

Analyzing Teachers' Interactions Through Social Network Analysis: A Multi-Case Study of Three Schools in Van, Turkey

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Abstract

This study aimed to catch a glimpse of teachers' social networks and explore the cause and nature of interaction patterns by using social network analysis. This study was designed as a qualitative case study research. Three high schools from Van, Turkey, were selected with purposeful sampling method and data were collected through semi-structured interviews. Through network and content analyses, it was found that informal interaction networks revealed a form that was different from formal structure. Although each school had a unique network pattern, gender played an important role in relationship patterns in all networks. In addition, similarity of teaching subjects, working duration at school and seniority seemed to bring teachers closer. Finally, it was revealed that teachers who shared common interests had more interactions. All in all, homophily was effective in shaping interactions between teacher dyads.

Introduction

Friendship, support, communication and information sharing ties among teachers and school staff who have face-to-face interactions in the same school building constitute social networks. As such, social networks could be summarized as relations among a set of individuals (Wasserman & Faust, 1994). The continuity and regularity of relations is described as social structure by Radcliffe-Brown (1940), who saw the web of really existing relations among interacting staff as an organization's social structure.

While teachers fulfill their bueraucratic responsibility for planning teaching, implementing, evaluating and reporting, they also interact with their colleagues, get to know each other, develop friendships and sincere relations as social entities. Interactions and relations mostly tend to be directed to the similar ones which is expressed as homophily in network theory. Homophily refers to the principle that a contact between similar people is more likely to occur than among dissimilar people. Homophily means that actors who are similar on socio-cultural and personal characteristics will have more interaction among themselves (McPherson, Smith-Lovin & Cook, 2001). In accord with Homophily, the similarity in ages, gender, beliefs, ethnicity, interests, and education level leads to an easier and faster relation formation among individuals (Rivera, Soderstrom & Uzzi, 2010).

Friendship relations among educators create an informal communication and interaction model within the formal structure of the organization. Thus, an informal organization within school comes to front where ties among members are stronger, relations are more sincere and information

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sharing is more extensive. As such, the school can be thought of as an iceberg, where the surface above the water represents the formal structure and the invisible part underwater symbolizes the informal structure. In addition to the personnel whose duties are specified in the organizational charts and who are of vital importance for organizational effectiveness, the natural organization which is formed by close relationships established in the workplace, especially in the context of various common interests, should be identified (Aydın, 2007; Cross, Borgatti & Parker, 2002; Schermerhorn, Hunt & Osborn, 2002).

Social network theory explains structure as a web of relations and actors are interconnected to each other with various ties. These ties act as pipelines by which advice, friendship, information, behaviors, beliefs, materials and gossips could be transferred to influence behaviors. Transfers and influence could be denser and more between similar actors, causing subgroup formations which might handicap overall network communication and integration. This could slow down and decrease efforts to reach organizational goals.

In summary; social networks can provide a common understanding in unity, cohesion and integration of the school community through many and different ties ensuring the circulation of information and resources among educators. Networks also have the potential to reduce the effectiveness of the school with possible fragmentation and grouping structures especially among similar actors. Homophily posits that similarity will bring teachers closer by their gender, age, tenure, teaching area or teaching beliefs, leading them to homogenous groups where not much information will be produced and shared with the whole community.

In this context, it is necessary to examine interaction networks among educators as network structures are important in terms of determining the internal dynamics and functioning of schools. Similarly, in this study, we focus on the integration and possible fragmentation of the structure, if there is optimal flow of resources in the whole network and what homophilic factors helped form the network structure. We target the following research questions:

1. What kind of relationship model do everyday interaction networks in schools form? What do the structural measurements of these networks tell about the integrity or fragmentation of the networks?
2. Which factors affected the formation of networks between teachers? What similar/common characteristics among teachers (variables such as gender, branch, seniority, etc.) have influenced the formation of networks within the homophily principle?
3. How do teachers interpret social relationships at school? Is there a consistency between teachers' views on school climate and the statistical and visual findings obtained by social network analysis?

Theoretical Framework of Social Network Theory

Network theory sees social structure as a network of relations and states that relationships between individuals can affect their behavior positively or negatively. Individuals are not independent from each other in network perspective, but are connected to other individuals through various bonds and relationships. This dependence on relationships affects the outcomes of individuals (Robins, 2015). Likewise, Degenne and Forsé (1999) indicate that the network may be an element of pressure on individuals' preferences, behaviors and ideas. Similarly, Borgatti, Everett and Johnson (2013) state that the position of an actor in the network is decisive for the obstacles or opportunities that s/he will encounter and therefore finding the person's position in the network is important in predicting his performance, behavior and beliefs.

Social network theory has several basic assumptions that differentiate the network perspective from the traditional social and behavioral science approach: 1) The actors in the social network are seen as interdependent rather than independent (Balkundi & Kilduff, 2006; Degenne & Forsé, 1999; Wasserman & Faust, 1994); 2) Relational ties between actors serve as channels in the flow and transfer of information and resources (Balkundi & Kilduff, 2006; Wasserman & Faust, 1994); 3) The structure of the network may offer pressure or opportunities to shape individuals' behavior (Moolenaar, 2012; Wasserman & Faust, 1994); 4) Moreover, network models conceptualize the structure as a continuous relationship between actors (Wasserman & Faust, 1994).

To better understand properties of networks, Homophily and Proximity are primarily important for interpreting the chances of establishing or dissolving ties. Propinquity implies that proximity in time or physical space increases interactions (Kadushin, 2012). Examples of this are that people whose rooms are adjacent or close to each other interact more with each other and make friends (Kadushin, 2012).

According to the concept of Homophily, which we interpret as the attraction power of similarity in this study, if two people have more similar aspects than other people in a group or network in terms of social characteristics, they are more likely to interact and relate to each other (Kadushin, 2012; Verbrugge, 1977). Homophily refers to the principle that a contact between similar people is more likely to occur than among dissimilar people (McPherson et al., 2001). Homophily, which structures all types of relationships like marriage, friendship, information transfer, joint membership and joint participation refers people to homogeneous structures in the context of socio-demographic characteristics. Homophily constitutes a significant limitation in the attitudes and interactions of individuals (Kossinet & Watts, 2009; McPherson et al., 2001).

The ties between individuals can be classified as strong and weak in terms of duration of interaction, frequency and also emotional aspect. Positive and mutual ties are strong ties and are seen in friendship relationships. However, relationships with distant acquaintances are examples of weak bonds (Granovetter, 1973). Weak links facilitate the flow of information between remote and different parts of the network. Moreover, weak links enable integration between social systems (Kadushin, 2012; Krackhardt & Stern, 1988).

