Ties with potential: nature, antecedents, and consequences of social networks in school teams

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CHAPTER 1

The Social Fabric of Elementary School Teams: How Network Content Shapes Social Networks

ABSTRACT

Background. Social networks among teachers are receiving increased attention as a vehicle to support the implementation of educational innovations, foster teacher development, and ultimately, improve school achievement. While researchers are currently studying a variety of teacher network types for their impact on educational policy implementation and practice, knowledge on how various types of networks are interrelated is limited. Moreover, studies that examine the dimensionality that may underlie various types of social networks in schools are scarce.

Purpose. The goal of this chapter was to increase our understanding of how network content shapes social network structure in elementary school teams. The study examines the extent to which various work-related (instrumental) and personal (expressive) social networks among educators are related. In addition, we explore a typology of social networks in schools and investigate whether the common distinction between instrumental and expressive social networks could be validated in the context of elementary school teams.

Method. Social network data were collected among 775 educators from 53 elementary schools in a large educational system in the Netherlands. The interrelatedness of seven social networks was assessed using the Quadratic Assignment Procedure (QAP) correlations. Multidimensional Scaling (MDS) was used to discern underlying dimensions that may explain the observed similarities. Finally, we describe and visualize the seven networks in an exemplary sample school.

Conclusions. Findings suggest small to moderate similarity between the social networks under study. Results support the distinction between instrumental and expressive networks in school teams and suggest a second dimension of mutual in(ter)dependence to explain differences in social relationships between educators.

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1 This chapter is based on:
INTRODUCTION

The rapidly growing interest in social networks can be characterized as one of the major trends in social science research. According to scientific databases (ERIC, Picarta, and Web of Science), the number of publications in social sciences using the word ‘social network(s)’ in the title, keywords, or abstract, has increased exponentially over the last two decades (Borgatti & Foster, 2003) (see Figure 1). Evidence of this trend in education is exhibited by an increasing number of articles focusing on the intersection of social networks and education in a growing variety of settings and areas of emphasis. The thesis that ‘relationships matter’ is currently inspiring educational researchers around the world to study social networks in school teams (Daly, in press; Daly & Finnigan, 2009; Daly et al., in press; McCormick, Fox, Carmichael, & Procter, in press; Penuel, Riel, Krause, & Frank, 2009) (see also Figure 1). An important prerequisite for gaining insights in the potential of social networks for schools is the emergence of social network studies that provide a deepened understanding of the structure and content of teachers’ professional relationships (Coburn & Russell, 2008).

Social network scholars emphasize that social networks are shaped by the content or purpose of the social resources that are exchanged in the network (Burt, 1992; Coleman, 1990; Lin, 2001; Putnam, 2000; Scott, 2000; Wasserman & Faust, 1997). Studies suggest that the distribution of resources in a network may depend on the content of the network (Haines & Hurlbert, 1992; Raider & Burt, 1996). For instance, a social network that is maintained for the purpose of exchanging work related knowledge and expertise may look significantly different from a social network that is created for personal support. Even though both social networks contain social resources that may be accessed and leveraged, both networks may be shaped quite differently. Several scholars have therefore voiced the need to examine multiple relationships simultaneously (Friedkin, 2004; Ibarra & Andrews, 1993; McPherson, Smith-Lovin, & Cook, 2001; Mehra, Kilduff, & Brass, 1998; Monge & Contractor, 2003; Pustejovsky & Spillane, 2009; Wasserman & Faust, 1997). Yet, few studies have been conducted into the ways in which social networks are shaped differently depending on the content of their ties (Hite, Williams, & Baugh, 2005; Moolenaar, Daly, & Sleegers, in press).

The goal of this chapter is to examine the extent to which multiple social networks among educators are shaped differently depending on their content. We will address this goal by exploring the similarity between multiple social networks in school teams and working towards a typology of social networks in
school teams according to underlying dimensions. Our enquiry is guided by social network theory and the social network concept of ‘network multiplexity’. In short, network multiplexity is concerned with the ‘overlap’ between social networks that that transfer different content among the same individuals. With this chapter, we aim to contribute to recent knowledge on the nature of social networks in school teams by comparing and contrasting different networks (e.g., friendship, advice) in 53 Dutch elementary schools located in a single district. We will start with an overview of social network theory and network multiplexity as these provide the conceptual background to the study.

Figure 1. Number of peer-reviewed publications over the period 1953-2009 containing the search terms ‘social network’ and ‘social network and education’ in title, abstract, and/or keywords
THEORETICAL FRAMEWORK

Social network theory
A growing body of educational research points to the potential of social networks to affect teachers’ instructional practice, and ultimately, benefit student achievement (Coburn & Russell, 2008; Daly et al., in press; Penuel, Frank, & Krause, 2007b; Penuel & Riel, 2007). Building on social network theory, these studies examine the extent to which the pattern of relationships among teachers and the exchange of resources within these relationships may support or constrain school functioning and improvement.

An important feature of social network theory is the focus on both the individual actors and the social relationships linking them (Wasserman & Galaskiewicz, 1994). Through social interaction among educators, social relationships develop into a patchwork of ties that knit the social fabric of school teams (Field, 2003; Putnam, 2000). Social network theory argues that the quality and denseness of this social fabric eventually determines the speed, direction and flow of resources through a social network (Burt, 1992). In turn, it is through the flow and use of social resources that collective action may be facilitated and organizational goals may be achieved (Lin, 2001; Lochner, Kawachi, & Kennedy, 1999). For instance, strong social relationships are suggested to facilitate joint problem solving, lower transaction costs, and support the exchange of complex, tacit knowledge among network members (Hansen, 1999; Putnam, 1993a; Uzzi, 1997).

