new ideas on school organization and a little less but also important in the teamwork network.

The *contextual factor* trust, especially ties received and mutual trust, was of great importance in all networks.

4. Discussion

The aim of this paper was to investigate teacher collaboration on teaching, team, and organizational improvement to gain an understanding of: (1) whether and how teacher collaboration is

Table 6
ERGM results of the network for new ideas on teamwork ($N_{school} = 4$).

Network	Teamwork							
School	1		2		3		4	
	Meta-estimate	*Pr* ($p < 0.05$)	Meta-estimate	*Pr* ($p < 0.05$)	Meta-estimate	*Pr* ($p < 0.05$)	Meta-estimate	*Pr* ($p < 0.05$)
Structural terms								
Density	-2.703	100/100	-2.620	100/100	-3.177	100/100	-3.450	100/100
Reciprocity	1.676	100/100	1.248	100/100	1.127	100/100	1.483	100/100
Transitivity (α=0.69)	1.355	100/100	0.745	100/100	1.139	100/100	0.825	100/100
Two-paths	-0.313	100/100	-0.165	100/100	-0.257	100/100	-0.109	0/100
Indegree (α=0.69)	0.336	0/100	1.058	0/100	3.510	100/100	1.449	0/100
Outdegree (α=0.69)	-0.550	0/100	-1.621	100/100	-0.905	0/100	0.232	0/100
Gender								
Sender covariate	0.386	7/100	0.104	0/100	-0.084	0/100	0.432	0/100
Receiver covariate	0.058	0/100	-0.201	0/100	-0.084	0/100	-0.121	0/100
Homophily	0.114	0/100	0.052	0/100	0.186	0/100	0.256	0/100
Seniority at school								
Sender covariate	-0.174	0/100	-0.177	0/100	-0.052	0/100	-0.216	0/100
Receiver covariate	0.066	0/100	0.107	0/100	-0.012	0/100	0.015	0/100
Homophily	0.269	0/100	0.288	0/100	0.253	0/100	-0.044	0/100
Percentage of full-time employment								
Sender covariate	0.067	0/100	0.262	0/100	-0.101	0/100	-0.345	0/100
Receiver covariate	-0.179	0/100	0.353	0/100	0.240	0/100	0.258	0/100
Homophily	0.396	100/100	0.401	0/100	0.281	0/100	0.150	0/100
Leadership position								
Sender covariate	0.653	100/100	0.046	0/100	0.448	88/100	-0.107	0/100
Receiver covariate	0.650	100/100	0.725	90/100	1.457	100/100	1.079	100/100
Homophily	0.146	0/100	0.162	0/100	0.066	0/100	0.290	0/100
Trust								
Tie sent	0.289	0/100	1.627	100/100	1.538	100/100	2.191	100/100
Tie received	1.031	100/100	1.866	100/100	1.400	100/100	1.258	100/100
Mutual tie	0.602	0/100	1.206	0/100	1.792	100/100	2.692	100/100

Note. *Pr* is the proportion of imputed datasets in which the term is significant ($p < 0.05$). Highlighted in gray are the results that are significant at 0.05 in at least 95 imputed datasets.

Table 7
ERGM results of the network for new ideas on school organization ($N_{school} = 4$).

