The flow and transformation of tacit knowledge in university class——An empirical study based on SNA

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Abstract

Class is the basic unit for education and management in universities and by managing class through tacit knowledge would be of great advantage for enhancing talent cultivating quality. This paper analyzes the group connectivity and informality of the tacit knowledge flow and transformation inside the class, reaching to the features of class tacit knowledge flow and transformation network. Utilizing social network analysis and taking a certain class in university as an example, this paper builds a network of the class tacit knowledge flow and transformation, calculates quantitative index, analyzes reciprocity and cohesive subgroups for the emotional network of class members and the class tacit knowledge flow and transformation, and also examines the connection between the two, providing strategies for the improvement of the class tacit knowledge flow and transformation.

Keywords

Universities, Class, Tacit Knowledge, Flow And Transformation Network.

1. Introduction

The twenty-first century is the age of knowledge economy, tacit knowledge has become an important factor that affects personal development and organizational innovation. Tacit knowledge itself cannot create real value. The only way to make tacit knowledge develop its intrinsic value is to let it be transmitted, learned, absorbed, diffused and developed in the organization, that is, the flow and transformation of tacit knowledge (hereinafter referred to as "transfer")[1]. The transfer of tacit knowledge would be of great advantage for enhancing the core competitiveness of individuals and sustainable competitive advantage of the organization. University students are valuable human resources in the country, and the basic requirements for them are to acquire and manage tacit knowledge [2].However, both the current social environment and the way of education management in universities make the tacit knowledge transfer of university students face difficulties.Class is the basic unit of educational organizations and social organizations in universities. It is related to the formation and development of style of study and school spirit, and plays an important subtle influence in the overall development of university students. How to use scientific methods to promote the transfer of tacit knowledge in class is an important issue to be solved urgently by college administrators. In view of this, this paper takes the college class as the research object, and constructs the tacit knowledge transfer network. By using the social network analysis method, it can provide clear visual schema and quantitative mathematical analysis for the network of tacit knowledge transfer[3]. In this way, it can reveal the inner relationship between the tacit knowledge transfer and the interpersonal relationship of university students. It can not only realize the visualization and accurate management of tacit knowledge transfer, but also provide theoretical support and practical

experience for improving the core competitiveness of college students and the sustainable competitive advantage of the class.

2. Tacit knowledge and its transfer network

2.1 Section Headings

Michael Polanyi distinguishes between explicit knowledge and tacit knowledge in the 1958 edition of "personal knowledge" and later works. According to Michael Polanyi, the dominant knowledge is a kind of knowledge that can be able to use the code system such as language, mathematical formulas, charts, braille and gesture symbol system to clear expression. It is also called Verbal Knowledge or Explicit Knowledge or Articulate Knowledge.It includes facts, data, reports, proposals, etc.In contrast, tacit knowledge refers to the knowledge that is difficult to express clearly in language, and it is also known as "Pre-verbal Knowledge" or "Inarticulate Knowledge"[4]. It includes experience, beliefs, insights, skills, etc. If compare the knowledge of the organization to an iceberg floating on the sea surface, the visible part of the sea surface is the explicit knowledge of the organization,the invisible part of the sink is the tacit knowledge of the organization. And through the sea water we can also see a small part of the iceberg under the sea, which is equivalent to the tacit part that is easy to convert into the explicit[5].

From the perspective of the owner of tacit knowledge,class tacit knowledge can be divided into three levels,namely: individual tacit knowledge,group tacit knowledge and class tacit knowledge.The individual tacit knowledge mainly refers to the implicit skills, know-how, experience, inspiration, insight, mental model of class member individual and so on.The group tacit knowledge mainly refers to the group tacit understanding, cooperation ability of class small group (such as team, group, department) and so on.The class tacit knowledge mainly refers to the common vision, value system, class culture of the class and so on.