Social Network Analysis and Related Terminology

The essence of social network analysis is the relations/links between social units and the outputs associated with these links. Social units are defined as actors or nodes. Examples of actors in educational research include students in a classroom, school departments, teachers in a district, and parents in the community. The concept of actor describes a social unit that plays a role in a larger system rather than the ability of these units to act (Carolan, 2014; Wasserman & Faust, 1994).

The social connection or contact between actors is expressed as a tie (Wasserman & Faust, 1994). Some common links pointing to the ties between actors in educational research may be behavioral interaction, material transfer, official relations, partnership or membership (Carolan, 2014).

At the most basic level, the two actors and the bond between these two actors form a simple network. The bond between the two actors shapes the dyad relationship style, which is a feature of both actors. From this point, dyad refers to two actors, triad refers to three actors and their possible ties (Wasserman & Faust, 1994). Network analysis makes use of a graphic display called sociogram where points represent actors and lines represent ties or relations. To understand the structure of a network, one should look at the dense connections within and among subgroups

built-up by dyads, triads and cliques which can be defined as a set of actors that are connected to each other (Hanneman & Riddle, 2005).

In terms of scope and method, social network researchers focus on two basic network patterns (Borgatti et al. 2013; Robins, 2015; Wasserman & Faust 1994). The first is ego network. Ego-centered networks are made up of a single actor and other actors to whom this actor is in direct contact. For example, a teacher and close friends associated with him/her are examples of this type of network. The second network pattern is whole/full network pattern that includes a group of actors with clear boundaries and their relationships. Examples of full networks include students in a classroom or teachers in a school, as in this research. In full networks, a single relationship type can be studied, as well as data on multiple relationships. Thus, results related to the social system can be obtained (Borgatti et al., 2013; Robins, 2015; Wasserman & Faust 1994).

Social network analysis also sheds light on informal organizational structures. Although the formal organization has defined the line of authority, influences and tasks are realized through the informal structure of friendships and contacts (Krackhardt & Stern, 1988). In other words, formal groups reflecting the formal structure of the organization and informal groups representing the natural aspect of the organization can interact with each other and consist of the same members (Cross et al., 2002; Katz, Lazer, Arrow & Contractor, 2004; Robbins, DeCenzo & Coulter, 2013).

The natural organization emerges in order to meet the socio-emotional needs that the bureaucratic structure cannot solve within the formal organization. It develops a sense of belonging, dignity and identification among employees and provides information on approved behaviors. The natural organization also creates an environment based on tolerance, trust, understanding and kindness among the employees. Finally, the natural organization establishes a natural communication channel that is softer and more intimate than formal communication (Aydın, 2007; Cross et al., 2002; Schermerhorn et al., 2002). However, the natural organization also has negative effects. One of these is the resistance to gossip and change that may have a devastating effect by distortions (Aydın, 2007).

In summary; as the significance of this study, networks can provide a common structure in unity, cohesion and integration of the school community ensuring the circulation of information and resources among educators. Organizational goals, reforms, initiatives and new programs could be started and managed successfully if the network is densely and optimally connected. Networks also have the potential to reduce the effectiveness of the school with possible fragmentation and grouping structures especially among similar actors. Homophily posits that similarity will bring teachers closer by their gender, age, tenure, teaching area or teaching beliefs, leading them to homogenous groups where not much information will be produced and shared with the whole community.

In this context, it is necessary to examine interaction networks among educators as network properties are important in terms of determining the internal dynamics and functioning of schools in terms of collaboration, professional learning, and collegial support. We focus on the integration and fragmentation of the structure to see if the structure allows flow of sources across whole network. We have also sought to find what homophilic factors helped to shape network structure.

Review of Literature

Literature given here is divided into two main bodies. First, mainstream research about social networks have been reviewed and second, studies about homophily have been outlined. Research in education has resorted to social network theory to understand the role of relationships between teachers in collaboration, professional development, promotion of student outcomes, and

facilitating educational change. (Moolenaar, 2012; Penuel, Riel, Crause & Frank, 2009). Research has shown the pattern of teachers' relationships may help us understand the ways by which teacher collaboration can take place and contribute to enhanced student learning, and teachers' instructional practice (Moolenaar, 2012). Educational researchers promote information sharing and common practice through collaborative initiatives such as professional learning communities. Relations among teachers are targeted as the most important way and resource to achieve it (Daly & Finnigan, 2009).

According to Coburn, Russel, Kaufman and Stein (2012), who examined the relationship between teachers' social networks and sustainability of teaching reform, teachers' strong social networks enabled the new approach to teaching to continue under the reform after the support for reform was completed. Penuel, Sussex, Korbak and Hoadley (2006) handled social network data to see the effectiveness of school development programs through teacher collaboration. They mapped the expertise and stars of the network who could provide improve or harm new initiatives. They also explored how network data could be used to review reform efforts. Penuel, Riel, Joshi, Pearlman, Kim and Frank (2010) sought if the formal organization of a school and patterns of informal interaction were aligned, faculty and leaders in a school would be better able to coordinate instructional change. They combined social network analysis with interview data and found that the school which was formally and informally better-aligned accomplished instructional decision-making through its local network structure. In addition, Baker-Doyle (2012) stated that social relations and strong networks among teachers lead to faster policy changes, solving professional problems, integration of new teachers and a certain amount of power in the participation to decisions.

As regards to Homophily, the literature is remarkably consistent across many different environments, relationships and dimensions of similarity: As McPherson et al. (2001) states, race and ethnicity create divides in diverse societies. Sex, age, religion, and education also strongly shape relations. Homophily is seen in occupation, network position, behaviors, and intrapersonal values. They also emphasized that the main causes of homophily are space (proximity) and organizational activity. Similarly Stehle, Charbonnier, Picard, Cattuto and Barrat (2013) searched for gender homophily in a primary school in France and revealed that gender homophily was present in all grades and notably in 4th and 5th grades it reached higher levels for boys than for girls. They also founded that gender homophily tended to increase with age at a higher rate for boys for strong ties. Yuan and Gay (2006) studied 32 university students enrolled in a distance learning class. Their study showed that homophily in group assignment and in location had significant impact on the development of network ties. In another study examining electronic correspondence on a university campus, Kossinet and Watts (2009) found that gender, age, status, branch and period at university had a convergent effect among individuals on the campus. Verbrugge (1977), who investigated friendship preferences among adults, showed that similarities in gender and marital status attracted individuals more. Finally, Moolenaar (2012), who compiled various researches in schools, concluded that the principle of homophily was marked by characteristics such as gender, age, experience, ethnicity, class level, branch, physical proximity, teaching perspectives, and previous professional relationships, and because of similarities, teachers can convert their networks into relatively homogeneous subgroups.