Studies into social networks among educators have focused on various types of social networks that connect teachers within and between schools, such as discussion about curricular issues (content, teaching materials, planning), communication around reform, seeking advice, and friendship among teachers (Coburn & Russell, 2008; Cole & Weinbaum, 2007; Daly & Finnigan, 2009, Hite, Williams, & Baugh, 2005; Pustejovsky & Spillane, 2009). While some studies focus on a single relationship (Coburn & Russell, 2008), others include and contrast multiple relationships (Cole & Weinbaum, 2007; Pustejovsky & Spillane, 2009), although not for the purpose of explicating their similarities or differences per se. Therefore, what is less clear is whether educators’ social networks are shaped by the content that defines their ties (Hite, Williams, Hilton, & Baugh, 2006; Podolny & Baron, 1997). Insights in the way network content shapes collegial relationships is important for understanding the extent to which teachers’ professional relationships may affect educational practice. As Little (1990) marks: ‘It is precisely such “content” that renders teachers’ collegial affinities consequential for pupils’. This insight can be provided by
investigating network multiplexity and exploring a typology of social networks in school teams.

Network multiplexity
In social network terms, multiplex relationships are relationships that serve multiple interests or are characterized by a multiplicity of purposes (Gluckman, 1955, 1965). In other words, multiplexity focuses on the extent to which there is overlap between different social relationships, for instance advice and friendship. Many studies focus on multiplex exchanges within a single relationship, for instance, whether a relationship between two individuals is characterized by the exchange of both work related advice and friendship (De Klepper, Van de Bunt, & Groenewegen, 2007; Hansen, Mors, & Lovas, 2005; Hite et al., 2006a; Hite, Williams, & Baugh, 2005, Koehly & Pattison, 2005; Lazega & Pattison, 1999; Lomi, 2002). Less attention has been paid to the issue of multiplexity in regard to whole networks. To advance social network theory in this direction, this chapter therefore focuses on multiplexity of whole networks. Meaning, we will examine the overlap between whole networks among the same set of individuals that are characterized by a multiplicity of purposes.

Multiplex relationships that serve multiple purposes are suggested to be stronger than relationships that only serve a single purpose, and individuals who are connected through multiplex networks will have greater success in accessing and mobilizing resources (Kapferer, 1969; Doreian, 1974). Multiplex, or multi-dimensional social networks have been studied outside education to validate name generator questions (Ruan, 1998), to examine the pattern of relationships among lawyers (Lazega & Pattison, 1999), to differentiate between different types of support networks (Bernard et al., 1990) and advice networks (Cross, Borgatti, & Parker, 2001). Yet, knowledge on the extent to which social networks in school teams can be differentiated is scarce.

Towards a typology of social networks in school teams
Teacher-to-teacher exchange can be captured by a variety of references that all refer to some form of collegiality (Little, 1990; Rosenholtz, 1989), such as sharing, giving advice, discussing work, and collaborating. Little (1990) argues that these exchanges are not just a straightforward collection of activities, but rather ‘phenomenologically discrete forms that vary from one another in the degree to which they induce mutual obligation, expose the work of each person to the scrutiny of others, and call for, tolerate, or reward initiative in matters of curriculum and instruction’ (p. 512). Little (1990) places various collegial forms
on a dimension of mutual interdependence, with storytelling as an example of collegiality that entails low mutual interdependence, and joint work as an example of collegiality that involves high interdependence. She poses that a shift on this dimension toward increased interdependence relates to changes in the frequency and intensity of teachers’ interactions and the likelihood of mutual influence. Moreover, increased interdependence poses rising demands for collective autonomy and teacher-to-teacher initiative (Little, 1990). While this dimension of mutual interdependence could serve as a valuable guide in typifying various forms of social relationships in school teams, it has not yet received much empirical attention. Given the popularity of social network studies in education, the question in which forms the amorphous concept of ‘collegiality’ permeates teachers’ daily practice is more relevant than ever before.

Another useful dimensionality of social relationships that has become common practice in social network research is the distinction between instrumental and expressive relationships (Ibarra, 1993, 1995). These distinct relationships are believed to provide different kinds of support and transfer unique knowledge and information (Erickson, 1988). Instrumental relationships encompass social interactions that are ultimately aimed at achieving organizational goals, such as work related advice or collaboration. Instrumental ties are believed to be ‘weak’ ties through which work related information and knowledge is exchanged between experts and people who seek information (Granovetter, 1973). Expressive relationships are formed through social interaction that is not directly aimed at work related issues, that often places the individual’s interest above that of the organization (Burt, 1997), and that is mostly characterized by an affective component, such as personal support and friendship. In general, expressive ties are believed to be stronger, more durable and trustworthy, and offer greater potential to exert social influence (Granovetter, 1973; Ibarra, 1993; Marsden, 1988; Uzzi, 1997).

Increased understanding of a typology of social networks in school teams is indicated as social network studies often examine various types of networks without specifically addressing differences between the social networks under investigation \(^\text{1}\). By exploring multiple social networks this chapter not only aims

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\(^1\) In fact, Burt (1997) writes: “Network content is rarely a variable in the studies - analysts agree that informal coordination through interpersonal networks is important as a form of social capital, but their eyes go shifty like a cornered ferret if you push past the network metaphor for details about how specific kinds of relations matter” (p. 357).
to deepen our insights in the social fabric of school teams, but also addresses
the validity of the common instrumental-expressive distinction in the context of
education. The boundaries between instrumental and expressive relationships
are fuzzy and often tend to overlap (Borgatti & Foster, 2003). In addition, recent
research has suggested that one type of relationship can in part determine or
reinforce another type of relationship (Casciaro & Lobo, 2005). Since a
systematic investigation of multiple networks in school teams is missing, this
chapter is one of the earliest to explore a typology of social networks in school
teams. In addition to advancing social network theory, the study thereby offers
a unique insight in the social fabric of Dutch elementary schools.

METHOD

Context
We conducted a survey study at 53 elementary schools in south of The
Netherlands. The schools formed the Avansa School District 1 and resided
under a single board that provided the schools with IT, financial, and
administrative support. The schools participated in the study as part of a
district-wide school improvement program focused on school monitoring and
teacher development. The 53 sample schools were located in rural as well as
urban areas and served a student population ranging from 53 to 545 students in
the age of 4 to 13. While the schools differed slightly regarding students’ SES
and ethnicity, the schools’ student population can be considered as rather
homogeneous in comparison to the Dutch average.

