An Empirical Study on Tacit Knowledge Sharing Based on Social Network Analysis

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Abstract

At present, entrepreneurship education research has become the current research focus. The research of entrepreneurial education mainly studies the quality of entrepreneurs and the curriculum system of entrepreneurship education. Some researchers study entrepreneurial education through knowledge sharing, especially tacit knowledge sharing. With China's "popular entrepreneurship and innovation", entrepreneurship education research to a higher level. Status shows that the current college entrepreneurial rate is low, but Yiwu Industrial and Commercial College students entrepreneurial rate reached a leading level in the world. However, the student entrepreneurial rate is still ahead of the national level, but the student business rate has declined since 2015. Therefore, in order to understand this situation and continue to maintain a higher rate of entrepreneurship, this study choose from the perspective of tacit knowledge sharing, the use of social network analysis method to study the problem. First, this study discusses the elements of tacit knowledge sharing in social network of entrepreneurial class from the aspects of network density and distance, centrality, cohesion and structural hole analysis. Secondly, taking social network established by an entrepreneurship class students of Yiwu Industrial and Commercial College as an example through interviews and questionnaires. Thirdly, the social network analysis (SNA) method is used to study the exchange and sharing of entrepreneurial tacit knowledge in this social network. Through the study, it is found that there are a series of factors that hinder the spread of tacit knowledge in the existing social network of entrepreneurship class, which indirectly affects the efficiency of entrepreneurship education. Finally, this paper puts forward some corresponding countermeasures and suggestions on these problems which can be used to improve the entrepreneurial rate of college students and to promote the sustainable development of national economy.

Keywords: Social network analysis, Entrepreneurial education, Tacit knowledge, Sharing of knowledge, Empirical study

1 Introduction

Starting in 2002, in order to develop and explore the main methods to promote the business starting education for college students, Chinese Ministry of Education has been carried out entrepreneurial education pilot work in 9 different universities. According to popular entrepreneurship and innovation policy, many colleges and universities have set up entrepreneurship research and education center, and started to research entrepreneurship education, achieved some preliminary results [1].

Yiwu Industrial and Commercial College was approved "Pilot Entrepreneurial University of Zhejiang" in 2010. Thanks to the business starting education, over 1,800 students have started their own business out of 8800 students in the college. More than 1200 students have run their online-shops, including 20 students reaching the level of the crown, and more than 500 students the level of diamond. In 2008, this college set up a business starting college. In 2009, this college began to recruit e-commerce business starting class. Now, there are currently 12 classes, each class of 30 students, developing into a large-scale entrepreneurial education [1-5].

Entrepreneurship education training mechanism is a full range of system engineering [4-5]. Over the past few years, through tracking research of Yiwu Industrial and Commercial College's e-commerce entrepreneurship class training process, we found that entrepreneurship education can teach students the basic knowledge of some explicit knowledge, such as opening online shop, image processing, web design, which can be accomplished by class teaching [6-8]. For the tacit knowledge, such as products choice, market development, which is the transmission between teachers and students and students themselves, is hardly teaching in the class. This is a transmission of tacit knowledge [9-12].

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Tacit knowledge is an indispensable resource for students' entrepreneurship success, Management of tacit knowledge can make the students get more ideal entrepreneurial performance [13-15]. Tacit knowledge has non-structural and personal characteristics, so it is capable of encoding. Since the introduction of this idea in 1970s, it gradually developed in various fields such as sociology, psychology, anthropology, mathematics, communication science, and so on [16-17]. It is difficult to share and communicate with each other, and it is necessary to realize the interpersonal communication and communication practice in the social network [18-19].

Taking Yiwu Industrial and Commercial College as an example, the present paper explored the Tacit Knowledge in the social network built on entrepreneurial class by means of SNA research methods, so as to promote the implementation of tacit knowledge sharing, and the optimization and reform of training mechanism of entrepreneurship education.

