

Research on Social Structure of Computer Supported Collaborative Learning

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Abstract—The research has done on the interpersonal relationships among the college students involved in the collaborative learning of a net course by using the social network analysis. And this analysis is also used to study interpersonal cooperation among learners in CSCL. Block model analysis, structural hole analysis, network medium analysis and core-periphery analysis have been adopted to construct and analyze the structural models of the interpersonal relationships in the collaborative learning, which provides visualized and measurable scientific analysis for the grouping of collaborative learners and establishing of the central of key members and the involving of the border members into the group. It has been shown that good relationships can play a vital role in the exchange of knowledge and the improvement of learning results. Besides, key members are more likely to make good use of learning materials and border members are easier to be ignored because of the imitations of the CSCL. However, the application of social network analysis can make it easy to locate these border members, thus having dynamic control over them and getting them involved.

Keywords- computer supported collaborative learning, social network, structural analysis

I. INTRODUCTION

Computer Supported Collaborative Learning (abbrev. CSC) develops on the basis of computer supported collaborative work and collaborative learning, which makes use of information technology to set up a collaborative learning environment to form a new pattern of discussion and communication between teachers and students, students and students. It is the extension of the traditional collaborative learning. As it is based on computer-mediated communication, it has many advantages: multi-media can provide user-friendly and visual interface as the interactive learning environment; network technology can not only offer transmission media of information among learners beyond the space and time limits but also organize hypertext and hyperlink

disciplinary information as well as other teaching materials. At present, there are a myriad of database and information network organized in this way on the Internet and these have become the biggest information resources in the world. This has given the unprecedented opportunities to the development and application of CSCL. Therefore, it has become the hottest issue and leading research area in international computer-assisted education.

SNA has been applied to study the interaction between members in the collaborative learning concentrating on the actual learning and interrelationships via the Internet. Block model analysis, structural hole analysis, network medium analysis and core-periphery analysis have been adopted to construct and analyze the structural models of the interpersonal relationships in the collaborative learning in hopes that it can provide some case studies for the researches on the collaborative learning as well as the establishment of friendly relationships in the web-based learning environment.

II. DESIGNING AND IMPLEMENTATION OF THE RESEARCH

In the current information age, most work has to be done within particular communities with the help of collaborative efforts by all the members in the same communities. CSCL refers to the collaborative learning assisted by computer technology (the multimedia and network technology). The constructivist theory believes that whether the collaborative learning is successful depends on whether the interaction between members of the same learning communities is fully based on the social construction of this view and the final result of the development of abilities, which are all closely related to the interaction of members of the learning communities. As a result, it has become vital to set up friendly relationships in the collaborative learning process. And locating the place of the members in the communities will benefit the coordination of all the members, the improvement of the learning result, the cultivation of the potential motives of learners and the enhancement of the exchange of invisible knowledge.

A. The contents of the research

According to the research, the interpersonal communication in the collaborative learning can be defined as a meaningful activity and process in which learners, under the specific tasks, exchange information and emotions via the Internet, and construct a certain social relationship. The interpersonal communication is represented by the properties of the whole social network formed by members and the property of individual learners within the learning online.

B. The source of data

The research takes course of Computer Network in Beijing Union University as an example. There are altogether 32 learners in the community plus one network administrator (a teacher) who offers routine guidance. After a 2-year learning process, a stable interpersonal relationship has been established and members of the community are quite familiar with each other.

C. Methodology

The research adopts the survey to collect pretest data about the learners and then uses SNA to analyze the relation data within the collaborative learning. Unicent has been used to analyze the data processed by the analysis of SNA. All these statistics can be made in the data analysis and the result can suggest the features of these data.

1) *Questionnaires*: The questionnaires are a set of questions designed according to the requirement of the research. Participants answer all the questions listed, which can be regarded as a measure approach to individual behavior and attitude. Some useful personal information has been obtained after the questionnaires have been collected. It provides some information on how familiar learners are with the course and how well they perform in the online learning. These pretest data are the foundation of the later research.

2) *Social Network Analysis*: SNA mainly deals with the study of the interrelation of social bodies as well as the patterns, structures and functions of these interrelations. It believes that behaviorists and their behaviors are interrelated. The relationship among behaviorists is the exchange of resources or a channel; the explanation perspective is established on the basis of the relationships, holding the opinion that the explanation from the perspective of behaviorist relationship is much better than the perspective of individuals. Therefore, the research hopes to acquire the property of the whole social network and reveal the feature of the network as well as reflect the specific interpersonal communication among learners by using SNA in the analysis of the social network in the CSCL.