Sample
All principals and teachers were asked to participate in the survey study. A
total of 51 principals and 724 teachers responded to this call, reflecting a return
rate of 96.8 %. Of the sample, 72.9 % was female and 52.5 % worked full-time
(32 hours or more). The age of educators in the sample ranged from 21 to 63 (M
= 45.7, sd = 10.7). Additional sample characteristics are included Table 1 and 2.

1 All names are pseudonyms
Table 1. Sample characteristics of schools (N = 53) and educators (n = 775)

<table>
<thead>
<tr>
<th>Individual level</th>
<th>Male</th>
<th>Female</th>
<th>Gender</th>
<th>210 (27.1%)</th>
<th>565 (72.9%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working hours</td>
<td>Part time (less than 32 hours)</td>
<td>368 (47.5%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experience at school</td>
<td>1-3 years</td>
<td>152 (19.6%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade level 1</td>
<td>Lower grade (K – 2)</td>
<td>353 (45.4%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School level</td>
<td>Upper grade (3 – 6)</td>
<td>422 (54.5%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team experience</td>
<td>6 months to 2 years</td>
<td>20 (37.8%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>More than 2 years</td>
<td>33 (62.2%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Sample characteristics of schools (N = 53) and educators (n = 775)

<table>
<thead>
<tr>
<th>Individual level</th>
<th>N</th>
<th>M</th>
<th>Sd</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>775</td>
<td>45.7</td>
<td>10.7</td>
<td>21</td>
<td>63</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School level</th>
<th>N</th>
<th>M</th>
<th>Sd</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender ratio 2</td>
<td>53</td>
<td>76.8</td>
<td>10.7</td>
<td>57.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Average age</td>
<td>53</td>
<td>45.3</td>
<td>3.7</td>
<td>35.4</td>
<td>52.8</td>
</tr>
<tr>
<td>School size</td>
<td>53</td>
<td>213.0</td>
<td>116.6</td>
<td>53</td>
<td>545</td>
</tr>
<tr>
<td>Team size</td>
<td>53</td>
<td>14.8</td>
<td>6.8</td>
<td>6</td>
<td>31</td>
</tr>
<tr>
<td>Socio-economic status (SES) 3</td>
<td>53</td>
<td>7.9</td>
<td>9.5</td>
<td>0.4</td>
<td>47.3</td>
</tr>
</tbody>
</table>

1 Educators who can be considered to be a part of both lower and upper grade were asked to choose with which grade level they worked most (e.g., principal, specialist staff).

2 Gender ratio is calculated as the percentage of female team members.

3 SES is calculated as the weighted percentage of students for whom the school receives extra financial resources.
Instruments
Social networks. To discern common types of interaction among teachers in elementary education, we interviewed seventeen elementary school teachers, two principals and one coach\(^1\) who volunteered in reaction to a canvas call among the personal social network contacts of the principal researcher. We asked the educators to describe a regular work week and give examples of the types of social interaction they had with their colleagues. The hour-long interviews were audio-recorded and conducted using a semi-structured interview guide (Patton, 1990; Spradley, 1980). We analyzed the interview data using a constant comparative analysis method (Boeije, 2002; Glaser & Strauss, 1967). We compared perspectives of educators with different formal roles and at different grade levels, grouped different forms of social interaction mentioned by the educators, and checked and rechecked emerging types of social interaction (Miles & Huberman, 1994). From this preliminary analysis, we deduced seven social networks that capture the forms of social interaction as described by the interviewed educators. As a member-check procedure (Miles & Huberman, 1994), these social networks were then shared with a new group of educators. This group comprised eleven principals and six teachers who formed a pilot sample to establish face validity of the social network questions. Based on their comments, slight adjustments were made that resulted in the final questions to assess social networks of educators in elementary school teams (see Table 3).

We include discussing work as social interaction concerning the discussion of work related issues. The nature of teaching requires the accumulation, transfer and exchange of ideas, experiences, expertise, and knowledge, all which can be shared through the discussing of work with colleagues (Monge & Contractor, 2003). Discussing work can be regarded a general form of resource exchange related to work and can pertain to various topics, such as instruction, planning, or use of teaching materials.

Collaboration refers to joint work among educators who are collectively responsible for the product of collaboration, and as such, collaborative relationships address collective action among teachers (Little, 1990). Interaction through collaboration may offer valuable opportunities for the exchange of knowledge and ideas, and the alignment of shared goals and expectations. Given the nature of schools as ‘loosely coupled’ systems (Weick, 1976) and the relative autonomy that teachers have in their classrooms (Lortie, 2002),

\(^1\) In Dutch: intern begeleider
Table 3. The seven social network questions to assess social networks in Dutch elementary school teams

<table>
<thead>
<tr>
<th>Network</th>
<th>English equivalent of the original Dutch question</th>
<th>Social network questions (in Dutch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussing work</td>
<td>Whom do you turn to in order to discuss your work?</td>
<td>Met welke collega's kunt u goed over uw werk praten?</td>
</tr>
<tr>
<td>Collaboration</td>
<td>With whom do you like to collaborate the most?</td>
<td>Met welke collega's werkt u het liefst samen?</td>
</tr>
<tr>
<td>Asking advice</td>
<td>Whom do you go to for work related advice?</td>
<td>Aan welke collega's vraagt u meestal advies over uw werk?</td>
</tr>
<tr>
<td>Spending breaks</td>
<td>With whom do you like to spend your breaks?</td>
<td>Met welke collega's brengt u graag pauzes door?</td>
</tr>
<tr>
<td>Personal guidance</td>
<td>Whom do you go to for guidance on more personal matters?</td>
<td>Met welke collega's heeft u wel eens meer persoonlijke gesprekken?</td>
</tr>
<tr>
<td>Contact outside work</td>
<td>Who do you sometimes speak outside work?</td>
<td>Met welke collega's spreekt u wel eens buiten het werk?</td>
</tr>
<tr>
<td>Friendship</td>
<td>Who do you regard as a friend?</td>
<td>Welke collega's beschouwt u als vrienden?</td>
</tr>
</tbody>
</table>
collaboration in Dutch elementary schools often follows formal task hierarchy and is prescribed by formal roles, such as coaches or social support specialists. However, collaboration may also be voluntary, such as participating in a committee for a specific event.

