

Characteristics of Class-Scale Social Network Structures of College Students over Time, Driving Factors and Their Implications for Chinese Higher Education

Jiaogen Zhou^{1*}, Caiyun Zhang²

¹School of Urban and Environmental Sciences, Huaiyin Normal University, Huai'an, China

²College of Music, Huaiyin Normal University, Huai'an, China

Email: *zhoujg@hytc.edu.cn

How to cite this paper: Zhou, J. G., & Zhang, C. Y. (2023). Characteristics of Class-Scale Social Network Structures of College Students over Time, Driving Factors and Their Implications for Chinese Higher Education. *Creative Education*, 14, 716-728.

<https://doi.org/10.4236/ce.2023.144047>

Received: March 14, 2023

Accepted: April 9, 2023

Published: April 12, 2023

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Abstract

Classes are the basic unit of learning and social activity for college students in higher education. A good social environment at a class scale has a positive effect on fostering the development of teamwork among university students. To assess characteristics of class-scale social network structures of college students over time, this study randomly selected a total of 30 classes of different majors and grades in universities in northern Jiangsu Province, China, and conducted questionnaires on students' social networks. Social network analysis method was used to model and analyze the social networks of class Interpersonal interaction for students. The results of the study show that there is significant temporal variability in the class-scale social network structure of college students. During freshman and sophomore years, students interacted closely with each other in class, with a high average network clustering coefficient of 0.81, while in junior and senior years, students tended to interact more distantly with each other in class, with the network clustering coefficient dropping to 0.55. This suggests that early collaborative education does motivate junior students to make friends, but this discontinuous collaborative education has a negative impact on senior students' motivation to make friends, since teamwork education is mostly concentrated in the early years of freshmen in many general universities in China. In addition, roommate relationships, participation in social activities and hometown gatherings influence class-scale socialization. Class-scale socialization prioritizes dormitory or club activities to become friends with the same class, followed by hometown parties. The results of this study confirm that long-term maintenance of cooperative education and multiple guidance for college students to actively

make friends and engage in group cooperation in class are conducive to a positive interpersonal interaction at the class scale.

Keywords

Interpersonal Interaction, Class Socialization, Collaborative Education, Social Network Analysis

1. Introduction

Classes are the basic unit of learning and social activity for college students in higher education. A good class Interpersonal interaction has a positive effect on fostering the development of teamwork among university students. Class Interpersonal interaction skills revolve around the ability of the teacher to provide certain core conditions which are essential in creating a positive educational setting. These conditions consist of warmth, empathy, respect, genuineness, concreteness, self-disclosure, immediacy, and confrontation (Cornelius, 2007; Hagenauer & Volet, 2014; Gerda et al., 2015).

Current research on interpersonal interactions among university students has different focuses. Some studies analyses the specific reasons for the formation of different class interpersonal structures from the perspectives of psychology, sociology and education, and propose measures related to teacher-student relationships on the formation of good interpersonal relationships in the classroom (Frenzel et al., 2009; Demetriou et al., 2009; Becker et al., 2014; Ang, 2015; Theelen et al., 2019). There are also some literatures that focused on the psychological changes in interpersonal interactions among college students in dormitories (Stephe et al., 1976; Wu et al., 2020). The university dormitory is the place where dormitory members most socially prioritize and directly confront each other, but the small size of the dormitory allows for consistency in terms of geographical space and time spent together, which in turn leads to a warming of relationships between members (Wei & Chen, 2019; Li et al., 2020). The dormitory members are familiar with each other due to similar interests and hobbies, and are attracted to each other due to their complementary personalities and temperaments. A harmonious and loving dormitory environment is conducive to the formation of correct interpersonal relationships and a greater sense of trust in others (Cheung & Hui, 2003; Li et al., 2016). On the contrary, dormitory members who are psychologically distant from each other will remain wary of each other for a long time, forming an introverted personality and being afraid to interact with others.