2.2 Tacit knowledge transfer and its characteristics

Tacit knowledge transfer in class is the interaction and integration of tacit knowledge sharing and transformation. Through one-way or two-way flow between the owner of the class. According to the concept of tacit knowledge, tacit knowledge has the characteristics of tacit and embeddedness. Tacit, not through language, mathematical formulas, charts, Braille and gesture symbols clearly stated, this is the most essential feature of implicit knowledge. Embeddedness refers to the tacit knowledge embedded in the mind of the tacit knowledge owner,others can not be obtained by direct observation.Tacit and embeddedness make the transfer of tacit knowledge very difficult,which also makes the transfer channel different from explicit knowledge. The high degree of tacit knowledge determines that tacit knowledge cannot be separated from its owner,it also determines the way to flow and transform tacit knowledge - contact transmission. Daily communication and working environment provide a lot of opportunities and channels for tacit knowledge transfer. The research shows that the tacit knowledge transfer requires a strong connection between the owners. Practice has proved that the learning in practice and apprenticeship is the common way of tacit knowledge transfer.Therefore, the transfer of tacit knowledge in class shows not only the nature of group connection, but also the informal nature. It is more scientific to study the problem of tacit knowledge transfer by combining these two characteristics[6].

The network has the following characteristics:

a. Complexity. The formation of the tacit knowledge transfer network is based on the spontaneous behavior of the members of the class, and whether or not a member of the network is connected with the other members depends entirely on his familiarity with the other members.

b. Dynamic. Because the network of tacit knowledge transfer in class is based on the degree of familiarity and the will of the members of the class, the network is in constant motion and change.c. Efficiency increasing. The value of tacit knowledge through transfer is much greater than the value

which is embedded in a single individual or a single group. Efficient communication, sharing and transformation of tacit knowledge are the keys to the innovation of class.

d. Result uncertainty. Compared with explicit knowledge transfer, the network of tacit knowledge transfer is more complex. It is difficult to measure the value of class tacit knowledge transfer, which may be different from the expected target.In addition, most of the tacit knowledge is difficult to be occupied and controlled like the instrument, so it is difficult to predict the result of creating new knowledge.

2.3 The motivation of social network analysis of tacit knowledge transfer

Social network is a collection of social actors and relationships.In other words, a social network is a collection of multiple points (social actors) and connections between points (the relationship between actors)[7]. Among them, the actors can be any social units or social entities, such as individuals, companies, villages, cities, etc.. Relationships can be expressed in a variety of forms, such as the relationship between people, the relationship between the upper and lower levels, scientific research and cooperation[8]. Compared with the research methods of sociology and behavioral science, the network perspective is more unique. From the network point of view, the characteristics of social actors are derived from the process of structure or relationship[9].

Social network analysis (SNA) is a specific tool in social network theory.It is a process to describe and analyze the relationship between social network actors and how to estimate their value. SNA advocates the way of thinking of the relationship theory, which takes into account the existence of the relationship between social actors, and it does not think that social actors are independent individuals[10] .In the social network analysis, the relationship between the actors is the main way, the attributes of social actors need to be understood through the relationship between the individual model and structure.According to the type of network, we can study the social network from three levels: the Ego network ,the Partial Network and the whole network. Among them, the whole network is a network of all the members of the group and the relationship between the network. It needs to study all kinds of graph theory, subgraph, location. SNA is a highly technical subject, but there are many software can help us to carry out a variety of quantitative analysis and calculation. Such as UCINET, NetDraw and so on, these strong visual function of SNA software greatly improves the visual analysis of SNA[11].

SNA has a unique analytical perspective, it provides the following tools for the study of tacit knowledge transfer. Improve the tacit knowledge transfer in the class. Identify the leader and the bottleneck of tacit knowledge in class. Find the most influential opportunities to enhance the tacit knowledge transfer in the class. [12] In other words, SNA can make managers have a clear understanding of the "gap" in the tacit knowledge transfer.

IV. The construction and visualization of class tacit knowledge transfer network

The visualization of the tacit knowledge transfer network is the transformation of the data of the tacit knowledge transfer network into the graph, relying on the computer and related software. In this way, researchers can visually see it and make more effective decisions. The main steps of the construction and visualization of tacit knowledge transfer network are as follows.[13]

a. Get data. There are a lot of methods for obtaining relational data in social network analysis,such as nomination law, nomination interpretation method.This study adopts the method of nomination and questionnaire. In the specific operation, we can assign a number to each class member and make a list. We set the relationship between the network form as the problem, and set the column as the number. After the respondents read the questions, they mark at the crossing where lead to the number and the question.