Asking for advice is of interest to the study of teacher networks since receiving advice may be part of ongoing teacher development and may facilitate the adoption and implementation of reform and innovation in schools (Moolenaar, Daly & Sleegers, in press). Asking for advice addresses the issue of ‘who seeks out whom’ for work-related advice and thereby, in contrast to the previous types of instrumental interaction, implies an interdependence of knowledge, expertise, or information between the advice-seeker and the advice-giver. For the advice-giver, advice relationships are a powerful tool to gain social control as they convey information and disclose vulnerability and risk-taking on the part of the advice-seeker. Research has indicated that advice-seekers often seek advice from people with a higher status than the advice-seeker (Blau, 1964; Lazega & Van Duijn, 1997). The interviewed educators mentioned spending breaks as another important form of social interaction. During breaks, teachers may exchange many types of resources, both work related and personal. Relationships based on spending breaks may be seen as mostly expressive since, according to the interviewed educators, breaks imply ‘off the job’ moments in which teachers may discuss personal issues or social conversation more easily than during formal meetings.

Another social relationship among educators involves going to a colleague for personal guidance and to discuss personal matters. This form of interaction explicitly addresses the informal, personal nature of relationships. A relationship around personal guidance and the discussion of personal matters implies a certain level of trust between the people involved in the relationship. Such a personal bond is believed to be more strong and durable than work related relationships such as work related collaborative exchange (Granovetter, 1973). Whereas ‘spending breaks’ and ‘personal guidance’ may be described as ‘friendly’ relationships, the next two relationships tap into interaction that more specifically addresses ‘friendship’ (Kurth, 1970).

The next social relationship, according to the interviewed educators, entails having contact outside work. When teachers have frequent contact with one another outside school, this may indicate a relationship that is built on more personal grounds than work. Therefore, having contact outside work may be a good indicator of some sort of friendship or strong bond, even though both individuals may not define the relationship as a friendship relationship (Ibarra, 1992; Zagenczyk, Gibney, Murrell & Boss, 2008).
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The final social relationship addresses *friendship*. Friendship is included in many social network studies as the prototypical expressive relationship (e.g., Cole & Weinbaum, 2007; Lazega & Pattison, 1999) as friendship expresses personal affect and social support (Gibbons, 2004). Individuals depend on friends for counseling and companionship (Krackhardt & Stern, 1988), and friendship ties facilitate open and honest communication that may boost organizational change (Gibbons, 2004).

These seven social network questions were included in a social network survey to assess social relationships among educators. Respondents were provided with a school specific appendix that contained the names of the school team members of their school, accompanied by a letter combination for each school team member (e.g., Mr. Jay Hoffer\(^1\) = AB). They were asked to answer each social network question by writing down the letter combination(s) of the coworker(s) they would like to indicate as being a part of their social network as specified by the question. The number of colleagues a respondent could answer was unlimited.

Data analysis

*Social network analysis*. The data were examined using social network analysis. Social network analysis is a technique to systematically analyze patterns of relationships in order to understand how individual action is situated in structural configurations (Scott, 2000; Valente, 1995). We first constructed matrices for each network question for each school. The matrices were compiled following the same procedure, namely if educator i nominated educator j as an advice relationship, a 1 was entered in cell Xij. If educator i did not nominate educator j, a 0 was entered in cell Xij. This procedure resulted in an asymmetric matrix that summarized all directed relationships among the educators within a single school. To explore and describe the networks, several social network properties at both the individual and school level were calculated based on the matrices using software package UCINET 6.0 (Borgatti, Everett, & Freeman, 2002; Borgatti, Jones & Everett 1998; Burt, 1983a).

Individual level properties include raw and normalized scores for out-degree and in-degree, and ego-reciprocity. *Out-degree* depicts the number of people nominated by the respondent, and can therefore be interpreted as a measure of individual activity. *In-degree* represents the number of people by whom the respondent was nominated, and can be read as a measure of individual popularity.

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\(^1\) All names are pseudonyms
Raw scores of in- and out-degree encompassed the actual number of educators that were named by the respondents. Because the average in-degree is the same as the average out-degree (each out-going relationship for one educator also implies an in-coming relationship for another educator), we only report the average in-/out-degree. The standard deviations of the out- and in-degrees reflect the variability among educators in the amount of out-going and in-coming relationships, and may thus be different for the out-degrees and in-degrees. For instance, educators may vary greatly in the number of relationships they indicate to have, but there may be less variability in the number of relationships that educators receive. The range of the average raw scores varies from 0 to 14.8 since this is the average team size of the sample schools. Besides these raw scores, we also report normalized scores for out-degree and in-degree to facilitate comparisons among schools with different team sizes.

Normalized scores can be interpreted as the percentage of relationships of the whole network that an educator maintains. The normalized out- and in-degrees range from 0 (the educator has no relationships) to 100 (the educator has a relationship with all of his/her team members). Again, the average percentage of out-going relationships is the same as the average percentage of in-coming relationships. The standard deviations of the normalized out- and in-degrees mirror the variability among educators in the percentage of relationships that are sent (out-going) or received (in-coming).

Ego-reciprocity is a measure of reciprocity at the individual level. Ego-reciprocity is calculated as the number of reciprocal relationships in which in educator is involved, divided by the total number of his/her relationships. Ego-reciprocity thus reflects the percentage of ties of an educator that is reciprocated. Ego-reciprocity ranges from 0 (none of the individual’s relationships are reciprocated) to 100 (all of the individual’s relationships are reciprocated).

At the school level, we calculated the network measures of density, reciprocity, and centralization. Density represents the concentration of relationships in a social network, and is calculated by dividing the number of observed relationships by the total number of possible relationships in a given network. This means that the greater the proportion of social relationships between school staff members, the more dense the social network. The density of a school’s network may range from 0 (there are no relationships in the school team) to 1 (all school team members have indicated to maintain a relationship with each other). The density of a network can be thought of as a measure of
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cohesion (Blau, 1977). A dense network is believed to be able to move resources 
more quickly than a network with fewer ties (Scott, 2000).

