

Using Mixed Methods in Studying Classroom Social Network Dynamics

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Abstract—In a multi-cultural learning context, where ties are weak and dynamic, combining qualitative with quantitative research methods may be more effective. Such a combination may also allow us to answer different types of question, such as about people's perception of the network. In this study the use of observation, interviews and photos were explored as ways of enhancing data from social network questionnaires. Integrating all of these methods was found to enhance the quality of data collected and its accuracy, also providing a richer story of the network dynamics and the factors that shaped these changes over time.

Keywords—Mixed Methods, Social Network Analysis, multi-cultural learning, Social Network Dynamics.

I. INTRODUCTION

STUDYING the social network of a learning group, whether online or face-to-face, has specific problems: partly linked to the brief time frame of a class' life and particularly the weak nature of links at the beginning of a course. The problem of fluctuating attendance and the instability of enrolment can also be barriers that interfere with students initiating and developing relations with each other but also interfere with collecting "clean" data. In this study data triangulation was explored as a means to address these issues in a study of the dynamics of the social network in a formal, face to face learning community over time.

Social network analysis is an approach that focuses on the pattern of the relationships among individuals rather than on their characteristics [1]. The main focus of social network analysis is the structure of networks [2], through methods that study the relationships among individuals in any social structure [3] (p.37). People in two different networks perform differently according to their pattern of relationship [4] (p.893). Social network analysis provides a visual representing of the structure of the network using sociograms [5] (p1). In social network analysis, researchers see the network as one unit that is constituted of actors and ties that connect those actors [1]. Representing the relationships among individuals in the networks is considered to be the basic difference between social network explanation and a non-network explanation [1] (p6).

Using a questionnaire to collect social network data is a common practice because it's simply an easy way to apply and analyze. Data collected by these means can be used to analyze

the network structure and represent the patterns of interaction among network members visually. However, significant limitations have been identified with using this source of data, such as informant accuracy and recall [6], [7]. Furthermore, those completing questionnaires may not be highly motivated to complete lengthy questionnaires with complete accuracy. They may also not recall all the interactions they have had. Further, sheer quantitative data does not show why the network is the way it is. It does not tell why actors interact more with particular others or how they themselves view the network.

Many researchers for this reason have suggested combining qualitative and quantitative data in the study of networks analysis to get a better understanding of networks in different contexts [8]-[17]. According to [8], for example, believes that combining qualitative and quantitative approaches in social network analysis is a complementary process, where each method can add its strength in a way that minimizes the limitation of the other approach [19], [8], [20]. Reference [12] (p.1) believes that integrating qualitative approaches with social network analysis would achieve "the most fruitful results". This is related to the qualitative approach's ability of extracting the meaning behind the network formation, which provides substantial benefits such as "exploring and developing new concepts, enriching the study of SNs in substantial ways and addressing challenges faced in network research" [12] (p.1). In a learning context, [17] has integrated qualitative methods with SNA in a study of the interaction of an online class to gain a deeper understanding of students' interaction patterns. They found that students "with high verbal-linguistic intelligence", were center students and acted as bridges to connect other members in that community. While the more knowledgeable and social individuals play an important role in information transmission, they also act as bridges to connect other members [17] (p.657). They suggest that interaction among peers enhances learning outcomes. They use centrality measures (in and out centrality) in order to find the position of an individual in the network which showed that degree centrality is an important measure in identifying peer interaction in *collaborative learning activities*. [17] Has suggested that in order to gain a deep understanding of the situation, social network analysis should be combined with qualitative approaches. In another study in a learning context, [21] has evaluated students' position in a network and their reported sense of community in an online class, combining social network analysis and qualitative methods that gave more insightful data about the relationships in that online community. [22] Also integrated content analysis and social

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network analysis in analyzing asynchronous discussion forums. They claimed that using these two methods improved the analysis quality in allowing for more “scientific and systematic” analysis.

Because of the special characteristics of networks such as being “fluid, flexible, and dynamic, constantly changing and evolving”, qualitative methods need to be incorporated with social networks studies, which can deepen our understanding and enable the study of different aspects of the social network [20] (p. 134). These considerations suggested taking a mixed methods approach, i.e. one that combines quantitative and qualitative research within one project [23], [24]. Using multiple methods in research provides “cross-data validity checks” [25] (p. 248) and “improves accuracy” [26] (p.149) while studies that use only one method are more vulnerable to errors linked to that particular method. Qualitative data offers a richness of understanding of actor perspectives not normally available from quantitative data alone.