Network	School overall							
School	1		2		3		4	
	Meta-estimate	*Pr* ($p < 0.05$)	Meta-estimate	*Pr* ($p < 0.05$)	Meta-estimate	*Pr* ($p < 0.05$)	Meta-estimate	*Pr* ($p < 0.05$)
Structural terms								
Density	-3.343	100/100	-3.883	100/100	-5.002	100/100	-4.325	100/100
Reciprocity	1.299	100/100	0.595	0/100	0.206	0/100	0.599	0/100
Transitivity (α=0.69)	0.389	0/100	0.709	10/100	1.117	100/100	0.861	100/100
Two-paths	-0.099	0/100	-0.075	0/100	-0.209	100/100	-0.057	0/100
Indegree (α=0.69)	-0.305	0/100	0.199	0/100	2.621	100/100	1.100	0/100
Outdegree (α=0.69)	-2.400	100/100	-3.003	100/100	-1.724	100/100	-0.969	0/100
Gender								
Sender covariate	0.081	0/100	0.631	100/100	0.016	0/100	-0.324	0/100
Receiver covariate	0.067	0/100	-0.203	0/100	0.024	0/100	0.905	100/100
Homophily	0.110	0/100	0.377	0/100	0.138	0/100	0.341	0/100
Seniority at school								
Sender covariate	0.018	0/100	-0.086	0/100	0.248	100/100	0.077	0/100
Receiver covariate	0.413	90/100	0.331	73/100	0.528	100/100	0.114	0/100
Homophily	-0.021	0/100	0.513	4/100	0.051	0/100	0.280	0/100
Percentage of full-time employment								
Sender covariate	-0.027	0/100	0.318	0/100	-0.052	0/100	-0.107	0/100
Receiver covariate	0.245	0/100	0.083	0/100	0.118	0/100	0.048	0/100
Homophily	0.755	100/100	0.096	0/100	0.228	0/100	0.105	0/100
Leadership position								
Sender covariate	0.508	78/100	0.640	0/100	0.761	100/100	0.301	0/100
Receiver covariate	0.331	0/100	1.824	100/100	1.704	100/100	0.663	100/100
Homophily	0.117	0/100	0.388	0/100	0.430	100/100	0.130	0/100
Trust								
Tie sent	0.153	0/100	-0.524	0/100	1.362	100/100	1.231	0/100
Tie received	0.888	1/100	1.247	100/100	2.017	100/100	1.518	100/100
Mutual tie	1.715	100/100	1.537	100/100	3.278	100/100	3.369	100/100

Note. Pr is the proportion of imputed datasets in which the term is significant ($p < 0.05$). Highlighted in gray are the results that are significant at 0.05 in at least 95 imputed datasets.

different in the three areas of school improvement, and (2) what factors influence these differences.

4.1. Moderate overlap of collaboration across the three school improvement areas (RQ 1)

In the case of tie overlap of the three school improvement areas, the findings suggest that there is moderate overlap, meaning that collaboration in the three school improvement areas is not congruent. As expected, these results reflect school improvement theory, which states that effective school improvement must "'pull all relevant levers' by emphasizing the instructional behaviour of teachers as well as school level processes" (Hopkins, 2005, p. 11) by "mobilising change at school, department and classroom level" (Harris, 2002, p. 1), and that these areas are at the same time interconnected, as improvement "comes about through the interplay among personal abilities, interpersonal relationships, and organizational structures" (Mitchell & Sackney, 2011, p. 14). These results are crucial in that they show that the construct 'teacher collaboration' can be better studied not only by focusing on different forms of collaboration regarding teaching improvement (Gräsel et al., 2006; Schuster et al., 2021) but also by including all areas of school improvement.

4.2. Structural differences in school improvement areas regarding density and centralization (RQ 2)

As to the structure of collaboration in the three school improvement areas, the results point to differences in the density and centralization of the networks. In three schools, the networks on exploring new ideas on teamwork were less dense than the networks on exploring teaching and school organization. This means that regarding team improvement, the school teams' social structure provides fewer opportunities to explore new idea and facilitates them less (Daly, 2010; Moolenaar, 2012). There are different explanations for this result. Exploring new ideas on teaching and on school organization is probably more a part of daily business than thinking about how to work together in teams. Also, teamwork in secondary schools is oftentimes formally regulated via grade level or school subject, and teachers probably see the least potential for innovation here. Furthermore, the content of team collaboration is predominantly about school-wide matters or teaching. Thinking about new ideas on how to further develop collaboration is probably not as high on the agenda. It could also be that school teams perceive collaboration as working well and see no reason to change it. Independent of these explanations, this result is unfavorable. If there is little focus on team improvement, this also means that less effort is put into improving the quality of

collaboration. This is disadvantageous, because research indicates that forms of collaboration that require high intensity and co-construction are rarely practiced in schools (Camburn & Won Han, 2017; Gräsel et al., 2006) and, further, that schools that engage in higher-quality collaboration have better student achievement gains (e.g., Goddard et al., 2007; Ronfeldt et al., 2015). The results for school 1 differ: Here, the density is the highest in the teamwork network (Table 4). We assume that at this school, collaboration in teams changed in some way shortly before this survey. Unfortunately, we do not have information on this.