The literature about social networks and homophily touches many different aspects of teachers social relations, collaboration, reform efforts, professional learning, causes of networks, similarity between pairs of teachers, gender, age, religion, ethnicity, etc mostly in western cultures. However

these findings must be tested with some other schools in different cultures and countries to see if network structures follow a general-universal pattern.

This study sheds light on Turkish schools in terms of network patterning behaviors of teachers. Social network analysis has been used in very few studies and they mostly deal with online interactions in Turkey. This study is one of the first empirical works and thus has a premium importance for using social network analysis to analyze face-to-face relations in schools. We wanted to investigate the nature and structure of teachers' networks and if the homophily principle was resistant among Turkish teachers. Thus we can enhance our understanding of networks, network structure, tie formation and dissolution and homophily. This study can contribute to literature by reflecting findings in Turkish high schools.

Methodology

Research Design

This study is designed as a multi-case study which is one of the qualitative research designs. The most fundamental feature of the case study is that it provides in-depth exploration and understanding of one or more cases in their context (environment) using different data sources (Baxter & Jack, 2008; Patton, 2002). In other words, factors related to the cases (environment, individuals, events, processes, etc.) are investigated with a holistic approach, and how they affect the situation and how they are affected (Yin, 2009; Cohen, Manion & Morrison, 2007).

Participants and Context

Within this research, there are three public high schools located in Van province, Turkey. One of the three schools is a general academic high school, another is religious studies high school and the last is a vocational studies technical high school. In sampling of schools, purposeful maximum diversity sampling type was applied in choosing schools by types, curriculum, organizational design, school culture and demographics of participants. According to Patton (2002), purposeful sampling allows in-depth study of situations with rich information. Knowledge-rich situations give a deep understanding of the subject rather than generalization. Maximum diversity as a sampling type reveals the differences between cases by selecting and studying heterogeneous states (Patton, 2002).

As Lange, Agneessens and Waeye (2004) state that social network questions could be seen as a threat to the privacy of the participants and that participants might be worried about possible harm, the real and full names of these high schools have not been given. High schools are represented only by their program names. In addition, in order to protect the privacy of personal data, codes were assigned to all participants. In all data collection, editing, analysis and reporting processes, codes were used instead of real school names and participant names.

In the technical high school, there are 23 teachers; 17 (74%) of them are male while six (26%) of them are female teachers. The number of vocational subjects teachers is seven (30.4%) and that of general subjects teachers is 16 (69.6%). While seven (30.4%) teachers are single, the number of teachers who are married is 16 (69.6%). The average period of working at school is 3.7 years while the overall average of years in teaching is 10.9 years.

In the religious studies high school, there are 30 teachers; 22 (73.3%) of them are male while eight (26.7%) of them are female teachers. The number of vocational subjects teachers is seven (23.3%) and that of general subjects teachers is 23 (76.7%). While six (20%) teachers are single,

the number of teachers who are married is 24 (80%). The average period of working at school is 3.7 years while the overall average of years in teaching is 10.3 years.

In the general academic high school, there are 31 teachers; 21 (74%) of them are male while 10 (26%) of them are female teachers. All teachers and managing staff are general subjects teachers and there are no vocational subjects teachers. While 15 (30.4%) teachers are single, the number of teachers who are married is 16 (69.6%). The average period of working at school is 2.7 years while the overall average of years in teaching is 6 years.

Data Collection

One-to-one interview (Creswell, 2012) was preferred as data collection technique to allow participants to feel comfortable and express their views freely without any worry. Data was collected through the semi-structured Social Network Study Interview Form developed by the researchers. According to Berg (2001), in a semi-structured interview, the interviewer directs the predetermined questions to each participant systematically and consistently. However, the interviewer is expected to ask new questions beyond the standard questions prepared to find more details or a different perspective on the subject. The questions used in semi-structured interviews reflect the idea that participants perceive the world in different ways. For this reason, researchers try to see the world through the eyes of the participant.

The interview form, which contained both qualitative and quantitative elements, enabled the simultaneous collection of two types of data. According to Creswell (2012) and Bentahar and Cameron (2015), both quantitative and qualitative data indicate that social realities are intrinsically complex and cannot be captured in their entirety by a single research method or data collection technique. Within the scope of this study, to draw social network of the schools, we asked teachers to name five colleagues with whom they like spending time and chatting as well as why they chose them. As regards qualitative part, we also requested them to talk about relations among teachers and the social side of their schools.

The interviews were conducted in the schools covered by the research between February and June 2016 after obtaining official research permit from the relevant education authority. Prior to the individual interview, the interview protocol questions, analysis and confidentiality issues were mentioned and verbal consent was obtained from each participant.

Table 1. *Participation Data Per School*

| School Name/Code | Participants on the Staff List | Those Interviewed | Written Participation | Total Participation | Percentage |
|-------------------------------|--------------------------------|-------------------|-----------------------|---------------------|------------|
| Technical High School | 24 | 23 | 1 | 24 | 100 |
| Religious Studies High School | 33 | 25 | 4 | 29 | 88 |
| Academic High School | 31 | 28 | 1 | 29 | 94 |
| TOTAL | 88 | 76 | 6 | 82 | 93 |

Table 1 shows that participation rate in the study is quite high, with a total percentage of 93% and the least participating school has a 88% ratio. Moolenaar (2012) states that participation rate should not be less than 80% in terms of the integrity of the relationship patterns in full networks.

Data Organization and Analysis

Network data were analyzed with UCINET (Borgatti, Everett & Freeman, 2002) and NetDraw (Borgatti, 2002) software programs which are used in social network analysis. Regarding the analysis of qualitative data, Yin (2011) mentions a 5-step analysis cycle: compilation, disassembling, reassembling, interpreting, and concluding. First, interview records were listened and deciphered in a different MS Excel file for each school and an appropriate database was created. Later, data were divided into codes (gender, culture, beliefs, school type etc) and unrelated parts to the main theme were extracted. In the third step, the themes that emerged through the codes were clarified and the participants' views forming the same theme were clustered together. In the fourth step, the interpretation step, the data grouped according to their themes were interpreted in the light of social network analysis results and relationship maps. In the last step, the findings of the schools in the research are compared and the results obtained with similarities and differences are summarized in the conclusion.