A social network is a network structure made up of many nodes and the relationships between them (Newman & Park, 2003). Nodes are usually individuals or organizations. Social networks represent the various social relationships that link people or organizations from casual acquaintances to close family ties. Social network analysis is an analytical approach used to view the social relation-

ships between nodes and links. Social network analysis has become a key technique and a popular study in modern sociology, anthropology, sociolinguistics, geography, social psychology, communication studies, informatics, social network analysis and prospecting, organizational studies, economics, and biology (Otte & Rousseau, 2002; Mehran et al., 2020). Interpersonal relationships among university students can be modelled and analyzed using social network analysis methods. The use of social network analysis methods to study the interpersonal relationships of university students at the class scale can effectively reveal the characteristics of changes in the interpersonal network structure of university students over time, which can have a positive effect on enhancing the psychological health of class members. At present, there are few studies on the characteristics of interpersonal network structure among college students in China. This study aims to investigate the evolutionary characteristics of class interpersonal networks and their influencing factors through social network analysis techniques, by collecting data on interpersonal interactions at the class scale among college students in local universities in China by means of a questionnaire. Our research contributions are: 1) we present evolutionary characteristics of the social network structure of college students over time at the class scale in Chinese higher education institutions through a social network analysis model. 2) Based on the evolutionary characteristics of social network structure of college students at class scale, teamwork and career planning education should be sustained in Chinese higher education in order to foster a good interpersonal interaction in university classes.

2. Materials and Methods

2.1. Questionnaire for Class-Scale Social Networks of College Students

In this study, a total of 30 classes of five majors in geographic science, geographic information science, real estate development and management, engineering cost, human geography and urban and rural planning were randomly selected for a questionnaire survey in a university in northern Jiangsu, China. Subject to the financial constraints of the questionnaire, a total of 770 college students were involved, and 690 completed the questionnaire. After excluding incomplete questionnaires or those with significant errors, the number of valid questionnaires reached 631. This questionnaire covers five areas including the class scale university students' views on friendships and frequency of contact with friends, social outlets and whether they will continue to have contact with friends after graduation. The personal information included gender, major, awards, grades, etc. The surveyed college students ages from 18 to 22, with a male to female ratio of approximately 3:2. The higher proportion of female students is mainly due to the fact that the universities surveyed are higher teacher training schools, which have a higher intake of female students.

The social data collected from university students were aggregated by majors

and grades, in order to count all the friends in the class from freshman to senior year under different social channels. The data was also desensitized to protect the privacy of all students who participated in the survey, so that information such as name, gender, student number and friends' names would not be disclosed. The essential name information was coded using a numerical code.

2.2. Modelling and Analysis of Social Network Structures of College Students

We used a complex network model to model the pre-processed social data of university students. Considering that university students may be one-way or two-way in their willingness to make friends, we use a directed graph network for modelling. Given a directed graph $G = \langle N, E \rangle$, $N = \{N_1, N_2, \dots, N_i\}$ is the set of nodes representing all students in a class, and $E = \{E_1, E_2, \dots, E_j\}$ is the set of connecting edges between nodes. Any two college students have a friend relationship with each other, and there is a connecting edge between two corresponding nodes. Note that in our construction of the directed graph network, we did not consider nodes that do not have neighboring nodes. To assess changes in class-scale social network structure over time, we used two parameters, the average clustering coefficient (Acc) and the average node degree (Lnodes), to reflect differences in social network structure across grades. The Acc reflects the strength of local clustering of nodes in a social network, while the Lnodes characterizes the number of neighboring nodes in the network with connected edges (Newman & Park, 2003; Otte & Rousseau, 2002). Overall, the greater the Acc and Lnodes values, the more connected the social network and the more the network has the characteristics of a small-world network, i.e. any pair of undergraduates in the class has a friendship relationship. Conversely, the smaller the Acc and Lnodes values, the more sparsely connected the social network is, and the more likely it is to form multiple isolated sub-networks, meaning that students in the class are relatively distant from each other and form multiple small isolated groups. The network model construction and parameter calculations involved in the manuscript were implemented programmatically under the beta version of matlab2022.