At three schools, the network for exploring new ideas on school organization shows the highest centralization. Furthermore, the network representations and the values of centralization indicate that innovation in this area is not driven by one person alone but by a few central actors. The results of the ERGM analysis for this network (Table 7) suggest that these actors have leadership positions. This result points to distributed leadership, in which interactions take place to a great extent between leaders and less so but also within the team (Spillane, 2006). This finding can be interpreted as positive because distributed leadership has the potential to positively influence school improvement as well as student outcomes (e.g., Harris, Leithwood, Day, Sammons, & Hopkins, 2007).

4.3. Leadership, reciprocity, and subgroup processes explain structural differences between school improvement areas (RQ 3)

In the case of individual and subgroup characteristics explaining differences in the three networks, the results reveal that the focal points of differences are leadership, reciprocity, and subgroup processes. For *individual characteristics*, the sender and receiver effects of gender, seniority, and percentage of full-time employment play a subordinate role in all three networks. This contrasts with previous studies (Moolenaar et al., 2014; Ortega et al., 2020). A negative effect for percentage of full-time employment as reported by Moolenaar et al. (2014) could not be confirmed. That a higher level of seniority leads to a higher probability of being sought out for exchanging ideas (Moolenaar et al., 2014; Ortega et al., 2020; Spillane et al., 2012) could be confirmed in two schools but only in the network for school organization.

In contrast, the important role of leaders is confirmed. Previous studies found that leaders are an important source of advice and information regarding teaching (Bryant et al., 2020; Ortega et al., 2020; Schuster et al., 2021; Spillane & Kim, 2012). In our data, receiver effects are evident in all three networks, although somewhat less in the teaching network. Looking at all leadership effects, however, we find that the leadership function carries the most weight in the network for exploring new ideas on school organization. This result is not surprising, as developing the organization is considered to be a central element of leadership practice (Leithwood, Harris, & Hopkins, 2019, pp. 1364–2626).

For *subgroup characteristics,* in this study subgroup processes related to structural factors in the ERGM model played an important role in the teaching and especially in the teamwork improvement network but a less important role in the organizational improvement network. This result can be explained by the fact that most probably this collaboration also takes place in corresponding formal teams. These subgroup processes were not analyzed in most of the studies in our literature review. It could be that the inclusion of these structural terms makes the differences in the results, as without these terms, individual and homophily terms might gain significance. Most previous studies (e.g. Moolenaar et al., 2014; Schuster et al., 2021; Spillane et al., 2012) analyzed the effects of grade level or school subject department, which was not possible in the present study. It is reasonable to assume that the subgroup processes in our study can be explained by the collaboration in grade-level teams. Further, a gender homophily effect as reported by previous studies (Moolenaar et al., 2014; Ortega et al., 2020; Schuster et al., 2021; Spillane et al., 2012) occurred exclusively in the teaching network and only in one school clearly.

Exploring new ideas is more likely to be mutual in the teaching and teamwork networks than in the school organization network. Thus, more unidirectional connections exist in this latter network, indicating that collaboration is less intense in this area (Hubers et al., 2017). The significant receiver effects for leadership suggest that teachers are more likely to approach actors with leadership function about new ideas for school organization but that actors with leadership function are less likely to perceive these conversations as a mutual exchange.

For trust, our data confirmed the finding of previous studies that trust is a central building block for collaboration in school teams, in our study as an individual as well as a subgroup characteristic (Louis, 2007; Moolenaar et al., 2014; Moolenaar & Sleegers, 2010; Tschannen-Moran, 2001). It played an important role in all school improvement networks, especially regarding received individual and mutual subgroup trust. This result indicates that there is a good basis for effective forms of collaboration for school improvement in all of the schools, as there is strong trust among team members (Brown et al., 2015; Cerna, 2014).

4.4. Future research and limitations

The differences identified in this study, both in terms of structure and explanatory factors, support the call for future research not only to examine teacher collaboration in the context of teaching improvement but also to take a multidimensional network perspective. Further, research should address how the different areas of collaboration for school improvement interact with outcomes at different levels (organization, team, teaching, student). Our findings point to the central role of actors in a leadership function. As teacher-leader collaboration tends to be a hierarchical relationship, a closer look at these collaborative relationships would be informative. A need for action in practice was identified above all in the area of team improvement. Working more intensively on improving teamwork and thereby reflecting on the way of collaboration and at the same time building trust could be a profitable addition to school improvement.