Reciprocity captures the extent to which the relationships in a social 
network are reciprocal, and is calculated as the number of reciprocal 
relationships in a team, divided by the total possible number of reciprocal 
relationships. Higher levels of reciprocity have been associated with complex 
knowledge exchange and higher organizational performance (Kilduff & Tsai, 
2003). The reciprocity of a school’s network may range from 0 (none of the 
relationships in the school team are reciprocated or mutual) to 1 (all of the 
relationships in the school team are reciprocated or mutual).

In-centralization was included to examine the central tendency of the 
social networks. This measure assesses whether the relationships in a given 
network are evenly dispersed in a network, or whether the relationships are 
centralized around one (or a few) very central people, who receive many 
nominations. In-centralization is based on the variability of in-degrees within a 
given team. High in-centralization reflects a high variability in the school team 
between educators who are often nominated and educators who are seldom 
nominated. As such, centralization of a social network refers to the difference 
between one or a few highly central person(s) and other (more peripheral) 
people in the network. Centralization ranges from 0 (no variability - all 
members of the network are chosen for advice as frequently) to 1 (maximum 
variability - every educator in a network only nominates a single person in the 
network, while these educators themselves are not nominated at all). The more 
centralized the social network is, the more resources are disseminated by a 
single or a few influential people to the rest of the network. In contrast, 
relationships and resources in a decentralized social network are much more 
evenly shared among all school team members.

Examining multiplexity. To determine the similarity between the seven 
social networks within each school, we estimated a series of Quadratic 
Assignment Procedure (QAP) correlations in UCINET (Borgatti, Everett, & 
Freeman, 2002; Hanneman & Riddle, 2005; Krackhardt, 1987). The QAP is a 
procedure to calculate correlations between social networks. When conducting 
social network research, statistical assumptions of independence are violated 
because relations between individuals are nested and embedded within the 
same network. Social network data are often interdependent, thus limiting the 
use of ‘conventional’ statistical techniques such as Pearson correlations. The 
QAP was designed as a variation on conventional correlational analyses for the 
use with social network data.
The QAP follows a specific process. First, a Pearson correlation coefficient is calculated for two corresponding cells of two matrices that contain network data. Then, it randomly permutes the rows and columns of one of the matrices hundreds of times (each time computing a new correlation coefficient), and compares the proportion of times that these random correlations are larger than or equal to the original observed correlation. A low proportion (p<.05) suggests a strong relationship between the matrices that is unlikely to have occurred by chance (Baker & Hubert, 1981). We calculated QAP correlations for the seven networks within each school, and then aggregated these correlations using matrix algebra to signify overall QAP correlations among the seven networks. These aggregated QAP correlations are measures that represent the similarity between the seven networks over all sample schools.

Towards a typology of social networks in school teams. To detect meaningful underlying dimensions that may explain the observed similarities between the seven networks, we used the aggregated QAP correlations as input in a Multidimensional Scaling (MDS) procedure (Kruskal & Wish, 1978). MDS provides a visual representation of the social networks that best approximates the given QAP similarity information. Since the MDS Alscal procedure as incorporated in the Statistical Packages for the Social Sciences (SPSS Version 16.0) manages data based on distances instead of similarities, the QAP aggregates were subtracted from 1 and then inputted in SPSS. Finally, to visualize the similarity of the seven social networks, we depict and describe the seven networks of an exemplary sample school.

RESULTS

Describing social networks
Table 4 presents the individual level descriptive statistics for the seven social network questions. A comparison of the seven networks at the individual level indicates that there is considerable variation between the networks in the average amount of ties that educators maintain. Educators have the highest number of relationships around spending breaks, on average six relationships. This is followed by about five reported relationships regarding the discussion of work-related matters. Educators maintain much less relationships around friendship and speaking outside work (respectively 1.57 and 1.87 relationships). Also, the standard deviations of the average number of relationships are relatively large, indicating that there is much variation among educators in the
Table 4. Descriptive statistics of the seven social network questions for the individual level network properties (n = 775)

<table>
<thead>
<tr>
<th></th>
<th>Raw scores</th>
<th>Out/In-Degree</th>
<th>Ego-reciprocity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>Sd</td>
<td>M</td>
</tr>
<tr>
<td>Discussing work</td>
<td>5.24</td>
<td>3.67</td>
<td>3.40</td>
</tr>
<tr>
<td>Collaboration</td>
<td>4.11</td>
<td>3.75</td>
<td>2.40</td>
</tr>
<tr>
<td>Asking advice</td>
<td>3.07</td>
<td>2.68</td>
<td>3.07</td>
</tr>
<tr>
<td>Spending breaks</td>
<td>6.06</td>
<td>5.34</td>
<td>2.93</td>
</tr>
<tr>
<td>Personal guidance</td>
<td>3.84</td>
<td>3.16</td>
<td>2.50</td>
</tr>
<tr>
<td>Contact outside work</td>
<td>1.87</td>
<td>2.22</td>
<td>1.62</td>
</tr>
<tr>
<td>Friendship</td>
<td>1.57</td>
<td>2.52</td>
<td>1.42</td>
</tr>
</tbody>
</table>

Table 5. Descriptive statistics of the seven social network questions for the school level network properties (N = 53)

<table>
<thead>
<tr>
<th></th>
<th>Density</th>
<th>Reciprocity</th>
<th>Centralization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>Sd</td>
<td>M</td>
</tr>
<tr>
<td>Discussing work</td>
<td>.37</td>
<td>.12</td>
<td>.39</td>
</tr>
<tr>
<td>Collaboration</td>
<td>.36</td>
<td>.15</td>
<td>.35</td>
</tr>
<tr>
<td>Asking advice</td>
<td>.23</td>
<td>.09</td>
<td>.25</td>
</tr>
<tr>
<td>Spending breaks</td>
<td>.46</td>
<td>.17</td>
<td>.39</td>
</tr>
<tr>
<td>Personal guidance</td>
<td>.30</td>
<td>.11</td>
<td>.37</td>
</tr>
<tr>
<td>Contact outside work</td>
<td>.13</td>
<td>.05</td>
<td>.41</td>
</tr>
<tr>
<td>Friendship</td>
<td>.12</td>
<td>.06</td>
<td>.35</td>
</tr>
</tbody>
</table>

1 Standard deviation of the out-degrees
2 Standard deviation of the in-degrees
number of relationships that they maintain. The normalized scores reflect this pattern. On average, educators have ‘spending breaks’ relationships with about 40% of their colleagues, and ‘work discussion’ relationships with about 36% of their colleagues. Educators consider about 10% of their colleagues as friends. Findings regarding ego-reciprocity suggest that the level of reciprocity that educators experience is relatively low (between 22.2% and 37.1%), with the exception of reciprocity in regard to contact outside work (55.5%). This means that of all ties that an educator indicates to maintain, approximately 22% to 37% are reciprocated. However, results show a relatively high standard deviation, which means that there is great variability between educators in the percentage of ties that are reciprocated by their team members.