2 System Model and Definitions

SNA originated from the adaptive network in physics, from a branch of the study of relations [20]. SNA can be used to analyze the social network from several different perspectives, including central analysis, cohesive subgroup analysis, core edge structure analysis and structural equivalence analysis [20-21]. In this paper, we will study the influence factors of the tacit knowledge mining and sharing in the social network of the entrepreneurial class from different aspects, such as structural hole analysis, density and distance, cohesive subgroup analysis and centrality analysis.

2.1 Network Density φ and Distance D

Set N as social network node number. Each of every two nodes can have an edge. Thus, the maximum number of edges in the network is shown in Eq. (1).

$$Lmax = C_N^2 = \frac{N(N-1)}{2} \tag{1}$$

Assuming L is the actual number of edges of the network, the network density φ is the ratio of L and N.

$$\varphi = \frac{L}{Lmax} = \frac{L}{N(N-1)/2} = \frac{2L}{N(N-1)} \tag{2}$$

In Eq. (2), network density Φ is used to measure the level of closeness between different subjects, only with suitable value able to successfully promote the diffusion and sharing of tacit knowledge. If the diameter is too small and each node is lack of communication, tacit knowledge is difficult to achieve sharing and dissemination. If the diameter is so high, the social network needs to spend too much time and effort to promote the sharing of tacit knowledge, pay more opportunity cost, which has a negative impact on the sharing effect [22].

Network distance D refers to the minimum number of edges between different nodes in the network. Assuming that the number of edges between two points is Dij, the network distance is shown in Eq. (3).

$$D = MIN\left(D_{ij}\right) \tag{3}$$

In Eq. (3), If the D value is small, it is easier to share and communicate the tacit knowledge between the two nodes. On the contrary, it is more difficult to share and communicate the tacit knowledge between the two nodes [23].

2.2 Centrality

The centrality of social network is the influence level of the subject in the network. It is mainly measured by three degrees: Degree centrality (DC), Betweenness Centrality (BC) and Closeness Centrality (CC). DC, BC, CC reflect the view of the social network subject. The Degree central potential, the Betweenness central potential and the Closeness central potential are the view of the whole social network.

Only when the social network has the appropriate centrality, can the tacit knowledge be realized smoothly. First of all, if the center value is too large, the impact of different subjects is very significant. If one of the subjects left, the impact on the entire network is very large, resulting in more serious consequences; Secondly, if the center value is too small, the influence of different subjects is subtler, and there is not much contact between different subjects, and it will have an adverse impact on the tacit knowledge and communication.

In-depth study on centrality can make the different subjects to participate in the communication and interactive activities. Therefore, through the research on the centrality of social network, it is helpful to the realization of tacit knowledge preservation [24].

2.3 Cohesive Subgroup

There will be some small groups in the social network, which shared and communicated tacit knowledge with each other. Cohesive subgroups can be used to study the basic properties of these small groups. The so-called cohesive subgroups, refers to a certain set of specific subjects with a certain set of conditions, in which the different subjects can better achieve the communication and sharing of knowledge, the relationship become closer [25].

These small groups have a certain degree of influence on tacit knowledge sharing. On the one hand, the small group of internal communication can make small groups more smoothly to achieve the tacit knowledge sharing; On the other hand, if only a small group of internal communication and lack of

communication between small groups, it is difficult to achieve tacit knowledge sharing in the social network, thus the development of social networks will have an adverse effect [26].

It is assumed that there are a lot of small groups in the social network, and the links between small groups are established by close contact. The links can effectively promote knowledge sharing [27].

2.4 Structural Hole

According to the theory of structural holes (Burt, 1992), it is assumed that a subject connects the other two subjects that are not directly connected, so the location of this subject is structural hole. The structural hole is mainly measured by four indexes: the effective scale, the efficiency, the restriction and the grade.

The subject located in structural hole, has control advantage and information advantage [28]. Freeman said: "for the subject, the other subjects can be subject to varying degrees of influence" [29].