Validity and Reliability

The social network questions in the interview form were related to the daily interaction, cooperation, friendship, and grouping relationships among teachers reflecting the social structure and climate of the school, which are relatively long-lasting (Wasserman & Faust, 1994). In addition, it should be kept in mind that a list of staff with real names and codes was provided to the participants during the interview to reduce cognitive load and remembering problems (Lange et al. 2004), to allow the participant to see all members of the school, and to give everyone equal opportunity to be selected. Participants expressed their preferences on this list and sufficient time was given to them to think over questions.

In addition, during the question development phase, attention was paid to the fact that the structure (social networks/structure as teachers' collaboration, advice and social support relationships) could be reflected in order to ensure the content validity of the questions (Cohen et al., 2007). In addition, in the context of cultural validity (Cohen et al., 2007), attention was paid to ensure that the questions were clear and understandable, and that they were compatible with common cultural values and meanings. After the questions were completed, they were presented to the thesis committee members for expert opinion. With the expert opinion (Yıldırım & Şimşek, 2011), the data collection instrument was applied with two teachers who were not participants of this research and it was used for real research after positive feedback.

In the analysis phase, social network outcomes and participants' views were compared. Both quantitative and qualitative data collected through the same instrument showed consistency. This consistency ensures the authenticity and accuracy of the acquired data in other words its internal validity (Cohen et al., 2007).

Findings

Daily interaction networks of teachers reveal relatively more persistent relationship patterns in the form of friendships within the school. This network also reflects the school's natural organization and informal leadership. The following research questions provided the main framework for examining everyday interaction networks.

1. What kind of relationship model do everyday interaction networks in schools form? What do the structural measurements of these networks tell about the integrity or fragmentation of the networks?

2. What similar/common characteristics among teachers (variables such as gender, teaching subject, seniority, etc.) have influenced the formation of networks within the homophily principle?
3. How do teachers interpret social relationships at school? Is there a consistency between teachers' views on teachers relationships and the statistical and visual findings obtained by social network analysis?

Analysis of the Technical High School's Daily Interaction Network

When the relationship map (sociogram) of Technical High School is examined, it is seen that there are 23 actors in the network and the network is unified and no actors are isolated. The blue lines on the map indicate reciprocal and strong ties, while the black lines indicate unidirectional and weak ties. It seems general subjects teachers and vocational subjects teachers formed two separate blocks.

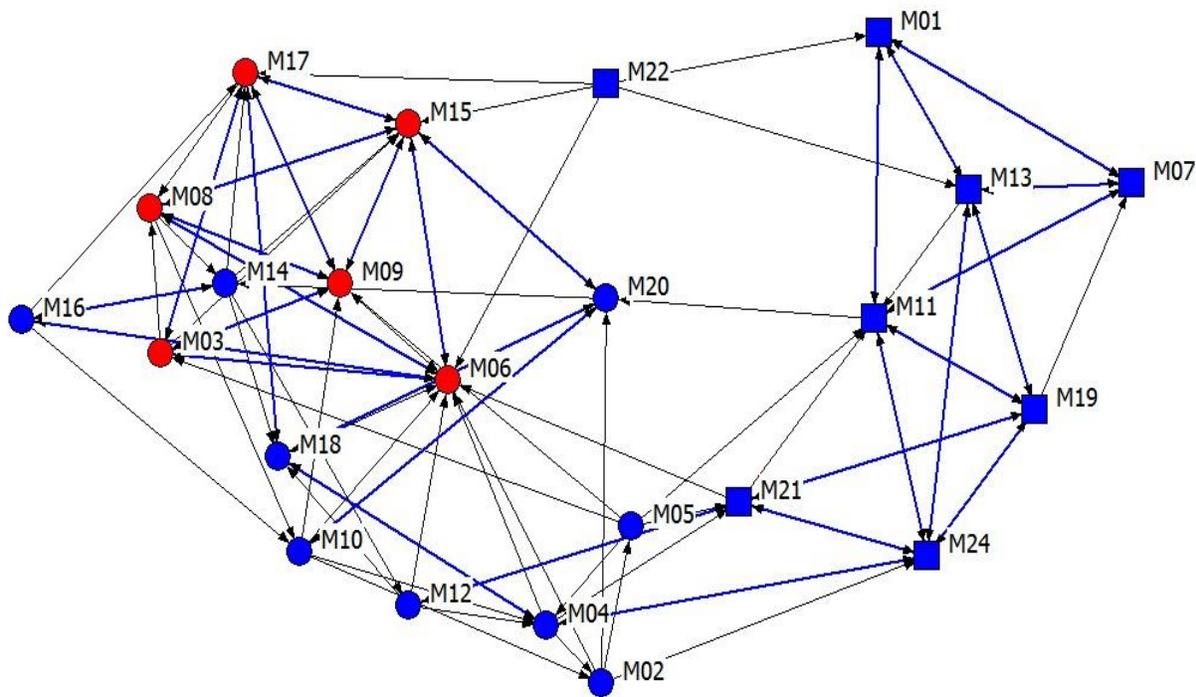


Figure 1. Technical High School's Network Structure by Teachers' Gender and Subjects

Note. ●=Female; ●=Male, ● = General Subjects Teacher, ■ = Vocational Subjects Teacher

The reciprocal relationship provides an optimal flow for the transfer of various resources such as information, material, social and economic support. However, when we observe the one-way links indicated by the black color in the middle of the map, it will be seen that the network is actually about to be divided into two. The bond from M11 to M20 is important in terms of establishing a relationship and keeping the two blocks together. The fact that M21 filling up a structural hole receives and responds to M12 and M19, and the mutual relationship between M04 and M24 (school management) has enabled the school's social network to remain as a whole. The positions and interaction patterns in the relationship map indicate that the channels of

communication, information sharing and material transfer between the actors are open and that the school network can provide integration and integration especially through intermediaries.