This paper presents the methodology adopted in our research [27], [28]. The research investigated the dynamic of classroom network among a group of international students and the factors shaping these networks over time. The group investigated was around 30 international students studying a first semester, 15 week long module at the master’s level, in the Information School, University of Sheffield. The overall research questions were: What types of networks do international students form in a UK Higher education context? What are the characteristics of these networks? How do these networks evolve over time? What are the factors shaping international students’ networks in a UK HE context? The focus of this paper is on the integration of multiple methods for the collection of network data such as social network analysis, interviews, photos, and field notes observation.

II. MIXED METHOD APPROACH

Mixed methods research is an approach that combines quantitative and qualitative research within one project [23], [24]. Some researchers, however, have more specifically defined mixed methods research according to the perspective they applied in their research; whether it applies a methods perspective, a methodological perspective, a paradigm perspective or a practical perspective [29]. Adopting mixed methods research can be appropriate in some cases, “due to the complexity of the research questions” [30] (p.129).

Mixed methods research can be adopted when the research questions need to incorporate both qualitative and quantitative data, in order to be answered [30] (p.129). Mixed methods approach is valuable for capturing the best of both quantitative and qualitative approaches [23] (p.22). Using multiple methods in research provides “cross-data validity checks” [25] (p.248) and “improves accuracy” [26] (p. 149). Adopting mixed methods helps in confirming results from both qualitative and quantitative approaches, and also helps to balance the weaknesses within one approach with the strengths of the other one [23].

III. QUESTIONNAIRE DATA

According to [1], questionnaire is the most commonly used data collection method for social network analysis. Normally, the questionnaires contain questions about the actors in a specific network and their relations to other actors in the network. The choice of the social network questions (what type of relationships students have in a multicultural classroom) in this research, was based on the researcher’s interest in investigating the social networks of international students and through finding a gap in the literature. This study aimed to investigate the social networks that international students build in a UK HEI. The social network questions were employed to investigate the type of networks international students create in the UK HE context. Consequently the question of what kind of relation each individual has with others in the network was asked, rather than how frequently they contact each other, because the research was not interested in investigating the strength of the relation among individuals in the network (as in [31]).

From the many potential network measures available, a number of specific measures were selected for this study. Cohesion was chosen because it is a measure of the extent to which everyone in the network is connected to everyone else; hence the information is easily flowed in the entire network. The centrality measure was also considered important, in order to find out the central people who have key role in the network and identify the extent to which some individuals were isolated.

The first questionnaire was distributed in class at the beginning of the semester to attempt to capture the initial status of the network. It consisted of three questions, the first asked students to indicate their relation to others in the class by choosing from the class names list. The relations students were asked to indicate were about whom they socialize with, work with, ask or give information to, give or receive personal support. The second question was about the communication tools they used to communicate with each other. And the final question was to ask about their general use of current ICTs, such as email, social networking tools and social bookmarking. 20 out of 27 students filled in this first questionnaire. The questionnaire was repeated in week 3 because students began to form their groups work for the first assignment. In the second questionnaire, participants’ photographs were added to the questionnaire, which aimed to improve the accuracy of the questionnaire. Adding students’ photographs was based on some findings from observation, which showed participants’ problems in recognizing each other’s names. Hence, photographs were used to the second questionnaire aiming to enhance the accuracy of the data collected using the SN questionnaire. The second questionnaire was filled from 19 out of 27 students. The third questionnaire was distributed in week 10, which was the deadline for submitting the first assignment, in order to investigate the impact of group work on the dynamic of students’ network. The number and order of questions were the same in all questionnaires. The number of students who filled the third questionnaire was 15. The final questionnaire

was in week 11, where 20 students filled in the last questionnaire.

The analysis of the network data was performed using UCINET 6 for windows [18]. Both cohesion and centrality measures were applied. The main finding was that network cohesion was driven by the group coursework, in the work network. Ties got more cohesive when there was a group work, and less cohesive when there was no group work. The centrality measure showed no student to be in the center position of this learning network.

Based on observation, questionnaire data had been improved by adding photos and changing or reducing the number of the questions. These changes were believed to improve the accuracy of the network data, without having a major effect on the comparability of the questionnaire. From observation, student's response of filling the second and the third questionnaire was better compared to the first questionnaire. Using photos in the second and third questionnaire, for example, had an impact on the cohesion measure, where there was a clear increase in the network consecutiveness. This can be in addition to other reasons, such as group work, related to the use of photos in the second and third questionnaire. However, this was far from offering a complete picture of the network. Hence, other methods were employed, such as interviews and observation, in order to increase understanding of the network.