The study has several limitations that might affect the interpretation of the results. The first concerns the sample size. The data from four schools are not sufficient to allow reliable statements about school improvement in general. Second, we had no data on school team members' affiliation with school subject departments, grade-level teams, working groups, and so on. Data on this would have made it possible to investigate whether subgroup processes are due to membership in formal groups, or whether these are more informal groups whose composition is not related to the influencing factors studied here. Third, we do not have data on how respondents perceived the network questions—for example, whether all respondents understood team improvement to be the same thing or something similar. Fourth, to survey collaboration on school improvement as well as trust, one central question was used, as is common in network research. To survey the complex constructs of collaboration and trust, it would have been desirable to capture them more broadly, for example by further differentiating new ideas, exploration, or emotional-motivational problems. Fifth, there are not many statistical models available to analyze networks from different schools in a comparative way. Analyses that go beyond the description of differences between schools of approximately the same size have therefore been scarce. A meta-analysis of ERGMs from multiple schools would be a viable option (Snijders, 2016), but to be meaningful this would require more schools.

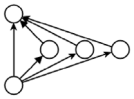
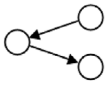
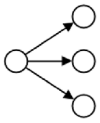
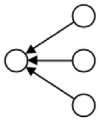
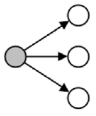
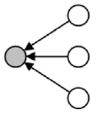
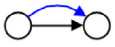
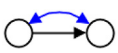
This paper demonstrates that it is worthwhile to bring the analysis of collaboration in school teams closer to school improvement theory by examining collaboration in terms of all areas of school improvement. This broader perspective helps to generate a deeper understanding of the collaborative processes that influence school improvement in school teams, as it captures collaborative activities in different areas. This differentiated view in turn will aid the designing of custom-fit intervention and support programs for schools to help teachers and school leaders to improve their collaborative practice holistically. The findings provide strong evidence that school improvement can be better studied in a more nuanced way through this broader perspective on collaboration.

Data availability

The data that has been used is confidential.

Appendix A

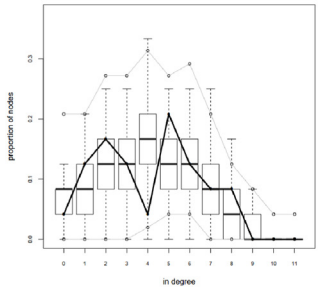
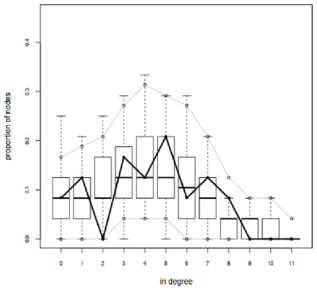
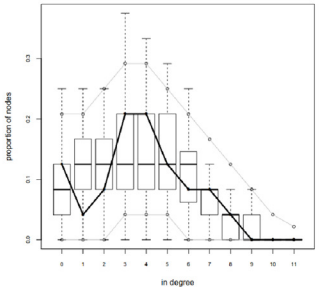
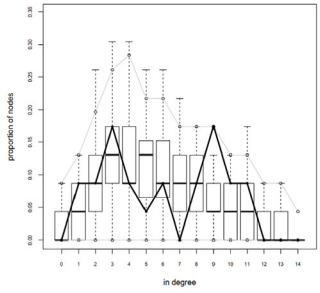
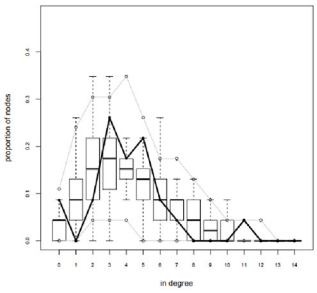
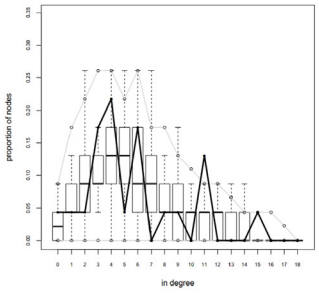
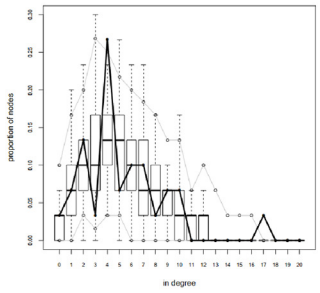
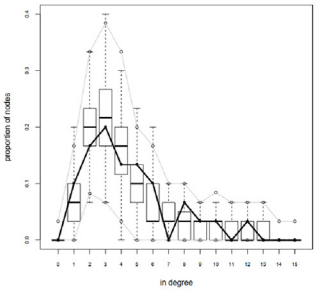
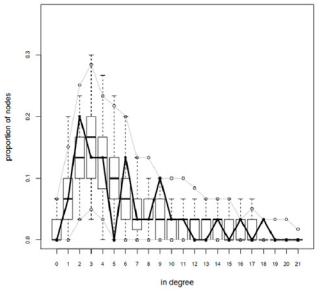
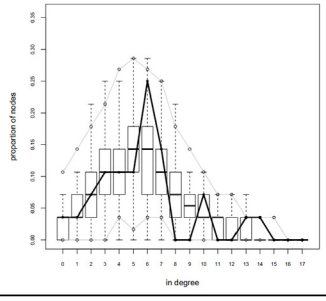
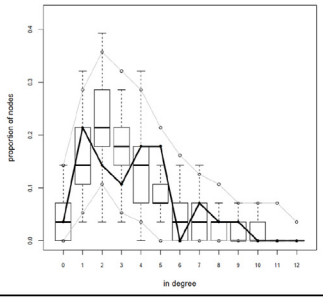
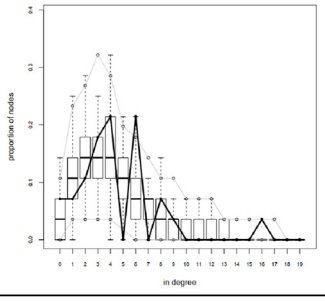
List of terms in the fitted ERGMs (based on Harris, 2002; Hunter, 2007; Lusher et al., 2013).