3. Results

3.1. Qualitative Analysis of the Structures of Class-Scale Social Networks among University Students of Different Majors over Time

The results of the study show significant differences in the structure of social networks at the class scale across majors and grades. In the case of the Natural Sciences major, it is evident that students in this major form a sub-graph of nine clusters that are mainly tightly connected within clusters and isolated between clusters during their freshman and sophomore years. However, the class-scale network structure becomes significantly sparser with increasing grades, retaining only one relatively compact subgraph in particular by the 4th year (Figure 1). In

the case of human geography, changes in the structure of class-scale social networks are also evident with increasing grade levels. In grade one, the university students surveyed in this major formed four tightly social groups, which changed to three social groups in grade two, two in grade three and only one grade four (Figure 2). In the case of the Real Estate and GIS majors, the junior students were significantly more active in socializing within their classes than the seniors (Figure 3, Figure 4). Similar to the evolution of class-scale social network structures in the four majors mentioned above, the surveyed students in the two engineering costing classes formed several well-connected social groups during their junior years, while friendships within the class became distant in their senior years (Figure 5).

To a certain extent, differences in the structure of social networks at the class scale of different majors are influenced by the number of university students who participate in the questionnaire. The total number of college students surveyed in this study was 770 and the number of valid responses collected was 631. The results of the survey showed that 211 of the valid questionnaires were returned by male students, accounting for 33% of the valid questionnaires. The total number of female students was 420, accounting for 67% of the total number of valid responses. In terms of the distribution of the questionnaires, students majoring in natural geography accounted for 56% of the total number of

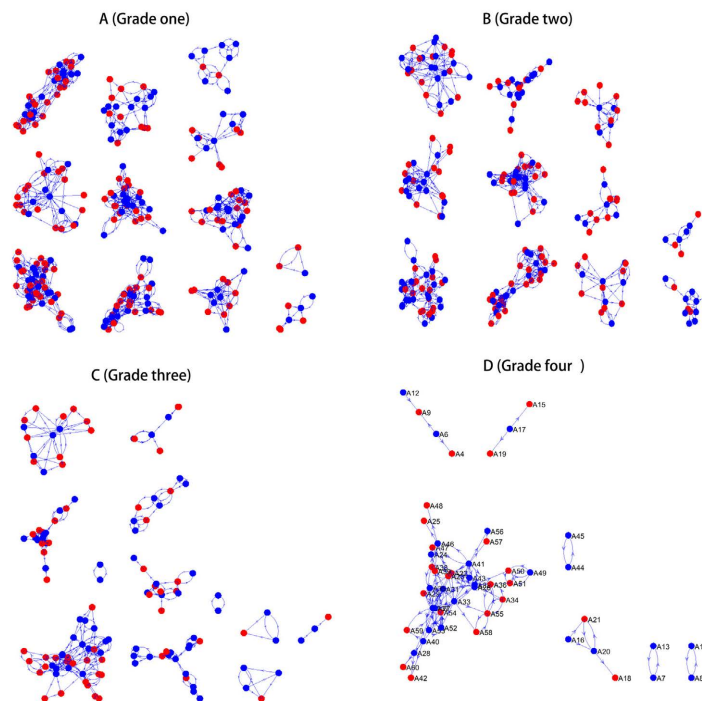


Figure 1. Changes in class-scale social network structure of college students majoring in natural geography. In the network diagram, friendships are biased rather than fully bidirectional. The blue arrow directions are the nodes that were passively selected as friends in social interaction; and the red nodes represent college students who have more passive friendships than active friendships, while the black nodes represent college students who have more active friendships than passive friendships.