Table 2. *Structural Analysis of the Technical High School's Interaction Network*

| Measure | Value | Measure | Value |
|------------------------------------|-------|----------------------------|-------|
| Density | 0.208 | Connectedness | 0.957 |
| Reciprocity | 0.419 | Fragmentation | 0.043 |
| Transitivity | 0.370 | Clustering Coefficient | 0.312 |
| Network Centralization (Outdegree) | 0.020 | Geosedic Distance | 2.5 |
| Network Centralization (Indegree) | 0.353 | Betweenness Centralization | 10.81 |
| Diameter | 6 | Size | 23 |

The density of ties in the technical high school's network is 21% (0.208) with 105 ties between 23 actors. This value is considered to be high in social network research even if it seems low. Because resources like time, labor, interest, desire, power and so on are limited, people will establish and develop relationships with a small number of people. Bonds are reciprocal at 42% (0.419), and the web can be seen as an interactive and stable structure with a transitivity rate of 37% (0.370). Since the indegree rate is 35% and the clustering is 31%, the links in this network are concentrated in a few actors. The betweenness ratio is around 11%, indicating that there are many intermediary actors in the network rather than a monopoly, and there are many alternative channels in the transfer of resources and information. If the betweenness value is high, it indicates that the major flow channels between the subgroups of the network are controlled by one or a few actors and that the network is open to manipulation of these actors.

Clique Formations

By examining the sub-groups in the vocational high school interaction network, the dominant factors leading to cliques were identified. Strong clicks with at least three members are given in the table.

Table 3. *Strong Cliques within the Technical School's Interaction Network*

| Clique No | Clique Members | Clique Commonality |
|-----------|----------------|--------------------------------------|
| 1 | M06 M08 M15 | Female and general knowledge teacher |
| 2 | M08 M09 M15 | Female and general knowledge teacher |
| 3 | M09 M15 M17 | Female and general knowledge teacher |
| 4 | M03 M09 M17 | Female and general knowledge teacher |
| 5 | M01 M07 M13 | Male and vocational subjects teacher |
| 6 | M01 M07 M11 | Male and vocational subjects teacher |
| 7 | M11 M19 M24 | Male and vocational subjects teacher |
| 8 | M13 M19 M24 | Male and vocational subjects teacher |
| 9 | M19 M21 M24 | Male and vocational subjects teacher |

In the vocational high school interaction network, 27 weak cliques and nine strong cliques were detected. Out of nine, four cliques composed of women teachers from the general subjects. The remaining five cliques consisted of male teachers. So, a strong homophily tendency on the basis of gender and teaching subject is evident. Nevertheless, it should be remembered that

vocational subjects teachers are located on a different floor in the school building and this physical division affected the relations between two groups of teachers.

Regression Analysis of the Technical High School's Network

Quadratic Assignment Procedure (QAP) analysis was carried out in order to see what factors effected interactions based on similarity and dissimilarity between dyads. Variables were seniority, working period at school, teaching subject (whether vocational or general subjects), gender and marital status in bilateral relations. As a result of multiple regression analysis, the fit index (adjusted R²) of the model in explaining the daily relationships was around 17%. In the daily relationships, the difference in seniority of the teachers, the difference in working period at current school, teaching areas, sharing the same sex and being single or married accounted for the formation of interactions by 17%.

Table 4. Multiple Regression QAP Coefficients

| Relational Variables | B | SE B | β |
|-------------------------------------|--------|-------|----------|
| Seniority (total years in teaching) | -0.001 | 0.004 | -0.021 |
| Working period at current school | -0.017 | 0.010 | -0.092** |
| Subject area (branch) | 0.291 | 0.046 | 0.358* |
| Gender | 0.163 | 0.046 | 0.197* |
| Marital status | 0.004 | 0.047 | 0.005 |

(Note. * p<.01; **p<.05; R² = .176, Adjusted R² = .168, p<.01)

These variables statistically significant were working period at school, being a teacher of the vocational subjects group and sharing the same gender. In this case, those who have similar working time spent at school have interacted more. General subjects teachers interacted within their group while vocational teachers preferred their fellows. Also, women chose to interact among themselves and men chose to interact with their fellow men. As the result of this analysis shows, it is difficult to explain the relationships only with measurable variables such as gender, subject or seniority. It is an accepted fact that social relations are very complex and are affected by very different stimuli.

Teachers' Statements About Daily Interactions

Statistical analysis and the sociogram showed that gender and subject-based interactions do exist in the technical high school. Teachers' statements confirm this consistency based on similarity of interests and characteristic. Three teachers directly expressed that men and women have more contact with their fellows on the basis of gender-similarity. A female teacher recorded: "Even though we are all together, we get closer to female friends because of similar issues and interests. We talk about food, children and home" (M08). A male actor (M01) touched on the potential of common interests and characteristics to bring people together, and stated how social and cultural perceptions can be effective in relationships. "I prefer to be with people close to me in personal characteristics. It can also vary according to gender and whether or not you are married. Spending time with someone of different sex can be misinterpreted." Another actor (M20) stated that common habits and interests brought teachers closer together and even grouped them and reiterated gender perception: "Women can form different conversation groups among themselves."

It was revealed that the branch was an important factor shaping the relations, especially with the use of different floors in the technical high school. M11, who is a vocational teacher explains the result of this settlement plan: “Vocational subjects teachers and general subjects teachers have classes on different floors. Of course, when this happens, there may be a lack of contact.” Likewise, another vocational subjects teacher adds: “We have to cooperate because we use the same laboratories, we do their maintenance and repair work together. We have common lessons. We have to be in coordination” (M13). A similar opinion was given by M07, who is also a vocational teacher: “Since we are technical teachers, we spend more time in the chef’s room. That’s why we don’t have many conversations with general subjects teachers.” Actor M17, a general knowledge teacher, stated that dialogues are not very developed and relations are distant: “As general subjects teachers, we are always in the same and only teachers’ room, but vocational teachers have lessons and they spend time upstairs. There is not much sharing with them.”

Analysis of the Religious Studies High School’s Daily Interaction Network

The general interaction network (sociogram) of the Religious Studies High School reveal that interactions are denser in the lower right of the relationship map than the other areas. In particular, actors such as i18, i10, i20, i16, i14 and i32, located in the middle of dense bonds, are located at the center of the network. These actors have a respectable position and therefore the power to influence because they receive more ties from other actors. In this relationship map, where blue bold lines show mutual and thin black lines show unidirectional bonds, it is seen that the relations between the school management team (i29, i30, i31) are mutual. It is obvious that there are two main blocks in this network, on the left are female teachers while male teachers are located on the right. We see that the actor i08 is isolated, s/he has no incoming and outgoing links.