b. Design questionnaire. We need to clarify the research objectives which are contribute to the design of the survey questions. David Krackhardt, a scholar of management, designed a questionnaire of interpersonal relationship, which is a relatively mature part of the whole network. For the relationship

within the organization, strong relationship is mainly embodied in the emotional exchange. Combined with the actual situation of the university class, the question will be "who will you talk to when you are upset?". The transfer of tacit knowledge may result in the decline of monopoly income. Therefore, it is necessary to obtain the data of tacit knowledge transfer from two aspects: tacit knowledge seeking and devotion. The problem is designed as "Which students can give you new ideas , stimulate and inspire you to think about new problems, explore new knowledge in the study?" and "What would you like to share about your learning experience?" In addition, in order to build a complete network of tacit knowledge transfer, this study uses the whole network method, that is, all the members of the class participate in the investigation.

c. Data processing and network construction. The data obtained from the table is the relational data between all members. The main objective is to investigate the relationship between the respondent and other members of the group. Set the value as 1 if there is a relationship, otherwise fill in 0. Through the collection of data, the data can be converted into the adjacency matrix between actors. [14]

d. Network analysis and interpretation. The three important dimensions of understanding the network are the nodes in the network, the relationship and the structure. According to the main measure of the whole network research, this paper explores and finds out the problems of the tacit knowledge transfer. According to the existing problems, we can further understand and explain the deep-seated factors that hinder the transfer of tacit knowledge. [15]

3. Empirical analysis

3.1 Data acquisition and network construction

1.Selection of research object. In this study, all the members in the class C of Grade two in S University were investigated. The class consists of 23 members, including 2 boys and 21 girls. All the class members have no violations of discipline, and they participated in the make-up examination for 17 times since they entered the university. This class is a representative of liberal arts specializing in universities. This class has a certain representation in the liberal arts colleges and universities.

2.Network construction.We assigned a number to each member according to the roster, from C1 to C23. For example, C1 only have interaction with C21 on a problem, C1 will select C21 in the questionnaire respondents, while other members will not be selected. Thus the value of the adjacency matrix in the first row and the twenty-first column is 1,and the rest are 0. We can input the rest answer of other members according to this method, and form a 23*23 adjacency matrix when we input all the answer. The value of the main diagonal of the adjacency matrix is not defined (Liu Jun, 2014), and it is written as 0 in this paper. Respectively input the adjacency matrix content to UCINET to get Class Members Emotional Network (figure 1), Tacit Knowledge Seeking Network (figure 2) and Tacit Knowledge Dedicated Network (figure 3). The box number represents the names of the class members, the connection represents the relationship between the members and the arrow points to the candidate.