Name	Model term in statnet	Description	Illustration
Structural terms			
(1) Density	edges	(Model intercept) Tendency of ties to be sent if all other term statistics are 0.	
(2) Reciprocity	mutual	Tendency of ties to reciprocate incoming ties.	
(3) Transitivity ($\alpha = 0.69$)	gwesp (Geometrically Weighted Edgewise Shared Partners), decay = 0.69	Tendency of ties to close transitive triads, with a decreasing effect from each additional triad closed.	
(4) Two-paths	twopath	Tendency of ties to be sent by actors who receive many ties (and vice versa	
(5) Outdegree ($\alpha = 0.69$)	gwodegree (Geometrically Weighted Outdegree Distribution), decay = 0.69	Activity spread: tendency for centralization in the outdegree distribution, with a decreasing effect from each additional tie sent.	
(6) Indegree ($\alpha = 0.69$)	gwidegree (Geometrically Weigthed Indegree Distribution), decay = 0.69	Popularity spread: tendency for centralization in the indegree distribution, with a decreasing effect from each additional tie received	
Individual covariate terms (gender, seniority, working hours, leadership)			
(7) Sender covariate	nodeocov	Differential tendency of ties to be sent by an actor with higher value on the covariate.	
(8) Receiver covariate	nodeicov	Differential tendency of ties to be received by an actor with higher value on the covariate.	
(9) Homophily	nodematch	Tendency of ties to connect actors with the same covariate value.	
Contextual terms (trust network)			
(10) Tie sent	dyadcov (adds three terms to the model)	Tendency of ties to be sent alongside a trust tie.	
(11) Tie received		Tendency of ties to reciprocate a trust tie.	
(12) Mutual tie		Tendency of ties to connect two actors who trust each other.	