The subject located in the structural hole position is able to acquire tacit knowledge more smoothly, promoting the communication between different subjects, and realizing the sharing of tacit knowledge [30-31].

At the same time, supposing that there are too many structural holes in the social network, because of different subjects in the process of development with a certain degree of selfishness, and in order to safeguard their own interests, these subjects could not to engage in tacit knowledge communication, thereby increasing the opportunity cost [32].

3 SNA Schemes and Functions

In this study, an entrepreneurial class was chosen as an example, and a questionnaire was used to research an empirical analysis of tacit knowledge sharing based on tacit knowledge exchange among the students in the class. In this college, there are three grades, and every grade has four classes. The first-grade students in entrepreneurship is still relatively weak, and the relationship between students is also quite strange. The third-grade students in entrepreneurship is very mature, and the social network of these students can adjust the place is relatively weak. Based on above reasons, we choose the grade 2 students as the research objects.

Through the conversation between entrepreneurship student's tutors, we explore some basic factors which affect students' entrepreneurship. Secondly, through conversations with the entrepreneurial success of students, we dig out the influence factors of their entrepreneurship. In summary, we dig out some tacit knowledge. Simultaneous, according to tacit knowledge, we design a questionnaire. Through the questionnaire, we explore the people who transfer tacit knowledge to the students. We used the relationship between them to building social networks of the class.

The 30 students in the class were coded from the series of 1 to 30. Secondly, based on the results of the questionnaire, this paper analyzed the basic situation of tacit knowledge exchange and sharing among different subjects, and eliminated the errors of 8 questionnaires. Third, on this basis, an $22 * 22$ adjacency matrix S_{ij} was formed, and S_{ij} represents the tacit knowledge of the exchange and sharing of the basic information of different subjects. Either tacit knowledge exchange and sharing S_{ij}=1, or S_{ij}=0. The adjacency matrix S_{ij} was researched and analyzed by Ucinet 6.0. A social network of entrepreneurial class diagram was draw by Ucinet tool Netdraw, sample output for the above example is provided (see Figure 1).

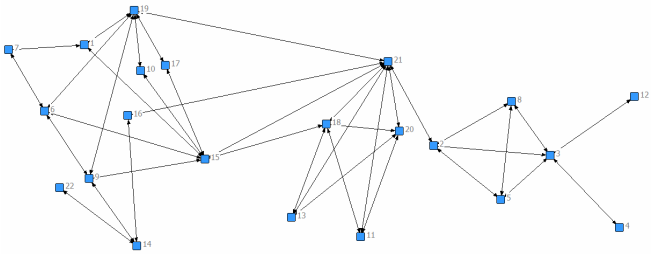

Figure 1. Social network of entrepreneurial class

4 The SNA Analysis

4.1 Distance Analysis

With the help of Ucinet 6 tool, "Network→Cohesion (Density) → (New) Density Overall" step was used to calculate the social network density, whose value is 0.165. It means that the tacit knowledge exchange between different subjects is not much, and the tacit knowledge sharing and communication has adversely affected.

Through Ucinet 6 "Network→Cohesion→Distance" path, the distance matrix of the entrepreneurial class network was got, whose output is provided in Table 1. The average distance between the subjects by calculating is 2.814. It can be said that different subjects can be connected with each other, and can only be contacted by two people, which shows that the exchange and sharing of tacit knowledge can be realized between different subjects.

4.2 Centrality Analysis

"Network→Centrality→Degree" step was used to calculate the DC of the subject of network; At the same time, "Network→Centrality→Freeman Betweenness→ Betweenness" was employed to calculate the BC of the subject of network, "Network → Centrality → Closeness" to calculate the CC of the subject of network. The results obtained are shown in Table 2.