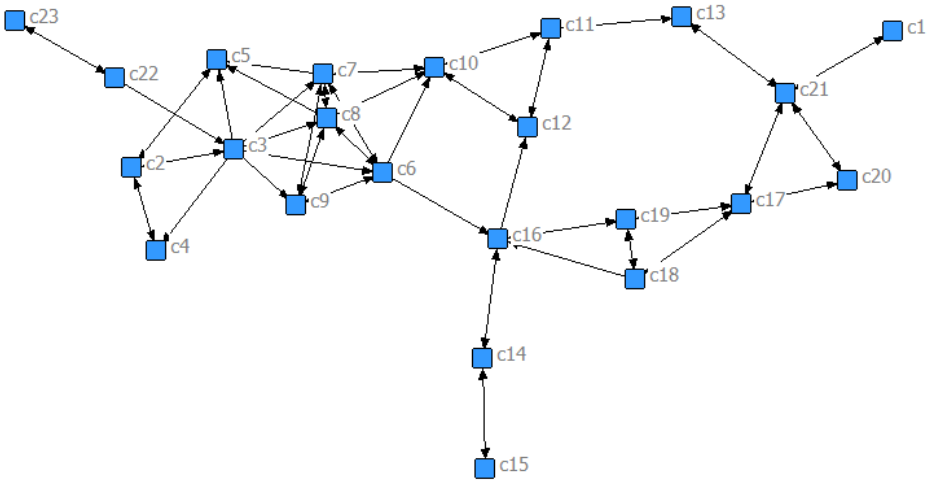

Fig. 1 Class Members Emotional Network

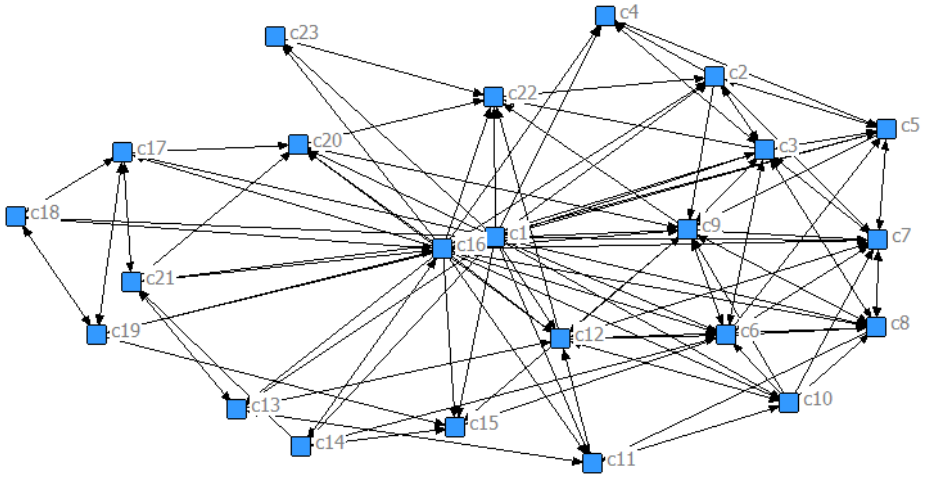

Fig. 2 Tacit Knowledge Seeking Network

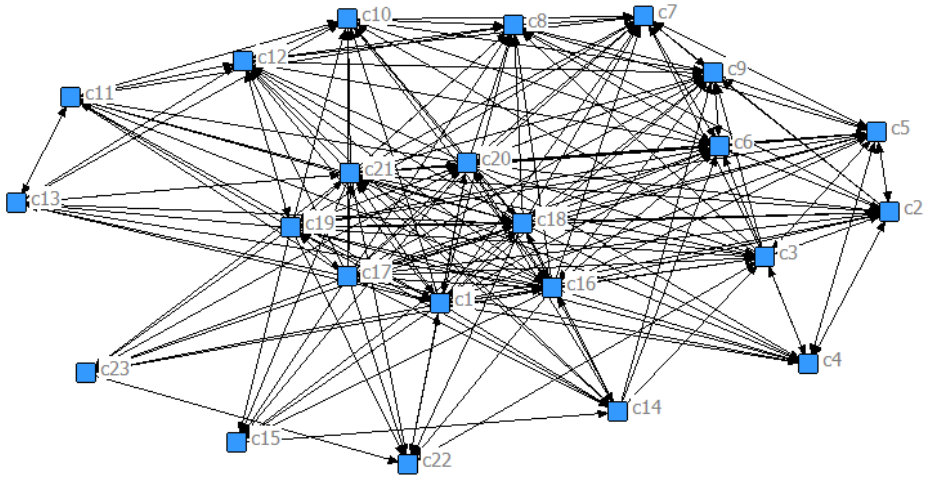

Fig. 3 Tacit Knowledge Dedicated Network

3.2 Analysis on the emotion network.

a.The general situation and characteristics analysis

The results of the analysis are shown in Figure 1, and all the nodes are reachable. The density of the network is 0.1304, which shows that the density is a little low, and the emotional communication between the members of the class needs to be strengthened.

According to the correlation index Krackhardt GTD Measures, the network correlation is 1. This confirms that the network is connected, there is no isolated node or isolated local network. Level degree is 0.1660, the member does not exist between the rigid hierarchical structure. Network efficiency is 0.9221, indicating that the network efficiency is very high, almost no redundant links. Recent upper limit index is 1, indicating that the network is a "common accessibility" point, and it can ensure that the differences and conflicts within the class to be better resolved.

Table 1. A brief analysis of the centrality of affective network degree of class members

	Mean Value	Standard Deviation	Minimum Value	Maximum Value	Network Centrality
Out-degree	2.870	1.541	1.000	7.000	19.628%
In-degree	2.870	1.262	1.000	5.000	10.124%

From the degree of emotional network centricity (table 1), the degrees of centricity is relatively high between the member of C3, C7, C6 and C8, indicating that they are the local connection center in the emotional network. The degree of centrality is low between C15, C1 and C23, so they are on the brink of emotional network. The average degree of the emotional network is only 2.870, and the high point of the members of the relatively is low, indicating that although the class does exist all the members of the network together, the direct link between the students is very limited. It is concluded that the emotional network is sparse and not dense, which is consistent with the results of the network density analysis.

b.Cohesive subgroup analysis

In cohesive subgroup analysis, set the subgroup size minimum value as 3, founding 4 groups in emotional network which size is not less than 3 (figure4). We found that each group members are from the same dormitory, indicating that the combination of the class members emotional network is weak. Through in-depth interviews, we found that the emotional support of the members in the class is far beyond the scope of the class. Their important source of emotional supporting include: high school classmates, relatives, fellow-villager and so on, and the supporting is less from the class.