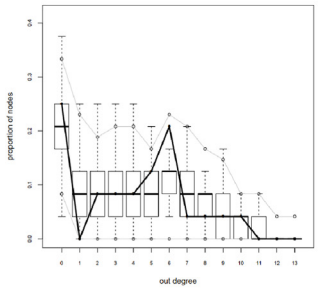
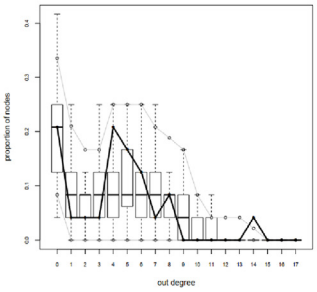
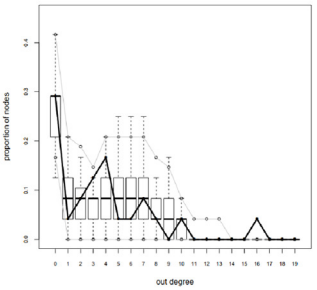
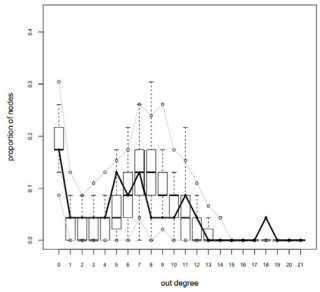
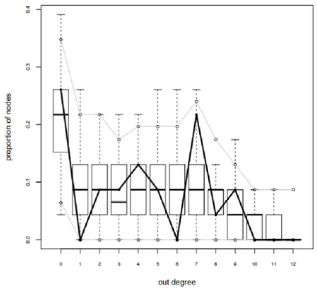
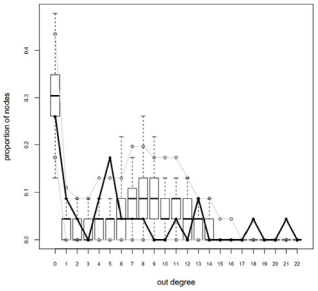
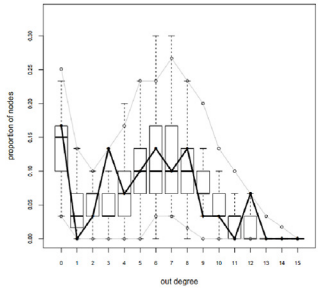
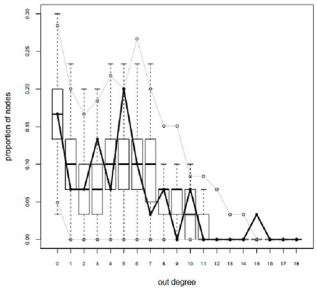
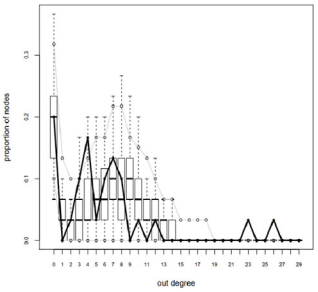
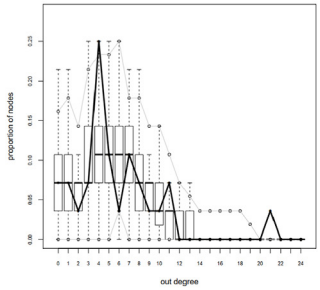
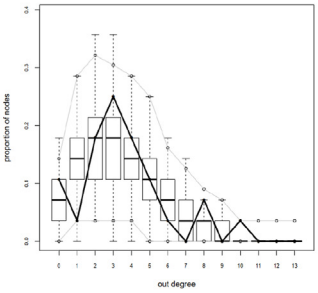
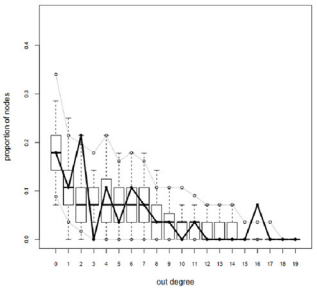
Appendix B

Goodness of fit: A random selection of simulation results for the ERGMs from each school for:

(A) indegree distribution

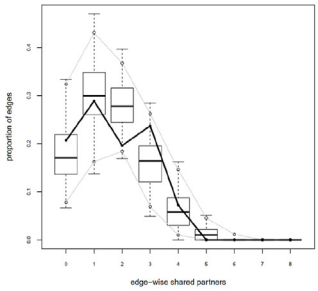
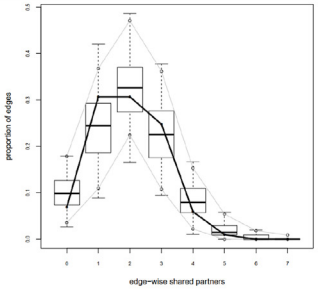
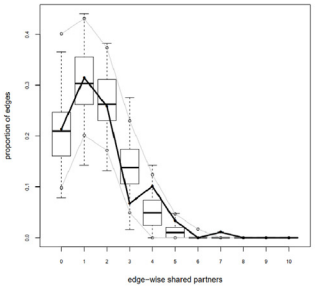
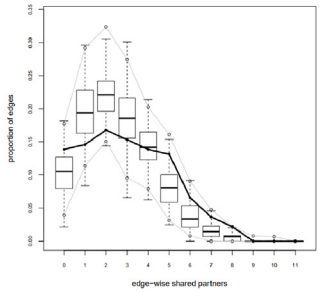
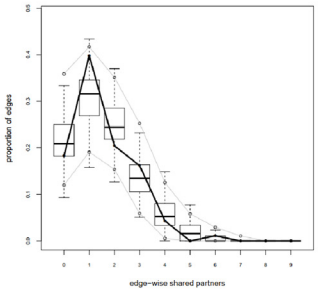
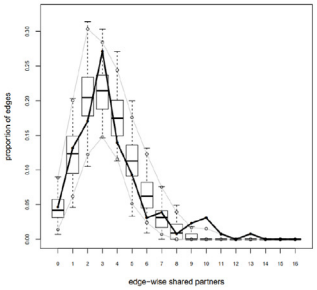
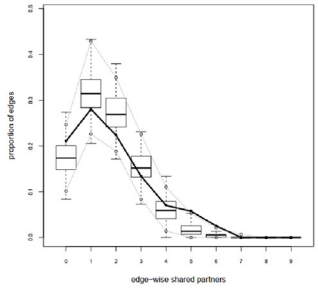
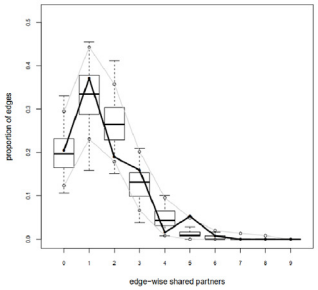
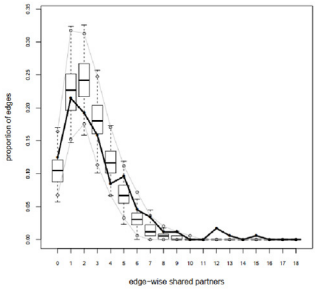
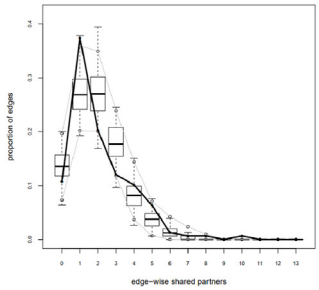
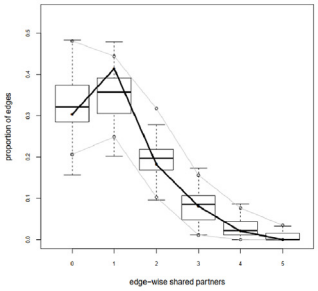
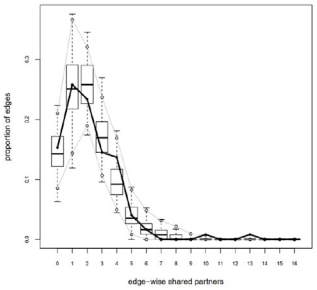
	Network		
school	teaching	teamwork	organization
1			
2			
3			
4			