School level descriptive statistics of the seven networks mirror the findings at the individual level (see Table 5). Results indicate that the networks around friendship and contact outside work had the lowest network density (respectively .12 and .13). In other words, of all possible relationships that could exist in a school’s network, only 12% is formed around friendship. In contrast, the highest density of relationships is found around spending breaks. On average, 46% of all possible relationships around spending breaks are actually reported by educators to exist. Remarkably, this means that on average, the densest social network only incorporates about half of all potential ties. School level reciprocity varies among the seven networks between .25 (asking advice) and .41 (contact outside work). This means that about 25% of all advice relationships are reported by both educators in the relationship, and 41% of the contacts outside work are reported mutually. With regard to school level centralization of the seven networks, findings suggest that the friendship network is the least centralized around a few educators (.18), while the work related advice network is the most centralized (.38). This means that in a friendship network relationships are more evenly distributed among educators, whereas in an advice network relationships are more centered on a few educators who are often sought out for advice.

**QAP correlation analyses**

Table 6 summarizes the average QAP correlations between the seven social networks summarized over the sample schools. In general, results indicate that all seven networks are weakly to moderately correlated (between .27 and .62). This finding suggests that all networks are measuring a different facet of teacher interaction, and none of the networks show extensive similarity with other networks. This supports the notion that educators tend to maintain
different networks for different purposes. In regard to a distinction between instrumental and expressive social networks, the following can be noted.

The correlations between the group of networks around discussing work, collaboration, and asking advice vary between .46 and .55. Similarly, the correlations between the group of networks around personal guidance, contact outside work, and friendship range from .42 and .62. The correlations within these groups are noticeably higher than the correlations between the groups, which range from .33 to .35. This may be a first indication of a distinction between social networks that are specifically aimed at work (instrumental social networks) and social networks with a more affective connotation (expressive social networks).

Yet, the similarity among the work related networks of discussing work, collaboration, and asking advice appears to be moderate, which signifies only partial overlap between the social networks (maximum average \( r = .55 \)). This is illustrated by the difference between networks around ‘discussing work’ and ‘asking advice’ with regard to density (respectively .37 and .23, \( t (52) = 18.27, p < .001 \)), reciprocity (respectively .39 and .25, \( t (52) = 8.51, p < .001 \)), and centralization (respectively .34 and .38, \( t (52) = -2.28, p < .05 \)). The personal social networks show similar partial overlap, although the social networks of contact outside work and friendship demonstrate a higher QAP correlation (average \( r = .62 \)) than the work related networks. These two networks were comparable in network density (respectively .13 and .12, \( t (52) = 1.31, \text{n.s.} \)), reciprocity (respectively .41 and .35, \( t (52) = 1.66, \text{n.s.} \)), and centralization (respectively .20 and .18, \( t (52) = 1.49, \text{n.s.} \). It thus appears that the social network questions each assess a different social network among teachers.

<table>
<thead>
<tr>
<th>Table 6. Average QAP correlations (N = 53)</th>
</tr>
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<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>1. Discussing work</td>
</tr>
<tr>
<td>2. Collaboration</td>
</tr>
<tr>
<td>3. Asking advice</td>
</tr>
<tr>
<td>4. Spending breaks</td>
</tr>
<tr>
<td>5. Personal guidance</td>
</tr>
<tr>
<td>6. Contact outside work</td>
</tr>
<tr>
<td>7. Friendship</td>
</tr>
</tbody>
</table>

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**Multidimensional Scaling**

In order to detect meaningful underlying dimensions that may explain the observed similarities between the seven social networks, we used the aggregated QAP correlations as input for a Multidimensional Scaling (MDS) procedure. A three-dimensional MDS representation fit the data best, accounting for 90.5% of the variance and the stress (an indication of fit) at the upper norm of acceptability, namely .15 (Borgatti, 1997). We visualize the two-dimensional MDS representation in Figure 2. This two-dimensional representation accounted for 75.7% of the variance of the scaled data, but the stress exceeds the upper stress limit (stress = .26). To facilitate the discussion of our findings, we chose to depict the two-dimensional representation. While caution should be exercised in interpreting a MDS representation that exceeds stress limits, longer distances tend to be more accurately displayed than shorter distances (Borgatti, 1997), and so the overall pattern is still visible even when stress is above reasonable limits to guarantee good fit. To ensure the trustworthiness of the findings, the results were checked and confirmed with the three-dimensional solution. Two findings stand out from the MDS analysis. First, the two-dimensional representation of MDS results shows a noticeable split between work related and personal relationships. In the upper right quadrant, we find three networks that refer to work related issues, namely discussing work, collaboration, and asking for advice. In and just outside the

![Figure 2. Two-dimensional representation of the multidimensional scaling analysis](image-url)
lower left quadrant, we find three networks that represent more personal relationships, namely contact outside work, friendship, and personal guidance. As such, the horizontal dimension may reflect the instrumental-expressive distinction as proposed by Ibarra (1993, 1995). The ‘spending breaks’ network can be found in the lower right corner and as such differs from the work related and personal networks. This network can thus be considered nor an explicit expressive nor a clearly instrumental social network. What is furthermore insightful is that the social networks around contact outside work and friendship are located in close proximity in the MDS dimensional space. This finding mirrors the highest QAP correlation between these two expressive networks.