III. SOCIAL NETWORK ANALYSIS IN THE COMPUTER SUPPORTED COLLABORATIVE LEARNING

According to the interactive theory by Kearsley, one of the important factors of CSCL is that it has positive influence on the efficiency of online education. Interpersonal communication is of great importance in the process of constructing knowledge and sharing knowledge. Hiltz stresses that the process of sharing knowledge through interaction is people's natural style of learning. CSCL involves group study, speculation study, constructivist study and the emphasis on the social interactive ability.

With the rapid development of collaborative learning, online education, based on the Internet, has been deprived of some of the advantages of the traditional educational mode owing to its specialties. There is the lack of face-to-face communication between teachers and students and among students. So if there is not a good collaboration and interaction among learners, not only is the learning result seriously affected, but also the whole teaching process will fail. As a result, compared with the traditional classroom teaching, CSCL makes it harder for educators to hold the balance point between compulsive interaction and free interaction, thus making it even harder to develop learners' ability to collaborate with others. That's why it is extremely important to control the grouping within the collaborative learning, detect the features of the location, and carry out a dynamic control.

A. Block Model Analysis in the CSCL and Construction of Scientific Grouping

The interaction between learners refers to the exchanging activity of information with the computer as the medium and collaborative construction of knowledge as the basic function. It is one of the important part of the CSCL to find an appropriate partner and form an effective collaborative study group. The Purpose of CSCL is to achieve the learning goal with high quality and high efficiency. And collaboration is the core of this kind of learning pattern. The precondition of grouping is the satisfactory collaboration among the members of the CSCL process. The study style, the study attitude and study pattern as well as the interrelation of individual learners have to be taken into consideration. A good collaboration can ensure the final completion of the task.

The application of block model analysis allows a reasonable grouping of the members in the CSCL so that their integrity can be enhanced. According to the requirement that every group should have 4-5 members, a block model chart can be drawn as in Chart 1. From this chart, 33 learners can be divided into 7 groups in the 3rd grouping phase, and 6 groups in the 2nd grouping phase with No. 22 not being involved into the CSCL process until the 2nd grouping phase. As a result, it can be seen that this member has a weak ability to collaborate with others and depends heavily on guidance from others. In the social network, members of CSCL are convinced that those who have many features in common and have frequent social relations with others can join the same model.

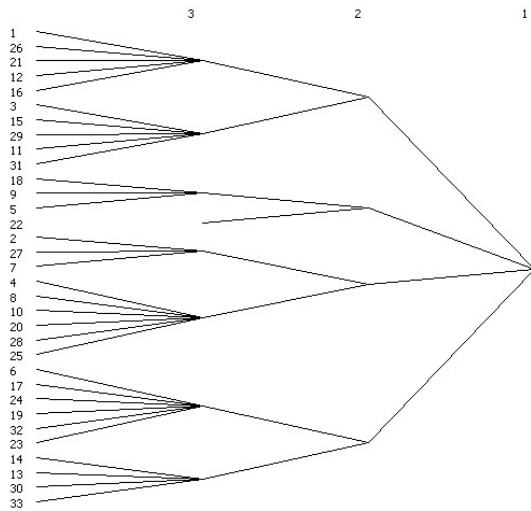


Chart 1: The Block Model Chart of relation network of the CSCL

Therefore, the adoption of block model analysis in grouping is helpful in the scientific and careful and accurate mastery of learners' characteristics. Grouping should be done according to the characteristics of learners. In this way, the learning environment can be improved and the development of learners and the promotion of learning result can be realized.

B. Structural Hole Analysis and role resource allocation in the CSCL

Structural hole theory is one the mainstream theories in the field of the mutual interpersonal network relations. Sociologist Ronald S. Burr suggested this theory for the first time in his book Structural Hole in 1992. In his viewpoint, there are only two kinds of relations in the network both in groups and among individuals. One is any main body in the network relations within the small groups (eg. classes) can be directly related to other main bodies. The other is in bigger groups or some particular groups, some main body or bodies are directly related only to some of the other main bodies, rather to all the other bodies. When there is an absence of direct relation to each other in the same group, an empty hole appears in terms of the whole network structure. This is the structural hole.

In the interaction within the CSCL, the establishment, maintenance and development of relationships among group members can be completed through the reference of member relationship and emotional exchange of attitudes towards each other. An inner agreement has been formed through the exchange of knowledge and sharing of knowledge and this inner agreement constitutes the "principles" which may influence the exchange among members. And also it offers the source of power for the solutions to the problems in collaborative groups and for the fulfillment of the tasks. Anyone who becomes the focus of consultation can become the one who can gain the largest information benefit and resource benefit.