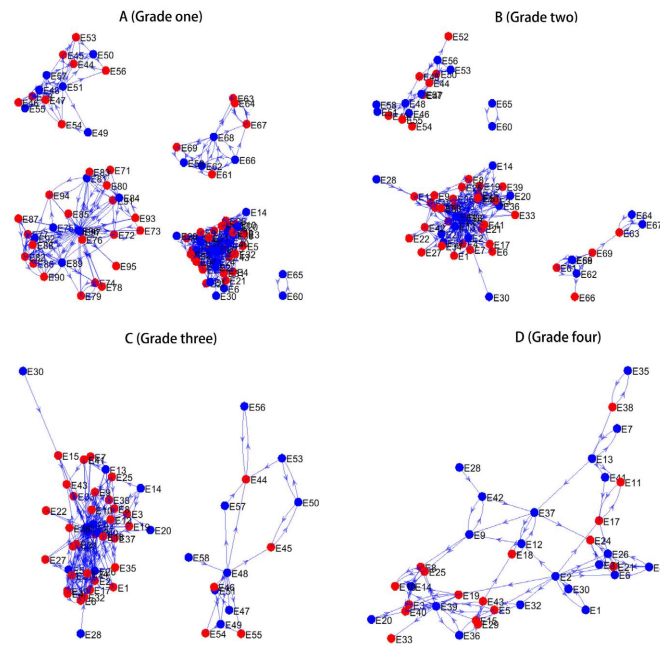


Figure 2. Changes in class-scale social network structure of college students majoring in human geography. In the network diagram, friendships are biased rather than fully bidirectional. The blue arrow directions are the nodes that were passively selected as friends in social interaction; and the red nodes represent college students who have more passive friendships than active friendships, while the black nodes represent college students who have more active friendships than passive friendships.

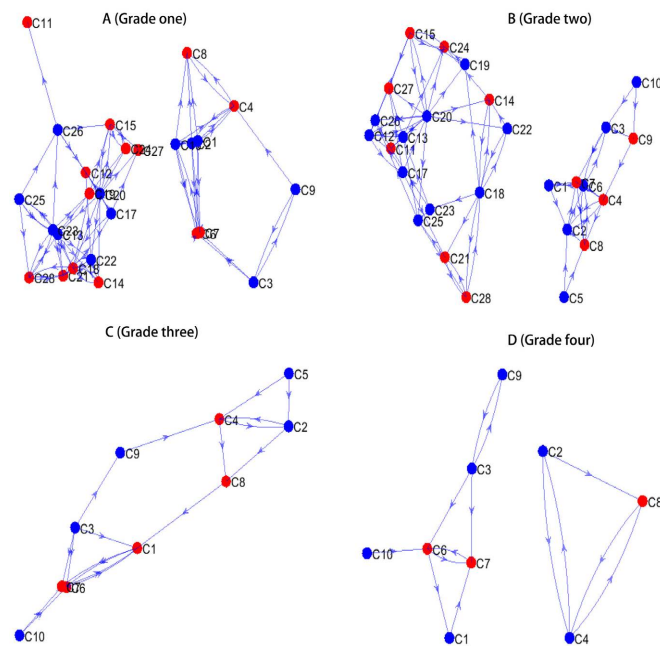


Figure 3. Changes in class-scale social network structure of college students majoring in real estate management. In the network diagram, friendships are biased rather than fully bidirectional. The blue arrow directions are the nodes that were passively selected as friends in social interaction; and the red nodes represent college students who have more passive friendships than active friendships, while the black nodes represent college students who have more active friendships than passive friendships.