Second, we find an interesting difference between asking for advice on one hand and personal guidance and spending breaks on the other. Apparently, the network in which work related advice is transferred is dissimilar to the network that pertains to the exchange of personal matters and spending breaks. As such, this dimension may reflect a scale of mutual in(ter)dependence as discussed by Little (1990). On one end of the dimension, typifying mutual independence, we find the networks of spending breaks and the discussion of personal matters that hardly detract from the inherited traditions of teacher autonomy, noninterference, and equal status. On the other end, there are the networks of asking work related advice and collaboration, that typify more mutual interdependence. These networks signify social relationships that require teacher-to-teacher initiative, shared responsibility of work, and uniformity of action. This finding also holds in three-dimensional space, pointing to an underlying dimension of mutual in(ter)dependence that may differentiate between social relationships among educators in elementary education and define the extent to which collegial relationships permeate daily educational practice.

In sum, results provide support for the distinction between instrumental and expressive networks and reveal a second dimension of mutual in(ter)dependence that may be used to typify social networks in elementary school teams. The instrumental networks of work related discussion, collaboration, and advice are interrelated but each tap into a unique part of instrumental relationships. Similarly, personal guidance, contact outside work and friendship networks are interrelated, but still seem to represent distinctive elements of expressive relationships.
Network visualization: The example of St. Michael Elementary School
To visualize our findings, we depict the seven networks as assessed in St. Michael Elementary School. St. Michael Elementary School\(^1\) is a school with 29 educators. This school is chosen because the pattern of QAP correlations in this school resembles the overall sample of schools. The networks are plotted so that individuals with relatively more relationships are centered visually, with individuals that maintain fewer relationships at the periphery. Noteworthy, the software program Netdraw (as incorporated in UCINET 6.0) visualizes these networks using the multidimensional scaling technique to approximate the relative distance between the individuals in the network. Educators are represented by dots, relationships are depicted by the lines that connect the dots, and arrows indicate the direction of the relationship nomination. Female educators are represented in red and male educators in blue. Moreover, educators in the upper grade level (grades 3 through 6) can be identified by squares, whereas educators in lower grades (K - 2) can be identified by circles. The principal of St. Michael is represented by the blue square in the right lower corner. The network visualizations are depicted in Figure 3. Enlarged versions of the visualizations are included in the appendix.

The network visualizations show that the spending breaks network is the densest social network in St. Michael, followed by the networks around discussing work, collaboration and personal guidance. The networks of work related advice and contact outside work appear less dense, with the friendship network being the sparsest network in St. Michael elementary school. It appears that especially the networks of contact outside work and friendship in St. Michael’s are formed by relationships among predominantly male educators, with most female teachers indirectly linked or even unconnected by expressive ties. While the classification between grade levels generally follows gender lines, the friendship network appears to indicate that same gender preferences (gender homophily) prevail over same grade level preferences (grade level homophily). In the next chapter, we will elaborate on the suggested gender segregation and homophily effects by examining the extent to which demographic characteristics affect social network structure.

Also noteworthy is that the principal is nominated by four male teachers as a friend and embedded in a locally dense network of friendships among the school’s male educators, but the principal himself indicated to be friends with only one male teacher and two female teachers. As such, these female teachers may occupy a strategically important position, as they may have an influence

\(^1\) All names are pseudonyms
on the network through their friendship tie with the principal. Since the friendship network in St. Michael is much less dense than all other social networks, this network offers ample opportunities for structural holes to be spanned by strategic individuals who may profit from the sparse flow of information (Burt, 1997). In all, the representations of these networks provide a powerful tool to visualize and support network findings in regard to network multiplexity and the pattern of ties among educators.

CONCLUSIONS AND DISCUSSION

In this chapter, we investigated seven social networks to examine the ways in which networks are shaped by their content. Drawing upon social network theory and network multiplexity we examined similarities between the social networks and explored a typology of social networks in school teams based on underlying dimensions that may differentiate between social relationships among educators. By doing so, we investigated whether a common distinction between instrumental and expressive social networks could also be validated in the context of elementary school teams. Key themes that arise from our findings are: the validation of the common distinction between instrumental and expressive networks for the field of elementary education; the addition of a dimension regarding mutual in(ter)dependence of educators; the importance of carefully targeting social networks for research and practice; and the potential and pitfalls of multiple networks for facilitating the flow of information, knowledge, and expertise in elementary school teams.

Validation of the instrumental vs. expressive distinction
In general, all social networks tend to show small to moderate overlap, thus indicating unique patterns of social relationships in school teams. This finding fuels the notion that collegial relationships among teachers take different forms in order to optimally accommodate to the intellectual, emotional, and social demands of teaching (Little, 1990). Building on the idea that different social networks are maintained to transfer different sources of information, knowledge, expertise, or materials, it is therefore vital to understand teacher interaction and informal social routines as going well beyond an intuitive grasp of what it means to ‘work together’ or ‘get along’ (Little, 1990; Spillane, 2005).
Figure 3. Visualizations of the seven networks at St. Michael Elementary School

- **Discussing work**
- **Collaboration**
- **Asking advice**
- **Spending breaks**
- **Personal guidance**
- **Contact outside work**
- **Friendship**

○ = lower grade (K - 2)
■ = upper grade (3 - 6)
White = female educator
Black = male educator
Grey = principal
Besides the similarities between networks, this chapter has also gained insights in the dimensions that may underlie various social networks in schools. Results confirm that social networks in elementary school teams can be categorized into instrumental and expressive social networks. Findings suggest that the social networks can be classified into a cluster of instrumental relationships concerning asking for advice, collaboration, and discussing work on the one hand, and a grouping of expressive relationships involving friendship, contact outside work, and, to a lesser extent, personal guidance on the other. Relationships regarding ‘spending breaks’ may serve both instrumental and expressive purposes. As such, this study confirms earlier work in organizational settings (Ibarra, 1993, 1995) that support a distinction between instrumental social relationships aimed at fulfilling organizational goals, and expressive social relationships that are not directly aimed at work.