After the conduction of structural hole analysis among

the collaborative learners, structural hole statistics can be obtained as shown in Table 1. It can be seen from the table that the Effsize of No. 17 learner is 17.375, meaning the amount of resources he has got is the largest. He is the focus of consultation in the group so he can get the most resources. From the MDS chart in Chart 2, it is revealed that the same learner is in the center of the whole MDS with No. 6, 14, 24 and 32 learners close to him. And these four learners score high in the structural hole analysis which indicates that they are in the central area of the information resources in the CSCL too. In table 1, No. 13 and 18 learners score high in the structural hole analysis of the information resources, but they are in the border area in MDS in Table 2, which shows that the two learners are the intermediary roles in the whole collaborative learning process and play the role of connecting some border learners.

Table 1: Structural Hole Analysis statistics of CSCL

	EffSize	Efficie	Constra	Hierarc	Indirec
1	6.273	0.784	0.244	0.091	0.326
2	4.250	0.850	0.293	0.126	0.152
3	2.000	1.000	0.500	0.000	0.000
4	2.000	0.667	0.425	0.019	0.123
5	2.500	0.833	0.406	0.010	0.100
6	7.615	0.762	0.206	0.105	0.345
7	3.000	0.750	0.379	0.121	0.182
8	2.000	1.000	0.556	0.278	0.000
9	4.700	0.940	0.240	0.018	0.087
10	6.214	0.888	0.194	0.031	0.148
11	3.625	0.906	0.281	0.005	0.058
12	8.000	0.727	0.208	0.066	0.454
13	7.682	0.768	0.202	0.082	0.355
14	5.318	0.665	0.273	0.109	0.391
15	5.214	0.745	0.225	0.037	0.232
16	6.300	0.788	0.224	0.091	0.277
17	17.375	0.827	0.137	0.077	0.594
18	9.450	0.945	0.134	0.025	0.140
19	5.071	0.724	0.257	0.068	0.300
20	2.500	0.625	0.354	0.012	0.184
21	1.625	0.542	0.504	0.130	0.186
22	1.000	1.000	1.000	1.000	0.000
23	4.714	0.673	0.261	0.016	0.342
24	7.929	0.721	0.220	0.088	0.469
25	6.438	0.805	0.192	0.026	0.223
26	6.636	0.737	0.243	0.090	0.407
27	7.111	0.790	0.196	0.030	0.308
28	3.000	0.750	0.315	0.004	0.122
29	3.800	0.760	0.334	0.021	0.281
30	3.333	0.556	0.339	0.104	0.355
31	3.000	1.000	0.333	0.000	0.000
32	7.786	0.649	0.228	0.083	0.574
33	1.000	1.000	1.000	1.000	0.000