Table 1. The distance matrix of the entrepreneurial class network

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	0	3	4	5	4	2	1	4	2	2	3	5	3	3	1	3	2	2	1	3	2	4
2	3	0	1	2	1	3	4	1	3	3	2	2	2	3	2	2	3	2	2	2	1	4
3	4	1	0	1	1	4	5	1	4	4	3	1	3	4	3	3	4	3	3	3	2	5
4	5	2	1	0	2	5	6	2	5	5	4	2	4	5	4	4	5	4	4	4	3	6
5	4	1	1	2	0	4	5	1	4	4	3	2	3	4	3	3	4	3	3	3	2	5
6	2	3	4	5	4	0	1	4	1	2	3	5	3	2	1	3	2	2	1	3	2	3
7	1	4	5	6	5	1	0	5	2	3	4	6	4	3	2	4	3	3	2	4	3	4
8	4	1	1	2	1	4	5	0	4	4	3	2	3	4	3	3	4	3	3	3	2	5
9	2	3	4	5	4	1	2	4	0	2	3	5	3	1	1	2	2	2	1	3	2	2
10	2	3	4	5	4	2	3	4	2	0	3	5	3	3	1	3	2	2	1	3	2	4
11	3	2	3	4	3	3	4	3	3	3	0	4	2	3	2	2	3	1	2	1	1	4
12	5	2	1	2	2	5	6	2	5	5	4	0	4	5	4	4	5	4	4	4	3	6
13	3	2	3	4	3	3	4	3	3	3	2	4	0	3	2	2	3	1	2	1	1	4
14	3	3	4	5	4	2	3	4	1	3	3	5	3	0	2	1	3	3	2	3	2	1
15	1	2	3	4	3	1	2	3	1	1	2	4	2	2	0	2	1	1	2	2	1	3
16	3	2	3	4	3	3	4	3	2	3	2	4	2	1	2	0	3	2	2	2	1	2
17	2	3	4	5	4	2	3	4	2	2	3	5	3	3	1	3	0	2	1	3	2	4
18	2	2	3	4	3	2	3	3	2	2	1	4	1	3	1	2	2	0	2	1	1	4
19	1	2	3	4	3	1	2	3	1	1	2	4	2	2	2	2	1	2	0	2	1	3
20	3	2	3	4	3	3	4	3	3	3	1	4	1	3	2	2	3	1	2	0	1	4
21	2	1	2	3	2	2	3	2	2	2	1	3	1	2	1	1	2	1	1	1	0	3
22	4	4	5	6	5	3	4	5	2	4	4	6	4	1	3	2	4	4	3	4	3	0

Table 2. Centrality index value of the entrepreneurial class network

	DC	Standardization DC	BC	Standardization BC	CC	Standardization CC
1	3.000	14.286	8.067	3.841	59.000	35.593
2	4.000	19.048	80.000	38.095	48.000	43.750
3	5.000	23.810	39.000	18.571	62.000	33.871
4	1.000	4.762	0.000	0.000	82.000	25.610
5	3.000	14.286	0.000	0.000	64.000	32.813
6	4.000	19.048	11.267	5.365	56.000	37.500
7	2.000	9.524	0.333	0.159	74.000	28.378
8	3.000	14.286	0.000	0.000	64.000	32.813
9	4.000	19.048	15.700	7.476	54.000	38.889
10	2.000	9.524	0.167	0.079	61.000	34.426
11	3.000	14.286	0.000	0.000	56.000	37.500
12	1.000	4.762	0.000	0.000	82.000	25.610
13	3.000	14.286	0.000	0.000	56.000	37.500
14	3.000	14.286	21.533	10.254	60.000	35.000
15	7.000	33.333	50.567	24.079	43.000	48.837
16	2.000	9.524	21.000	10.000	53.000	39.623
17	2.000	9.524	0.167	0.079	61.000	34.426
18	5.000	23.810	7.833	3.730	48.000	43.750
19	6.000	28.571	37.567	17.889	44.000	47.727
20	4.000	19.048	0.333	0.159	55.000	38.182
21	8.000	38.095	125.467	59.746	38.000	55.263
22	1.000	4.762	0.000	0.000	80.000	26.250

From Table 2, the DC value of 21 is max, followed by 15, 19, which shows that the three subjects are in the leading position in the social network. In contrast, the DC value of 4, 12, 22 is minimum, which means that three subject are in the marginal position in the social network, and communicate less with other subjects. The Degree central potential of the network is 23.81%.