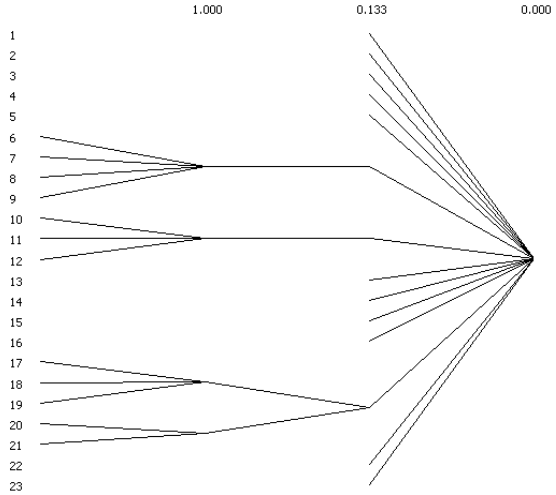

Fig.4 Class Members Emotional Network Faction Analysis Diagram

3.3 Analysis on the tacit knowledge seeking network

a.Situation and reciprocity analysis

The results of the analysis are shown in Figure 2, and all the nodes are reachable. This shows that the members in the class use the tacit knowledge to seek help frequently.Based on the above, we can analyze the reciprocity. Among them, the thick and red relation indicates the reciprocity relation, and the fine and blue relation indicates the non reciprocity relation. The former accounted for 48.85%, accounted for slightly lower mutual relationship. It can be seen that two members with tacit knowledge seeking relationship are more likely to connect with each other.

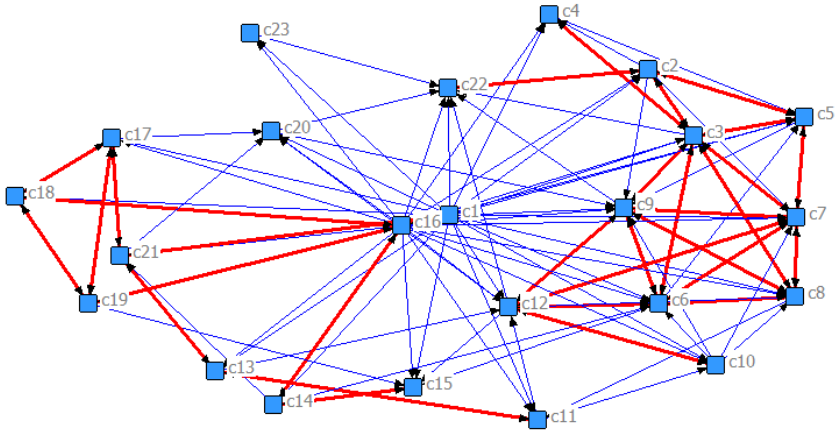

Fig.5 The relationship between tacit knowledge and network reciprocity Diagram

b.Network characteristics and centrality analysis

Through the density analysis, it is found that the network density of tacit knowledge is 0.2589. Relative to the emotional network of class members, the network connection is more, and the relationship between the students is closer. Through the correlation analysis, the correlation degree of the network is 1.000, which also confirms the connectivity of the network graph, no isolated nodes or isolated local network. The level is 0, indicating that there are no stiff hierarchy among the members in the network. The efficiency of the network is 0.6667, which shows that the network efficiency is high, but there are a small amount of redundant connections. The recent upper limit index is 1, indicating that the network is a "common accessibility" point.

From the view of the tacit knowledge seeking network centrality (Table 2), C1 and C16 have a high out-degree and a low in-degree, indicating that they mainly consult more people and less accept other people's advice. C3, C6, C7, C9 and C12 have a high out-degree and a high in-degree, indicating that they mainly consult more people and accept other people's advice. C22 have a low out-degree and a high in-degree, indicating that they mainly consult less people but accept other people's advice. By reading transcripts we can find that C22 and C3's academic performance is high, and the ranking of C1 and C16 is in the rear. From tacit knowledge seeking network central potential perspective, in-degree central potential is 25.207%, showing that the members of the class are more dispersed and there are no super-node. Out-degree central is 77.479%, showing that there are a clear trend of concentration in seeking consultation.