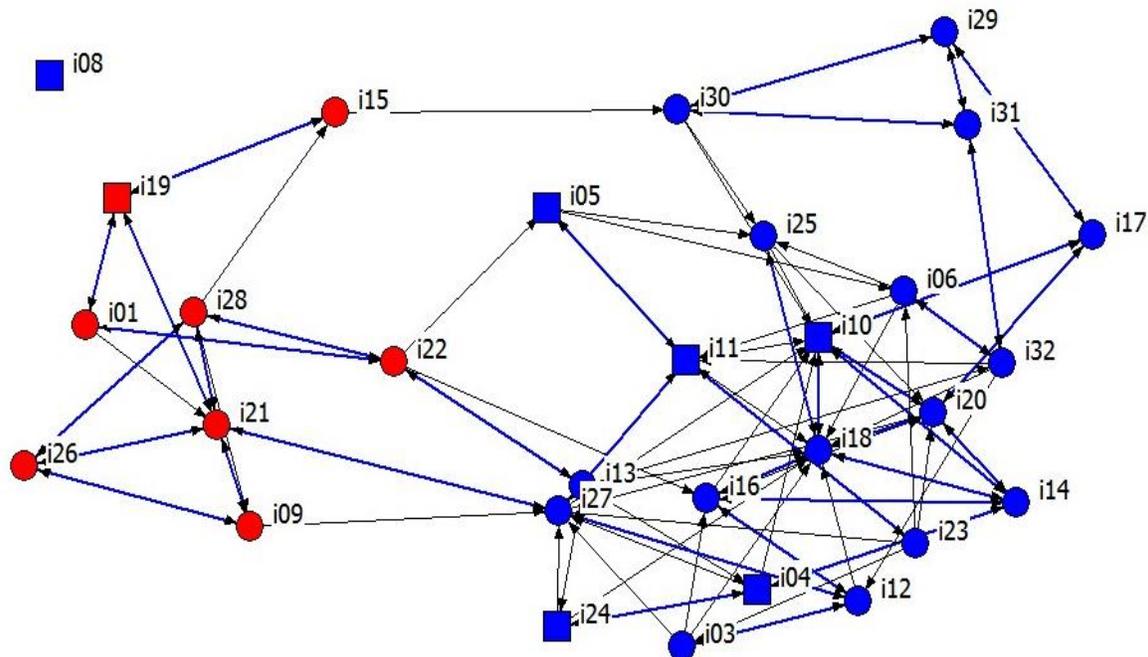


Figure 2. Religious Studies High School’s Sociogram by Teachers’ Gender and Subject
Note. ●=Female; ●=Male, ● = General Subjects Teacher, ■ = Vocational Subjects Teacher

The interconnections on the i13-i22-i28 and the i27-i21 lines between the two main blocks hold the groups together, allowing information, support and resource flow between the groups.

These actors have intermediary roles, having the positions to continue, stop or distort transfers. According to the data in Table 5, the density of the religious high school, which consists of 30 actors and 115 links between these actors, is 13%, the reciprocity value is 47%, and the transition rate is 33%, that is, approximately half of the relations are mutual and long-term. With the predominant disconnection of the I08 actor from the main network, the cohesion (integrity) ratio of the network increased to 93% and the fragmentation rate to 7%.

Table 5. *Structural Analysis of the Religious Studies High School's Interaction Network*

| Measure | Value | Measure | Value |
|------------------------------------|-------|----------------------------|-------|
| Density | 0.132 | Connectedness | 0.933 |
| Reciprocity | 0.474 | Fragmentation | 0.067 |
| Transitivity | 0.333 | Clustering Coefficient | 0.291 |
| Network Centralization (Outdegree) | 0.042 | Geosedic Distance | 3.1 |
| Network Centralization (Indegree) | 0.291 | Betweenness Centralization | 28.44 |
| Diameter | 8 | Size | 30 |

The centralization of the network is 29%. In summary, the network has several stars, so that the network appears more stable and horizontal. The betweenness centralization rate is high at 28%, indicating that there are few actors connecting the blocks to each other, and the lack of sufficient alternative intermediaries may be a disadvantage for the network in the flow of information and resources. While the average distance in the network is three bonds/steps, the number of steps required to move from one side of the network to the other side is eight, which is relatively high.

Clique Formations

Twenty-eight weak cliques and six strong cliques were detected in this high school's interaction network. It is seen that gender, teaching subjects, task similarity and closeness in physical space are important for individual and environmental factors that help make up the cliques. The cliques 1 and 4 are shaped on the gender axis. The cliques 2, 3 and 5 were formed on the axis of both the gender and the subject area group, and finally clique number 6 consisted of gender, task similarity and physical proximity.

Table 6. *Strong Cliques within the Religious Studies High School's Interaction Network*

| Clique No | Clique Members | Clique Commonality |
|-----------|-----------------|--------------------------------------|
| 1 | i10 i14 i18 i20 | Male |
| 2 | i14 i16 i18 | Male and general subjects teachers |
| 3 | i09 i21 i26 | Female and general subjects teachers |
| 4 | i10 i17 i20 | Male |
| 5 | i21 i26 i28 | Female and general subjects teachers |
| 6 | i29 i30 i31 | Male and school managing team |

It is seen that the school management team consists of male actors and they share work and duty related tasks. Also, proximity of their rooms have deepened the relations between them and brought the actors closer to each other.

Regression Analysis of the Religious Studies High School's Network

The below regression model was tested to find out which relational variables mainly helped the interactions and relations among teachers in the daily interaction network of religious studies school.

Table 7. Multiple Regression QAP Coefficients

| Relational Variables | B | SE B | β |
|-------------------------------------|--------|-------|---------|
| Seniority (total years in teaching) | -0.007 | 0.002 | -0.121* |
| Working period at current school | 0.004 | 0.007 | 0.024 |
| Subject area (branch) | 0.042 | 0.029 | 0.060 |
| Gender | 0.195 | 0.031 | 0.283* |
| Marital status | -0.038 | 0.034 | -0.053 |

Note. * $p < .01$; $R^2 = .092$, Adjusted $R^2 = .086$, $p < .01$

As a result of the multiple regression analysis, the fit index (adjusted R^2) of the model in explaining the daily interactions was approximately 9%. Hence, seniority of teachers, working duration at school, subject area, same gender and same marital status determined interactions by 9%. The statistically significant variables were same gender and seniority. Thus, teachers whose total length of service was close to each other interacted more. In terms of gender, female teachers interacted among themselves and men interacted with their fellow men and thus a gender-based relationship pattern emerged.