The BC value of 2, 21 are maximum, and the next are 3, 15 and 19. It shows that these subjects are in the position of structural holes in the social network, and can control and transfer the tacit knowledge exchange between other subjects. The BC value of 4, 5, 8, 11, 12, 13, 22 are 0, which means that these subjects in social network cannot be effectively linked to other subjects, completely unable to control the communication of tacit knowledge between other players. The Betweenness central potential of the whole social network is 53.09%, which indicates that the tacit knowledge transfer and sharing among the subjects of the whole social network is to a large extent controlled by member 2 and 21.

The relative CC values of subjects 4, 12 and 22 are higher. By contrast, the relative CC values of subjects 15, 19 and 21 are lower, which shows that subjects 4, 12, and 22 are most controlled by other subjects in social networks, and the subjects 15, 19 and 21 are difficult to be controlled by other subjects. As can be seen from Figure 1, with the help of subject 3, the subjects 4, 12 and 22 can smoothly realize the tacit knowledge exchange in the social network. It is concluded that the closeness central potential of the social network is 39.29%, which means that the closeness centralized trend in the network is relatively low, indicating that the main difference in the network is small, and there is no absolute dominance of the subject.

The value of BC based on relations of different subjects were calculated through the "Network → Centrality → Freeman Betweenness → Edge (line) Betweenness" step.

Because the style and results of the table are the same as Table 2, the data is omitted here. The result from this table shows that the BC value of relationship of the subjects 2 and 21 is up to 96, which indicates that these two subjects play a leading role in the communication and sharing of tacit knowledge. The "Network→Subgroups→Cliques" step calculated minimum size cliques number. The value is 3, and the number of cliques is 6. The result is shown in Figure 2.

```
6 cliques found.
        1:  13 18 20 21
        2:  11 18 20 21
        3:  15 18 21
        4:  2 3 5 8
        5:  6 9 15
        6:  6 9 19
```