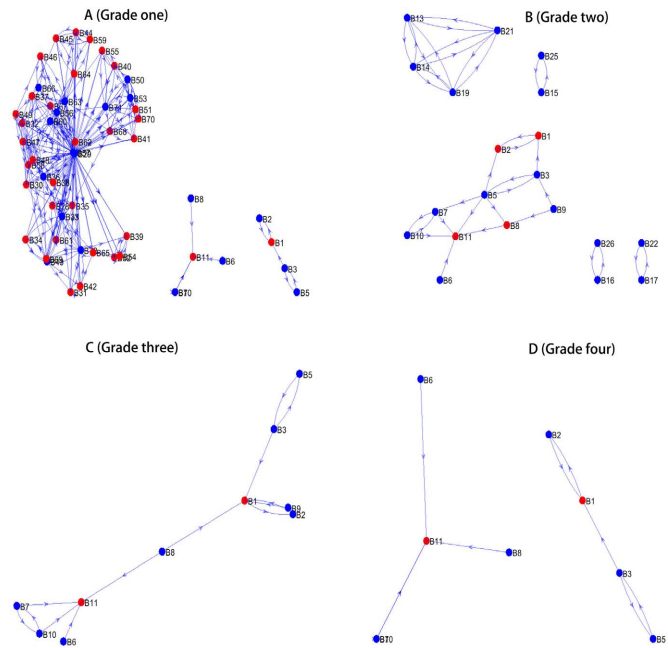


Figure 4. Changes in class-scale social network structure of college students majoring in geographic information System. In the network diagram, friendships are biased rather than fully bidirectional. Blue arrows directions point to the nodes that are passively selected as friends in social interaction. Red nodes represent college students who have more passive friendships than active friendships, while the black nodes represent college students who have more active friendships than passive friendships.

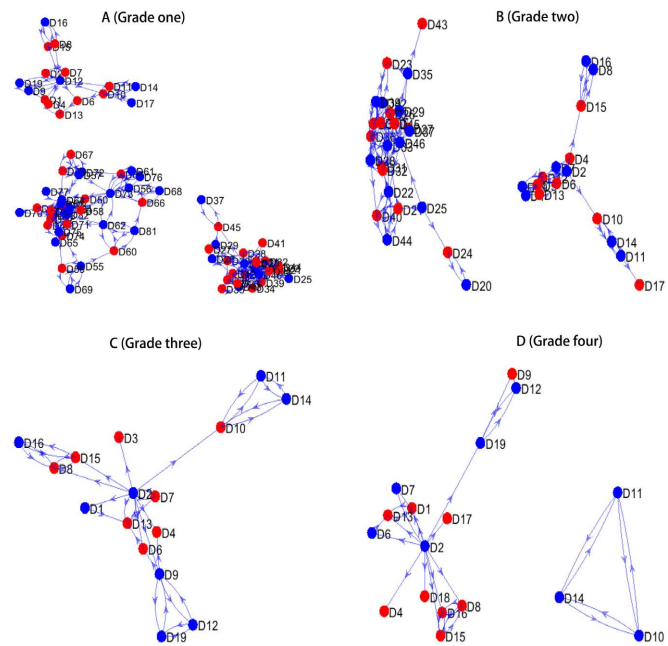


Figure 5. Changes in class-scale social network structure of college students majoring in engineering cost. In the network diagram, friendships are biased rather than fully bidirectional. Blue arrows directions point to the nodes that are passively selected as friends in social interaction. Red nodes represent college students who have more passive friendships than active friendships, while the black nodes represent college students who have more active friendships than passive friendships.

valid responses, with 352 students. The proportion of students majoring in Geographic Information Systems (GIS) was 11%, with 72 students responding. Real Estate Development and Management students accounted for 4% of the valid responses, with 28 students. Engineering Costs students accounted for 13% of the valid responses, with 82 students. Humanities and Geography students accounted for 16% of the valid responses, with 97 students.

On the other hand, our statistics also show that the highest number of friends in the same classes during the four years of undergraduate education occurs in freshman year, with a cumulative total of 2355 friends. As the grades progress, the number of friends in the same class begins to decrease, dropping sharply to 1287 cumulative friends in sophomore year, and continuing to decrease to 251 and 143 friends in the same class in junior and senior years. This further confirms the objective fact that the social networks of class-scale university students change, i.e. that class members tend to interact positively with each other in the lower grades, while in the upper grades they tend to interact distantly with each other.

3.2. Quantitative Analysis of Changes in the Structure of Class-Scale Social Networks among University Students of Different Majors over Time

Two evaluation indicators of average clustering coefficient (Acc) and node degree (Lnodes) were used to further assess the evolutionary characteristics of the social network structure of university students at different professional class scales over time. The results of the study show a decreasing trend in Acc and Lnodes values of social networks in all classes from lower to higher grades (Figure 6). In freshman year, the values of Acc and Lnodes varied from 0.82 to 0.98 and 4.9 to 8.3, respectively, while in senior year the values of Acc and Lnodes varied from 0.23 to 0.61 and 1.8 to 3.8, respectively. Especially in GIS classes, the values of Acc and Lnodes in the lower grades were scored as 0.89 and 8.9, and in the senior year, they dropped to 0.23 and 1.8 by senior year 4, respectively. The above findings further support our previous view that the interpersonal relationships of class members in all surveyed five professional classes, tended to become more distant as the grade level increased, and the class-scale social network structure tended to loosen.