Teachers' Statements About Daily Interactions in Religious Studies High School

Although this school is a vocational school, vocational subjects teachers and general subjects teachers use the same floors, classes and teachers' room. In short, they make common use of the same physical spaces. This led to a harmony between two blocks as expressed by four actors. The teacher with the code I05 stated: "There is no distinction between vocational and general subjects teachers. Both sides listen to each other and have conversations. Classes and areas used are common." Another similar opinion was expressed by I27: "General teachers and vocational teachers are entering the same classes. As such, there is no distinction." Another actor's (I04) opinion about the situation was as follows: "I did not see any distinction between the vocational group and the culture (general subjects) group, we sit together and talk. All areas and classes are for common use." Lastly, the opinion of I30 actor in terms of the strategy implemented by the school administration is important: "As administration, we involve everyone in every job so that there is no distinction."

The attraction power of similarities (homophily) is persistent in gender-based interactions. Teachers mentioned the impact of the type of school (being a religious study school) and local cultural context on the communication between genders. We brought forth four teachers' statements. In this context, as a male teacher, the opinion of I12 is as follows: "In this school, I see that gender is also a determining factor in relationships. There is a slight disconnect between men and women. There is the pressure of local culture." Another male teacher (I18) felt the pressure of local culture in the interactions between male and female teachers: "I am a little more careful with women because of culture." Noting that the gender factor is somewhat restrictive in relations, actor I19 commented that the dialogue between male and female teachers was not bad: "There is a bit more distance between women and men, but in general there is no problem. Everybody's getting

along well.” Female actor I01 expressed the tendency for women in relationships as follows: “Even if I were at another school, my relationship with women would be warmer again.”

Analysis of the General Academic High School’s Daily Interaction Network

The interaction network of the Anatolian High School consists of 31 actors, and since all actors are connected with other actors, the integrity value is 1. Although there is no actor (isolated) who has no connection with other actors, certain clusters in the three regions of the network immediately attract attention.

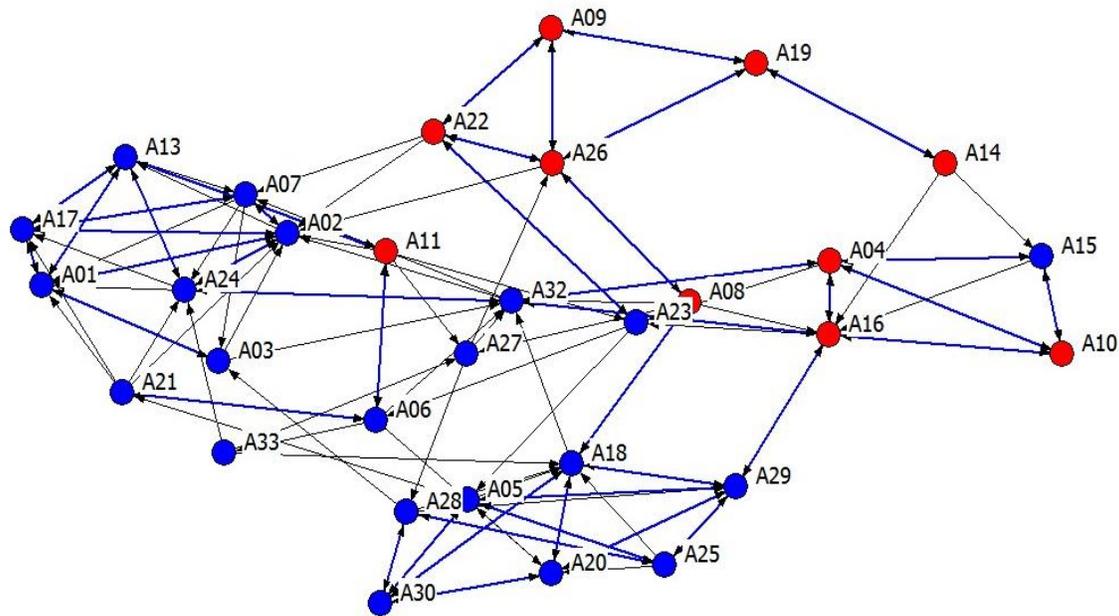


Figure 3. Religious Studies High School’s Sociogram by Teachers’ Gender and Subject

Note. ●=Female, ●=Male

Table 8. Structural Analysis of the General Academic High School’s Interaction Network

| Measure | Value | Measure | Value |
|------------------------------------|-------|----------------------------|-------|
| Density | 0.143 | Connectedness | 1 |
| Reciprocity | 0.462 | Fragmentation | 0 |
| Transitivity | 0.360 | Clustering Coefficient | 0.340 |
| Network Centralization (Outdegree) | 0.024 | Geosedic Distance | 2.9 |
| Network Centralization (Indegree) | 0.197 | Betweenness Centralization | 12.84 |
| Diameter | 7 | Size | 31 |

Table 8 shows that density of the relations in the Anatolian high school network is 14% and ties are reciprocal by 46%. Transition between the triads in the network is 36%. The clustering coefficient was relatively high with 34%. In other words, actors have a tendency to form blocks in their interactions. The degree of network centralization is 19% with five to six actors in the network attracting most of the relationships and tending to monopolize. While the distance between any two actors is three steps, the number of steps to move from one side of the network to the other is seven and is a relatively high value.

Clique Formations

Table 9 reveals 23 weak cliques and 11 strong cliques detected in the Anatolian high school general interaction network. Six of these powerful cliques (1, 2, 3, 4, 10 and 11) were purely male actors while three (6, 8 and 9) were purely female actors, and two (5 and 7) were mixed structures containing both female and male actors. In this case, it is seen that relations are shaped on the basis of gender. Nevertheless, it may not be right to think of these formations entirely on the gender axis. Gender is dominant in relationship patterns, but other common denominators among individuals, cultural affinity, world perceptions, structural constraints, and other factors may also be involved.

Table 9. *Strong Cliques within the General Academic School's Interaction Network*

| Clique No | Clique Members | Clique Commonality |
|-----------|----------------|--------------------|
| 1 | A05 A25 A29 | Males |
| 2 | A18 A20 A29 | Males |
| 3 | A02 A07 A17 | Males |
| 4 | A01 A02 A17 | Males |
| 5 | A04 A10 A15 | Males and females |
| 6 | A04 A10 A16 | Females |
| 7 | A04 A16 A32 | Males and females |
| 8 | A09 A22 A26 | Females |
| 9 | A09 A19 A26 | Females |
| 10 | A01 A13 A17 | Males |
| 11 | A18 A20 A30 | Males |

Regression Analysis of the General Academic High School's Network

As a result of the regression analysis in Table 10, the fit index (adjusted R^2) in explaining the daily interactions was approximately 4%. In other words, seniority, working duration at current school, teachers' subject matter, gender and marital status accounted for only 4% of daily interaction behaviour.