Figure 2. The clique's analysis social network of entrepreneurial class

4.3 Cohesive Subgroup Analysis

Analysis of the above 6 cliques: there are 3 small cliques' groups in social networks, as shown in Figure 3.

```
1:  11 13 15 18 20 21
2:  2 3 4 5 8 12
3:  1 6 7 9 10 14 15 16 17 19 21 22
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Figure 3. Small cliques' groups in social networks of entrepreneurial class

Combined with the social network diagram showed in Figure 1, there is a close relationship between the 3 small cliques groups, so the tacit knowledge communication is smooth. At the same time, it is found that subjects in different groups have less interaction, so there exist some difficulties and obstacles in the communication of tacit knowledge.

As shown in the Figure 3, subjects 15 and 21 exist in different groups. Only with the help of the subjects 15 or 21, group 1 and group 3 can communicate tacit knowledge. As for small groups 2, which contact less with other two groups, achieves tacit knowledge sharing only with the help of subject 2. In the social network, subjects 2 and 21 play the role of "bridge", which is very important in the process of tacit knowledge exchange and sharing in the social network.

4.4 Structural Holes Analysis

"Network→Ego-networks→Structural Holes" step was used to calculate Structural holes, and at the same time, the item "Method" applied "whole network method", and the output is shown in Figure 4. The value of EffSize of the subject 21 is the largest, followed by the subjects 15 and 19, which shows that these three subjects occupy the leading position in the social network. The value of Constra of 15 is Minimum, followed by subjects 19 and 21, which means that compared with the main body of the structural holes in the social network, the three subjects are more connected with other subjects, and play a relatively important role in the tacit knowledge transfer. The value of Hierarc of subjects 2, 4, 12 are the largest, followed by subjects 3, 18, 21, indicating that these subjects in the social network are in the edge position, which is different from the previous results.

At the same time, as Figure 1 shows that subjects 2, 21 is the "bridge" in the social network. The tacit knowledge sharing of social network cannot be achieved without the subjects 2, 21. The subjects 15, 21 play the role of "experts", promoting and guiding the tacit knowledge sharing between different subjects. With the help of subject 2, members of the small cliques group of 2 and members of other small cliques' groups achieve tacit knowledge sharing. Also, subjects

Structural Hole Measures

	EffSize	Efficie	Constra	Hierarc	Indirec
1	3.000	1.000	0.333	0.000	0.000
2	2.500	0.625	0.530	0.041	0.433
3	3.800	0.760	0.392	0.055	0.367
4	1.000	1.000	1.000	1.000	0.000
5	1.000	0.333	0.773	0.002	0.522
6	3.000	0.750	0.365	0.014	0.202
7	2.000	1.000	0.500	0.000	0.000
8	1.000	0.333	0.773	0.002	0.522
9	3.000	0.750	0.365	0.014	0.202
10	2.000	1.000	0.500	0.000	0.000
11	1.000	0.333	0.639	0.003	0.383
12	1.000	1.000	1.000	1.000	0.000
13	1.000	0.333	0.639	0.003	0.383
14	3.000	1.000	0.333	0.000	0.000
15	6.429	0.918	0.180	0.010	0.118
16	2.000	1.000	0.500	0.000	0.000
17	2.000	1.000	0.500	0.000	0.000
18	2.600	0.520	0.500	0.056	0.545
19	5.667	0.944	0.198	0.013	0.083
20	1.500	0.375	0.638	0.036	0.577
21	6.500	0.813	0.256	0.071	0.378
22	1.000	1.000	1.000	1.000	0.000

Figure 4. Results of structural holes analysis of the social network of entrepreneurial class

4, 12, 22 in the social network are in the edge position. In order to achieve the purpose of tacit knowledge exchange and sharing, the tacit knowledge communication and exchanges need to be promoted.

5 Summary and Conclusions

Through empirical research of tacit knowledge sharing of entrepreneurial class based on SNA, some suggestions can be put forward to promote the tacit knowledge communication. First of all, through the analysis of the relationship between different subjects in the social network, the level of communication and exchange of tacit knowledge between different subjects can be calculated, and the quality and frequency of communication need to be increased. Secondly, the small group in the social network were analyzed by the cliques' subgroup method, and the role of these small groups in tacit knowledge exchange can be calculated, which can be used to affect the whole class to improve the entrepreneurial tacit knowledge communication. Thirdly, with the help of structural holes' analysis, the subjects' restricted degree of the social network in communication of tacit knowledge can be measured. And the "bridge point" or "bridge" which plays a key role in the entire network of tacit knowledge sharing was found. And, the bridge can be created for the social network to eliminate limitation of the tacit knowledge transmission in the social network of entrepreneurial class.

Above of all, effective utilization of the above countermeasures can obtain basic elements timely and comprehensively, which affect tacit knowledge sharing of the entire social network in the new situation of entrepreneurship. According to the analysis results, some corresponding measures are suggested to improve the efficiency of tacit knowledge sharing and entrepreneurship education.

6 Future Works

Future works will be carried out from the following four aspects. First of all, the mined tacit knowledge becomes explicit knowledge, whether the effect also sustained influence; Secondly, after the artificial adjustment of the social network of the entrepreneurial class, whether it has an impact on the original social network, or even tacit knowledge changes; Third, to track the study of entrepreneurial class' students, observed the change of students' entrepreneurial performance, social network structure and tacit knowledge. Finally, the SNA method and the strategy for college student entrepreneurship education can be tried to apply to other types of education or class management.

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