(B) outdegree distribution

	Network		
school	teaching	teamwork	organization
1			
2			
3			
4			

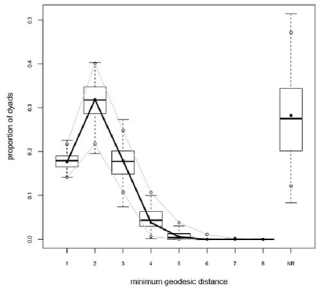
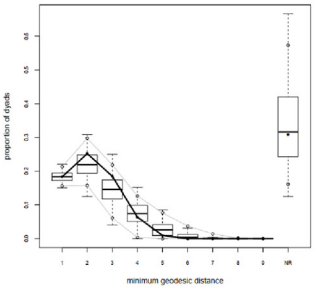
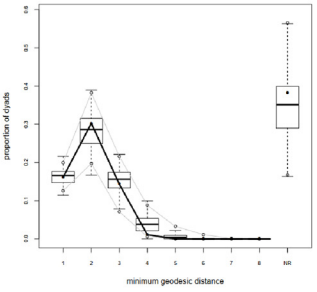
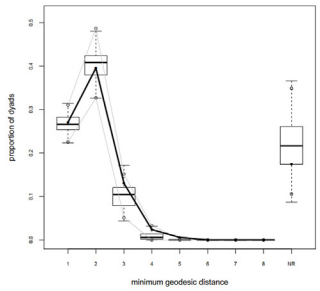
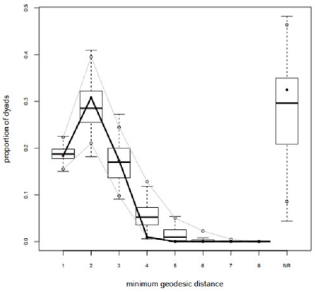
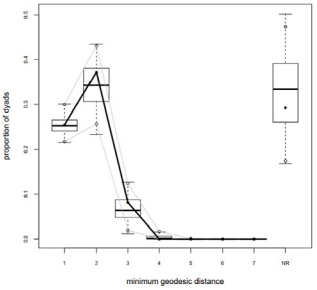
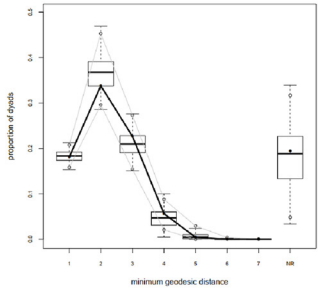
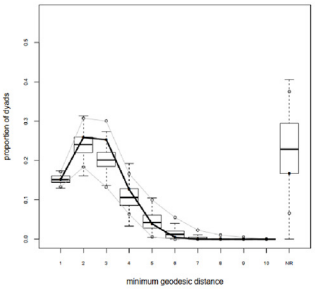
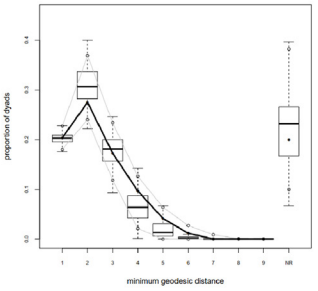
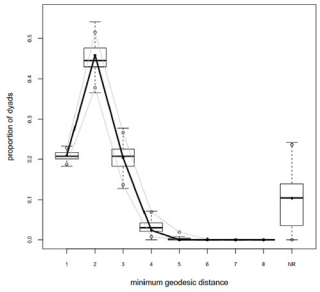
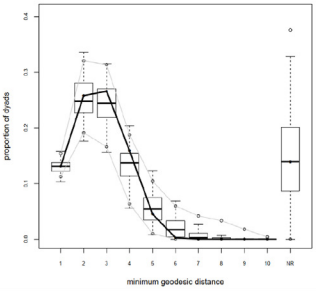
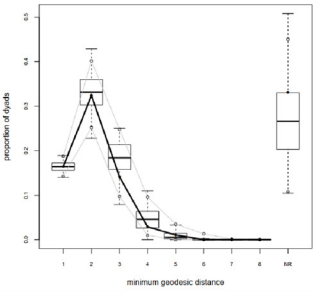
(***continued***).

(C) edgewise shared partners distribution

	Network		
school	teaching	teamwork	organization
1			
2			
3			
4			

(***continued***).

(D) minimum geodesic distance

	Network		
school	teaching	teamwork	organization
1			
2			
3			
4			

(***continued***).

Appendix C

Missings were imputed using the mitml package in R. The auxiliary variables listed in the table below were used for hierarchical models to impute the missing values in other variables.

		School	% of missings
Variables with missing data	– Seniority at school – Percentage of full-time employment	1	20.8
		2	17.4
		3	16.6
		4	14.3
		Total	17.1
Variables without missing data	– Gender – Leadership function		
Auxiliary variables for the imputation	– Seniority in total – Trust (indegree) – Function at the school		

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