3.3. Factors Influencing Changes in Class-Scale University Students' Social Network Structures

We further collated and summarized the questionnaires to study the ways in which university students make friends, and found that class members make friends mainly through four ways: through the same dormitory, team competitions, social activities and hometown gatherings. The greatest influence of dormitory friendships on relationship class members' interactions was found, with team events and club activities in the middle and the smallest proportion of students making friends through hometown gatherings (Table 1).

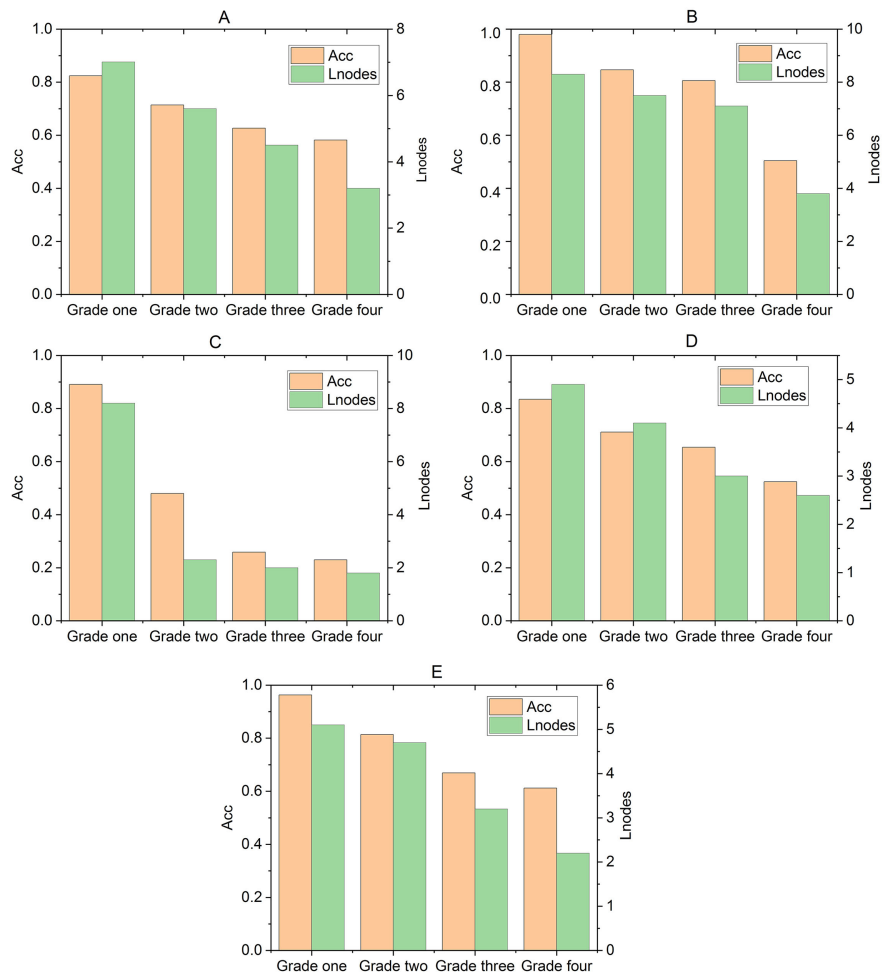


Figure 6. Social network structure parameters of average clustering coefficient (Acc) and node degrees (Lnodes) for university students of different majors and grades. Capital letters of A, B, C, D and E stand for majors of natural geography, human geography, geographic information system, real estate management and engineering cost, respectively.