IV. OBSERVATION

Observation is a qualitative data collection tool, defined by [32] as "a powerful, systematic and selective way of watching and listening to an interaction or phenomenon as it takes place" [32] (p.120). While Patton suggests that is a "personal experiencing" of a setting of interest to gain better understanding of the problem [25] (p.262). Evaluating its use in the study of a leadership program he says that "we would never have understood the program without 'personally experiencing it'" [25] (p.262). Observations are conducted with the aim of directly collecting data about social processes in a "naturally occurring context" [33] (p.21). Observation is often used when it is difficult to apply other data collection tool such as interviews as well as in studying a group interaction [32] (p.120). Observations are recorded by taking field notes in an unstructured or semi-structured way that describe the activities and behavior of those observed [23] (p.188). The setting of the observations, the activities of the participants, the participants and the meaning of these observations can also be elicited from observations [25]. Observation quality is evaluated by the way that gives the reader a "real" feeling and understanding of the observed setting [25] (p. 262). The researcher may either be an active participant and take part in the activities observed, which is referred to as participant observation or may not participate in their activities and be only a passive observer, which called non-participant observation [32].

According to [25]'s personal experience, observations enable better understanding and delineation of the observed setting and the interaction among participants. They also allow

researcher to be more creative, "discovery oriented" and "inductive". This is done by noticing nuances that may not be elicited by other data collection tools either because these nuances might appear not important to tell or they might be unwilling to talk about when they interviewed for example, which leads to new findings.

In this study, the researcher attended all the classes and labs for the module observing changes in the students' network, and recording them as field notes. She was introduced as a researcher, participated in some of the teaching, but was generally a non-participant. Research observation was focused on the relations students had with each other, such as who talked to whom, who attended classes, and who were vocal or quiet in the class. The results of these observations were compared with what students said in the questionnaire. This revealed the problem with the accuracy of the data in the first questionnaire. The participant observation and field note observations were helpful in spotting these problems, because students who clearly found to know each other from observation did not record this in the questionnaires. Questionnaire results were also compared with observations in term of network centrality and frequency of attendance and participation in class activities, which give a clearer picture of the real network students have in a learning context.

However, observation has some limitations such as being subjective, because it reflects the perspective of the researcher more than other qualitative data tools such as interviews, where participant perspectives are arguably more dominant. Observations were also experienced by the researcher to be intrusive, in the sense that, their presence in the observed setting could unintentionally affect it. Observations are also limited because they primarily enable the study of external behaviours. Hence researchers need other data tools to understand the "complete story" of a social setting [25] (p.306).

V. INTERVIEWS

According to [34] the research interview is "a professional conversation"; where the interaction between the interviewee and the interviewer is the base for building knowledge. The purpose of conducting interviews is to understand participants' views, experiences and thoughts and to reveal the meaning behind these perceptions [23][25]. The interviewer's aim is to "gather participant's stories" [25] (p.341) and to understand their worlds. Interviews can be conducted either face to face with one interviewee or with a group of interviewees as a focus group. An interview also can be conducted by telephone, or electronic forms such as email [30].

Interviews can be in three forms; a structured, semi-structured and unstructured. A structured interview has a fixed set of questions (schedule) in all interviews to ensure that interviewees answer exactly the same questions [32]. Semi structured interviews also have a schedule of questions but it is used in a more flexible way [24]. Unstructured interview on the other hand, allows for more freedom in terms of content and structure [32] (p. 123) and more interaction between interviewee and interviewer.

In this study, sixteen, 30 minute to hour-long, semi-structured, face-to-face interviews were conducted between weeks 7 and 12. The intention of these was to clarify questionnaire and field note results also to gain a deeper understanding of the dynamics of classroom social networks. A thematic analysis was developed to help delineate some of the factors shaping network formation. Thematic analysis is “a form of pattern recognition within the data, where emerging themes becomes the categories for analysis” [35] (p. 4). It is considered to be a flexible method of analysis [36]. The interviews allowed the researchers to construct a model of factors shaping the network. The interviews also showed how some informants had misunderstood some of the questions in the questionnaires.

VI. PHOTOGRAPH

Weekly photos of the whole class were taken with the idea of using them as an additional source of data, on the hypothesis that students who sit next to each other or close to each other have a relationship. Completing questionnaires is intrusive and makes considerable demands on the time of those being studied, if the hypothesis were correct, class photos could substitute for questionnaires, at least for collecting data about some aspects of the network. On the surface such data would be entirely objective.