Table 2 Analysis on the Tacit Knowledge Seeking Network Centricity

	Mean Value	Standard Deviation	Minimum Value	Maximum Value	Network Centrality
Out-degree	5.696	5.377	1.000	22.000	77.479%
In-degree	5.696	2.561	2.000	11.000	25.207%

c.Cohesive subgroup analysis

In cohesive analysis, set the subgroup size minimum value as 3, concluding that tacit knowledge seeking network contains 6 groups which size is not less than 3. There is an overlap between the 6 factions, that is to say, there are a large number of "bridge" nodes, forming a small group of interconnected core through the "bridge" nodes in the network. C3, C6, C7, C9 is the lowest branch node in the tree, that is, they are agents of different tacit knowledge groups. And we can promote the transfer of tacit knowledge, through the guidance and management of these informal groups. Review of Figure 5, there is a reciprocal relationship between the small groups, such as, the group consisting of C6, C7 and C9 and the group consisting of C17, C18 and C19.

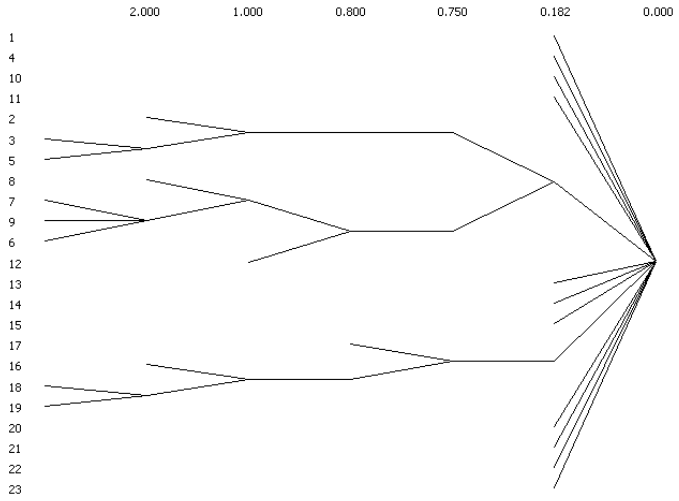

Fig.6 Tacit Knowledge Seeking Network Faction Analysis Diagram

3.4 Analysis on tacit knowledge dedicated network of university student

a.The general situation and characteristics analysis

We can see that all the nodes are reachable, and there is no isolated or isolated local network, which shows that the members of the class are more interactive in the tacit knowledge contribution, and the results are shown in figure 3. Observe the reciprocity analysis in Figure 7, we use the thick and red relationship to express the relationship of reciprocity, and the relationship between the blue and the non-reciprocity, founding that the former account for 43.29%. Dedicated network of mutually beneficial relationships account for a slight decline, compared with the tacit knowledge seek reciprocal relationship network

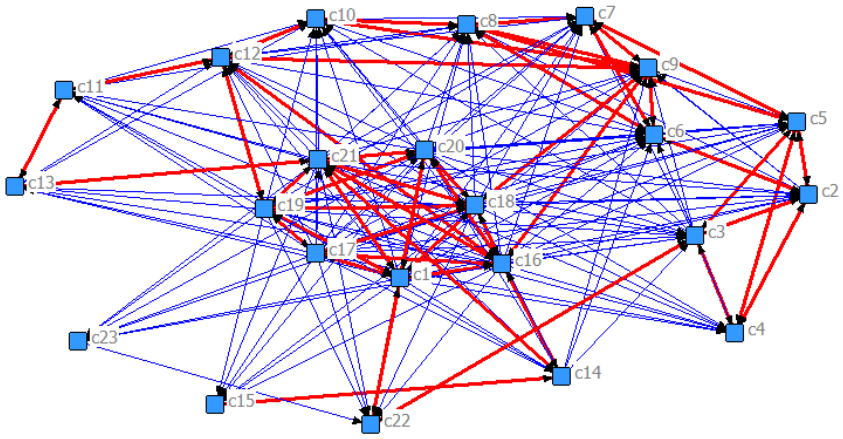

Fig.7 Tacit Knowledge Dedicated Network Reciprocal Relationship Diagram

b.Network characteristics and centrality analysis

Through the analysis of the density, we can find that the density of tacit knowledge network is 0.4565. Compared with the tacit knowledge seeking network, the network has more links, and the tacit knowledge relationship between students seems to be very close. However, through the correlation analysis, it is found that the network efficiency is only 0.3117, which shows that the network efficiency is low, and there are a lot of redundant connections. It can be concluded that the existence of a large number of redundant connections is the main reason for the high density of tacit knowledge.