The fact that dormitory friendships have become a key factor in driving class members to make friends can be explained by the following objective reality. In the colleges surveyed, most of the dormitories are four-roomed or two-roomed, thus the number of friendships made through dormitories is three or less, and the fact that they spend the most time with their housemates and with each other makes the dormitory a place where students feel they belong. In addition to housemate relationships, team events and club activities are also important factors in influencing class members' friendships. Groups of students who take part in competitions and club activities tend to do so in small groups and can therefore gain many friends. Having common interests is particularly important in making friends among university students, and the most important factors are similar personalities and mutual comfort. College students who will participate in unified competitions or clubs are like-minded in one way or another and can easily become close friends.

Table 1. The impact of social pathways on the number of friends made by class members.

Grade level	Number of friends	Social pathway			
		Roommate relation	Team events	Club activity	Hometown gathering
Grade one	1 - 3	376	111	102	45
	3 - 5	0	20	33	3
	5 - 7	0	7	17	1
	7 - 9	0	3	9	0
	>9	0	5	15	0
Grade two	1 - 3	210	33	67	21
	3 - 5	0	9	23	1
	5 - 7	0	6	3	1
	7 - 9	0	4	6	0
	>9	0	3	9	1
Grade three	1 - 3	57	15	26	6
	3 - 5	0	7	4	0
	5 - 7	0	2	4	1
	7 - 9	0	1	0	0
	>9	0	1	2	0
Grade four	1 - 3	21	10	5	4
	3 - 5	0	0	1	1
	5 - 7	0	0	1	0
	7 - 9	0	0	0	0
	>9	0	0	0	0

4. Discussion

Classes are the basic unit in which university students learn and carry out their social activities in higher education. Maintaining positive social activities within class members is important for the healthy development of university students (Cornelius, 2007; Gerda et al., 2015). Our findings show that the social network structure of university students progresses from tightly connected nodes to sparse nodes on a scale from lower to higher classes, suggesting that senior university students are relatively less motivated and proactive about dating activities than their lower classmates. The reasons for this phenomenon may be related to the current situation of higher education in China. Since the marketisation of Chinese higher education, Chinese universities have expanded massively, and by 2020 the number of Chinese university graduates have reached millions. The large number of university graduates greatly increases the competitiveness and difficulty of employment. As a result, in order to increase the employment rate

of university students, Chinese universities have focused on educating students from their junior year onwards on examinations and vocational qualification examinations, while neglecting to provide ongoing teamwork education for senior students, especially in local general education universities in China. As a result, many seniors become too busy preparing for graduate or professional exams to spend time maintaining friendships among class members. Active alienation from class members coupled with graduate exams, employment pressures and epidemic have become major triggers of anxiety, depression and other psychological disorders in the senior year (Hunt & Wheeler, 2010; Teh et al., 2015; Holland & Wheeler, 2016; Zhang et al., 2021).

Some suggestions are useful to promotion of the development of cohesion and collegiality among university students in order to enable them all to achieve good interpersonal relationships as well as physical and mental health and development. 1) First building students' awareness of the importance of active relationships. Teachers should focus on introverted students who are shy about making friends and extroverted students who are good at socializing, and guide the two very different personalities to socialize so that introverted students can develop a positive and progressive sense of friendship. 2) Restructuring class associations during the period when college students are slacking off on making friends. As they enter their junior and senior years, university students have established their own friendship circles and lack interest in making friends with other students in the same class, resulting in a precipitous decline in class socializing. This requires teachers to take a leading role in carefully regrouping and dividing the class into new collaborative groups to stimulate interaction.

5. Conclusion

This study analyzed the changing characteristics of the social network structures of university students at class scales over time by a complex network model to. Overall, the network structure changed over time from tightly clustered in the lower grades to loosen and isolated in the upper grades. Our findings imply that teamwork and career planning education should be sustained in Chinese higher education in order to foster a good interpersonal interaction in university classes. In the future, college student social data from more universities and more majors will be used to validate our findings.

Acknowledgements

This study is supported by Ministry of Education University-Industry Cooperation Collaborative Education Project (220505308231919) and the Natural Science Foundation of Huai'an (HABL202105).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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