In practice the findings were not helpful in reflecting the relationships people have. Also it showed that the network was not captured by studying where people sat. However, few people who had a relationship, found to sit next to each other. But because of the attendance instability, it was difficult to study the whole network.

However, photos were useful to demonstrate the invisibility of the social network from student's perspective. From the lecturer point of view, central people seem to be vocal and attend the classes, and students who are less attendee are isolated in the learning network. Surprisingly, what was found by the photos that students who were low attendees, were central in this learning network. It is possible that the result was strongly connected to the character of the seating in the particular room where lectures were held, but this remains to be shown. Interviews were helpful in understanding these results. Also photographs were certainly useful in the interviews to elicit more accurate data about the network dynamics.

VII. DATA ANALYSIS

Data Analysis implies “*working with data, organizing them, breaking them into manageable units, coding them, synthesizing them and searching for patterns*” [37] (p. 159).

A. Qualitative Data Analysis

In Qualitative analysis there is no specific way to follow in the analysis process [38] (p. 58); [25] (p. 432). Starting the analysis process early in the research is strongly recommended to help the researcher to continuously refine the data collection methods to collect “new, often better, data” [39] (p. 50).

For the analysis of data in this research thematic analysis was applied. The analysis started by building themes, which is a basic approach to analyzing qualitative research [40], [36], [24]. Themes building constitute building the “core meaning” within the data [25] (p.453). Thematic analysis is considered to be a flexible and straightforward technique for data analysis that can be used in all stages of research [40] and within various theoretical frameworks [36] (p.81) to give a better understanding [41] (p. 562) and richer account of the content of the data [36] (p. 78).

B. Social Network Analysis

The Social network analysis is a multidisciplinary approach that has been widely used in different disciplines [1], [2]-[4]. , In information science, specifically, the interest in applying social network theory has grown [42], [43] (p. 592). In fact, social network analysis is considered to be “a powerful new approach to the study of social structure” [44] (p.1411). From the many potential network measures available, a number of specific measures were selected for this study. Cohesion was chosen because it is a measure of the extent to which everyone in the network is connected to everyone else; hence the information is easily flowed in the entire network. The centrality measure was also considered important, in order to find out the central people who have key role in the network and identify the extent to which some individuals were isolated. In this research context, having a more cohesive network could be favorable to learning, because in cohesive networks, information can be easily exchanged among all actors in the network, hence having better chances to learn. UCINET SNA software [18] was used for the analysis of the SN data.

VIII.DISCUSSION

In this research of a formal learning context, the dynamic character of the network and lack of mutual knowledge between participants particularly at the beginning of the module meant that using social network questionnaires alone gave an incomplete picture. Questionnaires did provide some basic network data and the positions of individuals in the network and how this evolved over time. However, completing questionnaires is also intrusive and makes considerable demands on the time of those being studied. The questions that could be answered from social network data alone were also restrictive. This led the researchers to taking a mixed methods approach to data collection.

Observation revealed some problems with the questionnaire data, e.g. students newly arrived in a class do not know each other's names. Photos were added to the questionnaire. Also an attempt was made to use photos of the class to sample some aspects of the network, and gather data more frequently than would be practical with a questionnaire. Observations were also used to explore network characteristics and also to identify isolates. The questionnaire findings were enhanced from these sources, but were still far from offering a complete picture. Clearly it was not possible to observe every change in the students' network, especially as in a learning group many

changes happen outside the class. Observation was also experienced by the researcher as intrusive and felt to be partly subjective. Interviews were conducted to fill in gaps and discover "the story" of the factors shaping the network.

IX. CONCLUSION

Using social network analysis was helpful to describe quantitatively the different positions individuals had in the learning network, and how this changed over time. However, using this method alone was not enough because of limitations in informant accuracy and recall, also because of the dynamic nature of this learning context. It makes considerable demands on respondent time. Observation and photography were explored as ways to improve the questionnaire, hence increase the accuracy of the picture of the network. They also provided their own insights into the character of the network. Interview data was beneficial in enriching the understanding of the factors that shaped the dynamic of classroom social network. Triangulation of methods in studying social networks proves to be effective in providing a fuller picture, overcoming some of the limitations of each specific method. Nevertheless, no package of research tools can be comprehensive. There remained some gaps about the relations that isolated students have in this network, for example.

This package of methods will be applied and further developed in the next step of the research in order to collect more accurate and rich social network data, and compare results with the next cohort of students. It may also offer a model to other social network research in education or similarly dynamic fields.

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