From the view of the centrality of the implicit knowledge contribution network, C6, C7, C8 and C9 have a high in-degree, indicating that most members of the class are willing to give tacit knowledge to them. C1, C18, C16 and C17 have a high out-degree, indicating that they are willing to give tacit knowledge to most members of the class. In the view of the center of potential network in the dedication of tacit knowledge, the center penetration potential is 28.306%, the degree of potential is

56.818%, showed that the class of tacit knowledge dedicated network structure is uniform and symmetrical. This shows that there is no significant concentration trend, which is conducive to the occurrence of tacit knowledge contribution behavior.

Table 3. The Simple Form of the Tacit Knowledge Contribution Network Node Degree Centrality Analysis

	Mean Value	Standard Deviation	Minimum Value	Maximum Value	Network Centrality
Out-degree	5.696	5.377	1.000	22.000	77.479%
In-degree	5.696	2.561	2.000	11.000	25.207%

c.Cohesive subgroup analysis

In the cohesive subgroup analysis, the network has 13 faction which size is 3, and 6 faction which size is 4. Therefore, we can set the faction size to 4. We can learn that the tacit knowledge contribution network consists of 6 small groups which size is not less than 4 (Figure 8). There is overlap between the 6 factions, that is, there are a lot of "bridge" nodes. C1, C18, C16, C20, C21 serve as the bridge point. C10, C11, C12, C13, C14, C15, C22, C23 do not belong to any faction, that is to say they are blocked in the core of the small group in the dedication of tacit knowledge. Mastering the network structure of tacit knowledge of the class is conducive to the development of tacit knowledge contribution policy.

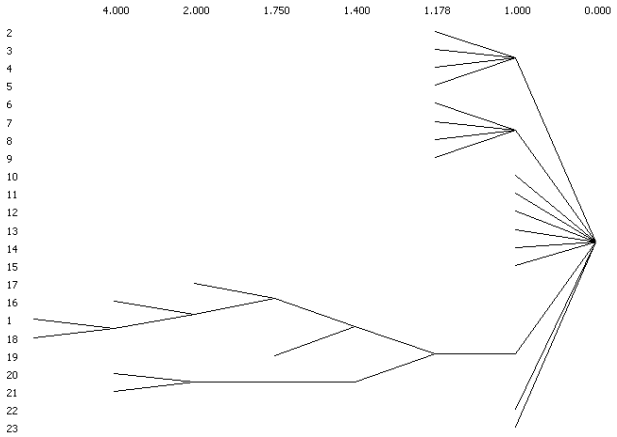

Fig.8 Tacit Knowledge Network Faction Analysis Diagram

3.5 QAP analysis on the relationship of tacit knowledge transfer in class

Is there any relationship among emotional relationship, tacit knowledge seeking relationship and the devotion relationship? Using the Quadratic Assignment Procedure (QAP) of UCINET, we can test the correlation coefficient and the degree of significance between the three adjacency matrices. It can be found that there is a positive correlation between emotional relationship and tacit knowledge seeking relationship, and their correlation coefficient is 0.518. There is positive correlation between emotional relationship and tacit knowledge contribution, and their correlation coefficient is 0.273. There is a positive correlation between the relationship between tacit knowledge seeking and dedication, and the correlation coefficient is 0.416. In other words, the emotional relationship between the members of the class has a positive impact on the relationship between the search for tacit knowledge and dedication, which confirms the results of Hansen.

4. The optimization strategy of tacit knowledge transfer in class

Based on the above research, combined with the actual situation of the investigation, we can give the following recommendations:

4.1 Set up the concept of tacit knowledge transfer based on "mutual trust, mutual benefit, mutual benefit and win-win", and create a class based on "mutual benefit".