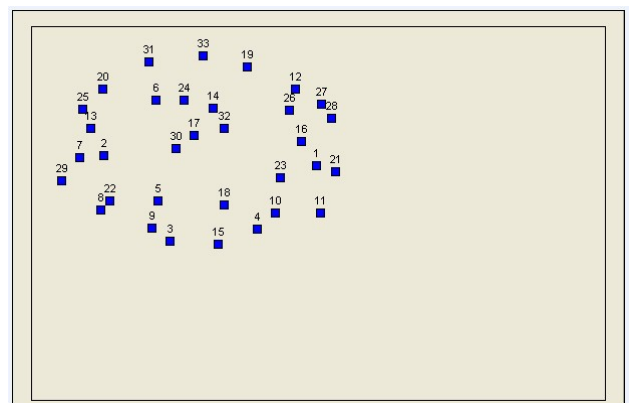


Chart 2: MDS in the CSCL

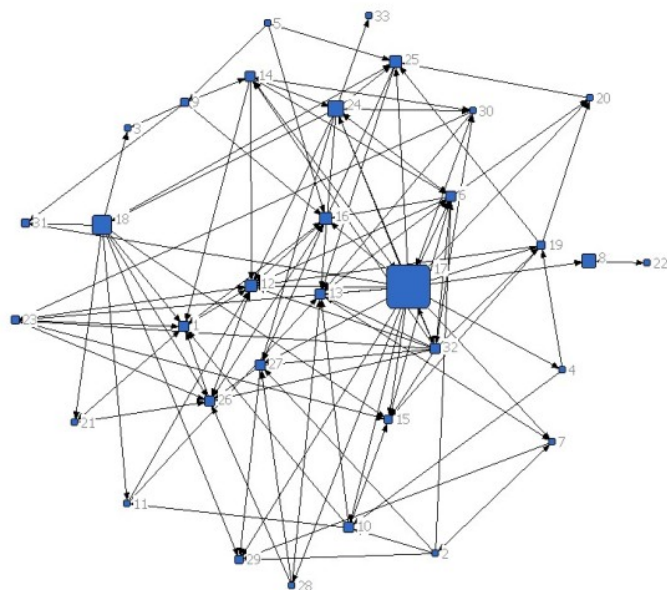


Chart 3: The Intermediary Chart of CSCL

Through the intermediary analysis of the collaborative learning interpersonal network in Chart 3, it can be seen that No. 17 and 18 score the highest in the intermediary analysis (the bigger the dot is, the higher the intermediary score will be). And they can shoulder the responsibility of collaboration in learning. They are also playing an important role in the CSCL and they are in control of the communication in the learning process. It indicates that the communication among learners in the CSCL depends on the control power coming from their position of structural hole in the CSCL. If the learner who is in the structural hole is left out of the CSCL, the communication of the CSCL will never be realized. The decrease of the communication among learners in the CSCL will lead to the decline of the interaction and the network density. Consequently, the rate as well as the efficiency of information exchange will be very low, and it will be difficult to realize the function of exchanging ideas, sharing knowledge and solving problems. Therefore, the central learners can have great “interpersonal” influence on other learners in the CSCL process. In the whole process, those learners in the position of structural hole can act as brokers, gatekeepers and middlemen.

C. Core - Periphery Matrix Analysis and the Search of Periphery Learners in the CSCL

In the social network, the relationship between nodes has a certain impact on the transfer of knowledge. Collaborative learning relationships with strong core can promote the stable transfer of knowledge in the network and this kind of relationship contains some trust, cooperation and stability, so it can easily carry and transfer complicated and invisible knowledge. But those periphery learners can hardly get their hands on learning information which may affect their learning

result. And they may get away from the whole CSCL process. As a result, the precise location of the periphery learners in the whole CSCL process is crucial because the appearance of these learners can degrade the learning result.

The application of core - periphery matrix analysis in the search of periphery learners in the CSCL can lead to the analysis in Table 2, which shows that in the whole CSCL process only No.22 learner is the periphery member and is kept isolated from the whole CSCL. Table 3 provides information about the fact that the relation density figure among the key members is 0.124 and the relation density figure among periphery members is 0. The relation density figure between the border and the center is 0.031 and the relation density figure between the center and the border is 0.031. It has been clearly shown that the relation density figure of No. 22 learner is close to 0 which means this learner is rather inactive in the CSCL and at the same we can notice that this learner has been away from the 3rd level grouping according to Chart 1 and only when he is in the 2nd level grouping is he involved in the learning process. So we can draw a conclusion that he is a periphery learner in the CSCL.

Table 2: The Analysis of Learners in the Core - Periphery Matrix

Core/Periphery Class Memberships:

1: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 23 24
25 26 27 28 29 30 31 32 33
2: 22

Blocked Adjacency Matrix(xiezu)

1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3 3 2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34

1 1 | 1

Table 3: Core - Periphery Matrix Analysis in the CSCL

Density matrix		
	1	2
1	0.124	0.031
2	0.031	

Therefore, as far as the administrators are concerned, it is necessary to pay attention to the role of periphery learners in the network to ensure a better exchanging of ideas and sharing

of knowledge and solving of problems and the enhancing of a better learning result for learners in the CSCL. Besides, necessary measures should be taken and the network should be optimized.

V Conclusion

The research of interpersonal communication in the CSCL is the key to the understanding and promotion of the application of CSCL. It is also the difficult point of the research. It has been proved in many experiments that although the technical support and teaching designing have been improved, there is still a lack of cooperation, a lack of prediction in sharing knowledge and a deep understanding and comprehensive abilities.

After the research done in the behavior of acquiring knowledge and the interrelations among learners in the CSCL by using the SNA, it can be found that learners in the CSCL can acquire knowledge both directly and indirectly. And the main form of knowledge acquisition is through structure holes. The relation network formed in information acquisition benefits the learners in the structural holes and they can not only acquire information easily but also control the information obtained by others and their communicative abilities. Moreover, block grouping can offer a scientific way to group learners in the CSCL, thus effectively and directly grouping similar members together which is good to the flow of knowledge. It can also promote the efficiency of learning. The accurate location of periphery learners in the CSCL enables administrators to carry out effective dynamic control and improve the feasibility of involving them into the CSCL. In this way it can enhance the CSCL network to develop.

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