Table 10. *Multiple Regression QAP Coefficients*

| Relational Variables | B | SE B | β |
|-------------------------------------|--------|-------|---------|
| Seniority (total years in teaching) | -0.002 | 0.002 | -0.027 |
| Working period at current school | -0.001 | 0.009 | -0.007 |
| Subject area (branch) | 0.028 | 0.027 | 0.041 |
| Gender | 0.128 | 0.028 | 0.182* |
| Marital status | 0.059 | 0.028 | 0.084** |

Note. (* $p < .01$, ** $p < .05$; $R^2 = .042$, adjusted $R^2 = .037$, $p < .01$)

Of the variables that are statistically significant are the same gender and same marital status. Thus, female teachers tend to interact more with female colleagues and men prefer the same inclination for their fellow men. In addition, single teachers tended to interact with singles and

married teachers prefer to interact with male colleagues. The fact that the model is very limited in explaining interactions indicates that there may be factors not included in the analysis. These could be characteristics of the environment, personal preferences, local cultural perceptions, common interests, similarity of regional cultures, etc.

Teachers' Statements About Daily Interactions

We can infer from the sociogram and clique analysis that there exists a gender-based interaction model in this school in line with homophily. Teachers' statements support our findings. In essence, as A13 noted, "Gender also plays a role in interactions." Teachers saw gender and similarity in ages as a reason for teachers' intimacy and grouping. Actor A24, a male teacher, stated that he had more interaction with male teachers: "Men are more comfortable with each other and the conversations are more free." Recognizing that gender is a determining factor in relationships, A11 said: "I can say that there is gender-based communication. Married women are more drawn to their own shell and communicate with each other more." Linking relationships on the basis of gender to regional conditions and cultural perceptions, A19 stated that she is also a member of a group of women: "Ladies hang out mostly with ladies. I also attribute this to some regional conditions and culture." Actor A22 also stated that women prefer female actors because of the common shares: "Women feel more comfortable with women and the issues they share are different from men. For this reason, gender is a natural factor in relationships."

Limitations and Discussion

Before proceeding to discussion, it is important to refer to the limitations of this study. First, the present study has been designed as a case study research and the results of our three cases cannot be completely generalized for all other schools. Second, we chose schools where the number of teachers was less than 35 and this could be a structural restriction over friendship choices. Third, schools were located in Van, an eastern province of Turkey and local culture could have played a role in network structure and friendship choices. Apart from these, every school has a unique social self and may not produce similar results with other schools.

As regards our preliminary findings, since social structure and relationships in schools have a unique structure, the social networks of each school also differ. Gender, teaching subject, seniority, physical design of school, characteristics of school community, school culture, leadership styles, local socio-cultural perceptions could cause such a difference all together.

Everyday interaction networks involving both the bureaucratic and the human dimension have revealed the natural organizational structure, which is the informal dimension of the formal organization. Thus, relationship models in everyday interaction networks shed light on relationship models in friendship and social support networks. As Penuel et al. (2010) found out when the formal and informal organizations are aligned, instructional change and collective decision making are easier to reach.

The structure revealed by social networks differs from the bureaucratic structure. Interestingly, in this research, school principals at the top of the hierarchy in the formal school scheme have not achieved a central position in informal network structures. This finding repeats itself in all three schools. As for the informal stars of the network, Penuel et al. (2006) warned of the stars of the network who could improve or harm new initiatives due to their central role in the network.

The physical design of the school affects the relationships and networks in the school. Teachers whose rooms or classrooms were closer interacted more with the possibilities of physical proximity. For example, in technical high school, vocational teachers and general subjects teachers

took place on different floors and this situation supported the interactions within the group whereas the relationship among these two groups weakened. Krackhardt and Stern (1988) reported as interactions are denser in subunits which are designed places within an organization as colleagues meet more often as a result of proximity.

Main findings of this research about the social networks of three schools are greatly in conformity with the results of previous studies. Moolenaar (2012), who compiled social network studies in education, mentions five key findings related to the network structure of schools: (a) Because social processes of schools are not alike, social network structure differs from school to school; (b) The overall network structure of schools is subdivided into subgroups, particularly through the mechanism of homophily; (c) Social network structures of schools generally deviate from the formal hierarchical structure; (d) Social networks serve multiple purposes as they involve both business relationships and socio-emotional ties between teachers and are shaped accordingly; and (e) Teachers' perceptions of the profession, their gender, and so on. School-specific organizational arrangements such as floor arrangement, class distribution with personal characteristics affect social networks. In this sense, social networks are shaped by different individual and school characteristics.

As for the variables shaping teachers' networks, this study has found that gender, subject area (branch) supported by proximity and working duration at school are important factors in shaping social relationships among teachers in vocational high school. Likewise, seniority and gender have been found to be leading factors in the network of Religious studies high school while gender and marital status are found to be determinant in relations in General academics high school.

Kossinet and Watts (2009), McPherson et al. (2001), Moolenaar (2012), Rivera et al. (2010), Stehle et al. (2013), Verbrugge (1977), Yuan and Gay (2006) investigated the relationship tendencies of teachers (and individuals) and found that gender, age, working duration at school, years of experience, class level, marital status, ethnicity, intelligence and education level were determinative in the interactions between teachers (and individuals).

Conclusion and Implications

Social network analysis reveals the nature, functioning, integrity and fragmentation of teachers' social networks, their sub-groups, and key actors in the network. Network analysis also reveals whether important resources, such as information and materials, are available throughout the network. In addition, the natural organization and natural communication channels of the formal organization become visible.

This research has focused on the factors shaping teachers social networks within schools. It is seen that the homophily principle is dominant in dyadic relationships between teachers. In other words, similarity in gender, subject area, working duration at school, years in teaching, and marital status leads teachers to subgroups. The closeness in physical space known as propinquity, common past experiences like school friendships, neighborhood and common ineterests can also increase interactions among teachers.

Referring back to this study's limitations, more network researches may be conducted in schools which are located in different cultures. Schools which have a greater number of teachers and with various teaching programs could produce interesting findings for researchers, practitioners and policy-makers.

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