On the one hand, if each member of the class can give their own experience, know-how and other tacit knowledge, tacit knowledge of the collective will be greatly increased. We can give the class tacit knowledge to each member of the class, so that each class members will benefit from it. On the other hand, if the competition within the class is too intense and hostile to each other, it will inevitably lead to the slow and even collapse of tacit knowledge transfer. As the main position of personnel training, it is the bounden duty of colleges and universities to provide tacit knowledge and maximize the value of tacit knowledge. Therefore, the class should be people-oriented, to create a conducive to the transfer of tacit knowledge of class culture, driven by the culture of the class of tacit knowledge transfer and innovation. In practice, we can gradually change the conservative thought of the class members through the establishment of innovative practice group, scientific research project team, holding the exchange meeting, etc. Let "mutual trust, mutual benefit, mutual benefit and win-win" tacit knowledge transfer idea be internalized in the heart, outside of the line, in order to achieve the effect of 1+1>2.

4.2 Improve the overall emotional network density of class members, increase the number of small groups.

Through the analysis of the general situation of the emotional network, centrality and cohesion subgroup, we found that the direct contact among the members of the class is limited, and the small groups of emotional network are derived from the same dormitory. In other words, the proximity of the place of residence brings the convenience of interpersonal communication, and also brings the dormitory boundary of the small group of emotional network. These boundaries lead to the emotional network to be not strong. Emotional relationship has a positive impact on tacit knowledge transfer, so the class should hold a variety of social activities to increase the frequency and scope of direct contact between members. This can break the emotional network of small groups of dormitory boundaries, prompting the class members from ordinary students to friends. On this basis, it can form a positive interaction between the collective and the individual. It not only taciturnity the individual members of the collective sense of belonging to the class, but also enhances the class collective for members of the individual "Stickiness", prompting the class collective from the "loose" to "cohesion" change.

4.3 Strengthen the role of core members in the transfer of tacit knowledge, encourage edge members to connect other members of the class.

Through the center analysis, some students in the class are in the core of tacit knowledge transfer. Encourage them to communicate with other members of the class, which is conducive to the increase of the tacit knowledge transfer activity and the improvement of the tacit knowledge. The cultivation of potential core members can reduce the dependence of tacit knowledge transfer on a few core members. In this way, it can avoid the collapse of the network of tacit knowledge transfer and the loss of important resources. Some of the students in the class are isolated or on the edge of the network. We should help them analyze the reasons why they are being isolated or on the edge of the network, and encourage them to establish a relationship with other members. Sorting out and building a more clear and reasonable tacit knowledge transfer map for these students can be conducive to the overall perspective of the station to find the best path of tacit knowledge transfer.

4.4 Open up new media positions, build a diversified exchange platform.

The transfer of tacit knowledge is mainly "contact" transmission, but it does not exclude the effectiveness of information technology. The dialogue and communication in the virtual environment is given a sense of security, because of the virtual and anonymous network. Plus, across the tacit knowledge and dedication, devaluation may cause competitive barriers. In addition, the dedicator of the tacit knowledge in the virtual environment can also meet the needs of self-realization when

interacting with others. In the era of new media development, the class should make good use of social media technology, and actively build a activity area of new media. Let the class members deeply appreciate the dedication of the convenience and happiness and promote the "mutual trust, mutual benefit, mutual benefit, win-win" tacit knowledge transfer concept, to promote the tacit knowledge transfer.

5. Conclusion and Expectation

According to the research of this paper, the tacit knowledge transfer in class shows the characteristics of network. We can use the SNA network structure clearly to describe the class of tacit knowledge transfer. This can form a class of tacit knowledge transfer "map", and provides a theoretical basis and practical experience for the realization of tacit knowledge which flow visualization and accurate management.

University students can get a map of tacit knowledge transfer. On the one hand, it can know the location of tacit knowledge and the best access path, and help them to enhance their core competitiveness. On the other hand, it can know which position is easy to obtain tacit knowledge and take attention according to their actual situation.[16]

The class can also get a tacit knowledge transfer map of the class. On the one hand, it can promote or hinder the transfer of tacit knowledge in the class through quantitative analysis, and clear which network structure can accelerate the speed, depth and breadth of the tacit knowledge transfer. It will lay the foundation for improving the level of tacit knowledge. On the other hand, it can make the individual tacit knowledge condense into the collective tacit knowledge through the continuous transfer of tacit knowledge. Scattered tacit knowledge can be transformed into the tacit knowledge of the system, and it can provide methods and ways in order to transfer the tacit knowledge of class.

Combined with the complex theory and network dynamics, we can use SNA to study and compare the tacit knowledge transfer of the class. It is also the next research direction.

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