**Addition of a mutual in(ter)dependence dimension**

Besides validating the distinction between instrumental and expressive social networks, this chapter offers a unique contribution to social network research by identifying a second dimension that may differentiate between social networks in school teams, namely the amount of mutual in(ter)dependence involved in the relationship between educators. Our findings suggest that social networks in school teams can be categorized by the extent to which educators are mutually dependent in achieving desired goals. Social relationships around spending breaks imply high levels of independence that may uphold a traditional mode of instructional autonomy and noninterference. In contrast, relationships around asking advice and collaboration may create tension for individual autonomy by requiring teacher initiative, joint work, and shared responsibility. While the typology described in this chapter is informative and useful, we acknowledge that it is a broad stroke approximation of the complexity of social networks in practice. Teacher interaction in school teams is multi-faceted, and teachers may use multiple channels simultaneously to access and leverage resources that may help them achieve their goals.

**The importance of targeting the ‘right’ social networks in research and practice**

While educational researchers are interested in teachers’ social networks to ultimately explain various teacher and school outcomes, practitioners may regard social networks as a meaningful concept to contextualize teacher interaction in support of teacher development and school improvement (e.g., collaborative practices, collective (organizational) learning, and professional (learning) communities). This study adds to the current debate in educational
practice and policy around such collaborative initiatives by emphasizing that the social networks that underlie these collaborative initiatives are shaped by their content, and as such may be specifically targeted to optimally facilitate organizational goals.

For instance, several scholars point to the value of unplanned or unstructured informal teacher interactions, whether in the hallway or during breaks (e.g., Little, 1990; Spillane, 2005). This study suggests that these types of interactions are indeed not specifically directed towards work or affective purposes. A social network study or professional development program that aims at increasing collegial relationships should be aware that these relationships are not clearly targeted towards a single purpose, and probably incorporate both instrumental and expressive types of resource exchange. This is not to say that these relationships may not be valuable; on the contrary, it may be that during these frequent informal interactions, a solid bond is formed that may later evolve into an advice or friendship relationship (Casciaro & Lobo, 2005). The spending breaks network may resemble other dense networks in that it transfers simple, routine, and explicit information (Hansen, 1999) and consists of many redundant relationships (Burt, 2000). On one hand, information spreads quickly in such a dense network (Degenne & Forsé, 1999), on the other, dense patterns of interaction among teachers may potentially hinder educational change by perpetually repeating redundant information and knowledge (Little, 1990).

Building on this finding, social network studies interested in innovation, which often involves the exchange of new and complex knowledge (Nonaka & Takeuchi, 1995; Paavola, Lipponen, & Hakkarainen, 2004), are advised not to focus on such general networks. Furthermore, our findings indicate that there is a distinction between expressive and instrumental networks in regard to the configuration of relationships. Therefore, researchers and practitioners are advised to target both instrumental and expressive relationships as the structure of these networks may affect the speed and ease with which information is conveyed through its different channels. Different networks only partially overlap, which means that these networks may serve as semi-unique conductors of knowledge, expertise, social support, teaching materials, and other resources valuable to school performance and educational change.

In regard to framing social network questions, recent studies suggests that even within instrumental social networks around advice, the subject matters (Coburn & Russell, 2008; Hayton & Spillane, 2007; Spillane, 2006; Spillane & Diamond, 2007). On average, teachers were found to seek out more colleagues for advice on literacy instruction than on mathematics instruction,
with advice networks for mathematics being about a third less dense than those for literacy (Spillane, 2005). Moreover, research also indicates that the order of social network questions in a survey may affect the shape of social networks (Burt, 1997; Ferligoj & Hlebec, 1999; Pustejovsky & Spillane, 2009; Straits, 2000). These findings emphasize the importance of carefully framing and ordering social networks questions and considering the significance of targeting the ‘right’ social networks in order to maximize their potential (Cole & Weinbaum, 2007; Pustejovsky & Spillane, 2009).

**Delimiters and areas for further research**

The underlying assumption of our social network questionnaire is that one type of relationships (e.g., friendship) means something different to teachers than another type of relationships (e.g., collaboration). However, it may be questioned whether different teachers perceive the described social relationships in the same way. For instance, the concept of ‘friendship’ is ambiguous and open to individual differences in interpretation (Fisher, 1982; Pustejovsky & Spillane, 2009). Fisher (1982) found that the label ‘friendship’ is likely to be applied. Indeed, in an earlier study placed in the United States, Cole and Weinbaum (2007) found that teachers name more friends than people with whom they discuss curricular or reform related issues, resulting in the densest network being the friendship network. In contrast, the data from this Dutch sample schools suggest that friendship among teachers is in general less common than work related discussion. There may be two issues at play here that relate to the generalizability of the research. On average, Dutch elementary schools are smaller than US elementary schools, which may limit the opportunities of friendship relationship but may not affect the minimum number of work related contacts that an educator needs to perform his/her daily tasks. In addition, there may be a cross-cultural difference in the tendency to form and nominate relationships between the two countries. Therefore, it would be interesting to conduct a comparative study of educators’ social networks in multiple countries to examine such cultural differences.

The theoretical framework of this study suggests that different resources may be exchanged within different types of relationships. Yet, in this study, we did not specifically focus on the resources that were exchanged in the network. We focused on similarity among whole networks, and therefore, inferences of the resources that are actually exchanged in these different types of networks should be drawn with caution. We would recommend future research to provide more in-depth knowledge on the actual resources that are transferred in these networks. One valuable route through which deepened understanding
can be gained in the exchanged resources, as well as teachers’ perceptions and interpretations of social relationships, is through combining social network analysis with qualitative data (e.g., Daly et al., in press; Spillane, 2005).

The social fabric of school teams
This study demonstrates that ‘network content matters’. What is further required from social network research in education is a validation of the underlying assumption that ‘relationships matter’. In addition, if scholars, practitioners, and policy-makers are to embrace social networks as a valuable lens to uncover the potential of teacher interaction for innovation, reform efforts, and improved student performance, deepened insights in the elements that shape social relationships among teachers are needed. With this chapter, a first step to understand the nature of the social fabric of school teams has been taken. Now it is time to scrutinize the circumstances that affect the pattern of this social fabric and its potential to warrant school outcomes that matter. It is through these next steps that social network research can make a difference in educational practice.