# The Relationship between the Knowledge Heterogeneity and Innovation Performances of the Innovation Teams of College Students

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**Abstract**

Based on the questionnaire survey of 102 innovation teams of college students, the relationship among knowledge heterogeneity, knowledge sharing and innovation performances is studied. Empirical results show that explicit knowledge heterogeneity has a direct positive impact on innovation performance; the pseudo tacit knowledge heterogeneity not only has a direct positive impact on innovation performance, but also affects the innovation performance through the mediating effect of knowledge sharing; the true tacit knowledge heterogeneity has negative impact on innovation performance, and knowledge sharing is also an intermediate variable between the two.

## 1. Introduction

"Mass entrepreneurship and innovation" was written into the report on the work of the government of 2015. Innovation is not only the inherent requirements of the new normal of the Chinese economy, but also the pursuit of the common value of the whole society. College students, as the inheritor of knowledge and builders of the future society, need to enhance their awareness and ability of innovation. That is the permanent driving force to constantly create new discoveries and catch up with the world's advanced productive forces. So it is an important task for the universities and governments to stimulate and encourage their innovation activities. In the face of fierce market competition, comprehensive and complex innovation, individual college student's knowledge and ability is not enough. People use team as heterogeneous and complementary resources. The height of the task interdependence production mode has become the first choice to recruit more capable personnel, creative and innovative.

The purpose of the university students' innovation team is to use the exchange of different knowledge among the members, to realize the innovation of technology or ideas. Therefore, in the professional background, knowledge and skills, values, innovation and other aspects of the differences between the members of the team is essential to the innovation team. The complexity of the innovation work makes the team have to rely on the heterogeneity of different knowledge to complete. On the basis of integrating multi domain knowledge to enable the team to get a broader perspective of the problem, stimulate creative thinking, enhance the team's ability to innovate and promote innovation performance. Therefore, it is particularly important to study the relationship between knowledge heterogeneity and innovation performance.

## 2. Theoretical Basis and Research Hypothesis

### 2.1 Theoretical Basis

Knowledge heterogeneity refers to the differences among team members in the knowledge background, knowledge structure and cognitive style (Ni, 2010). According to whether the knowledge can be expressed clearly and effectively, the knowledge can be divided into two categories, explicit knowledge and tacit knowledge. For further study, Wang Yingluo divides tacit knowledge into pseudo tacit knowledge and true tacit knowledge. Pseudo tacit knowledge can be transferred by natural language or other common modulation, or by way of connecting learning; True tacit knowledge only can be transferred through connecting learning limitedly (Wang, 2002). This classification clearly describes the connotation of knowledge heterogeneity, and it is helpful to understand the influence of knowledge heterogeneity on innovation performance in a more detailed way.

Knowledge heterogeneity can be described as a "double-edged sword for the team" (Horwitz & Horwitz, 2007). Some scholars believe that knowledge heterogeneity may have a negative impact on innovation performance. In this kind of research, the theory of social classification is widely used, according to the "similar to attract" paradigm, individuals with the same attributes tend to have higher mutual recognition (Byrne, 1971). And it is easy to give priority to the team and the members of their own similar exchanges. Therefore, knowledge heterogeneity may lead to the formation of small groups within the team, due to population stratification, effects of team communication, and even cause tensions between the team members, and ultimately undermine the members of team goals and cooperation, adversely affect the team's output.

Positive views are mainly based on information process and cognitive resources. Information process view is that heterogeneity knowledge is beneficial for the team members to come into with different scenarios, vision and information, which helps individuals to generate innovative ideas at the individual level (Yao, 2012). The basic logic of cognitive resource view is members of the team will have different knowledge which form a larger pool of knowledge, provide more ideas and increase the cognitive resources, so knowledge heterogeneity and team task tend to promote team performance (Bell, Villado, & Lukasik, 2011).

According to the research of innovation performance, the authors firstly put forward the innovation performance is Jassen and Yoeren Van. They believe that innovation performance is the formation, development and implementation of new ideas from employees, department or organization (Janssen & Van Yoeren, 2004). At present, the definition of team innovation performance can be summarized into three aspects. First, the results oriented definition pay attention to the output record of the specific work functions or activities in a specific period. Second, the behavior oriented definition is that performance is related to the individual or organizational effectiveness, the employee's teamwork, and some of the situational elements and process elements that are very important to the organization. Third, the innovation performance is not only the result of behavior, but also the behavior of the process (Fan, 2014). In this study, the innovation performance of College Students' innovation team refers to the use of new methods and knowledge to solve the problems in real life, and finally to obtain innovative achievements.

### 2.2 Research Hypothesis

Knowledge heterogeneity's effect on team innovation performance is not consistent. In Duan Guang and Yang Zhong's paper, empirical results show that knowledge heterogeneity is the essential foundation for innovation and has a significant effect on team innovation based on the higher level of team identity (Duan & Yang, 2014). Mao Qinli found that: the skills heterogeneity and career experience heterogeneity have a positive impact on innovation performance. The greater the heterogeneity is, the more favorable to improve the innovation performance it is (Mao, 2012). Watson et al. find that the value heterogeneity is always associated with higher conflict and lower performance (Watson, Kumar, & Michaelsen, 1993). Mo Yufeng and Xu Guofang point out that the educational background difference of the team members is easy to cause the team conflict and will eventually bring about the reduction of innovation performance (Mo & Xu, 2009). In this study, the explicit knowledge heterogeneity mainly refers to the differences among the academic background, professional knowledge and other aspects; this type of heterogeneity is more obvious to be clearly identified. The pseudo tacit knowledge heterogeneity refers to the differences in the work experience, methods and logic, which can influence each other in the work and complete the mutual transfer of pseudo tacit knowledge. Finally, the differences in the values, ways of thinking and acting style is called the true tacit knowledge heterogeneity. It is difficult to understand and not easy to change, which hinder the communication between members and cause interpersonal conflict.

To sum up, put forward the following hypothesis:

H1: Knowledge heterogeneity has a significant impact on innovation performance.

H1a: Explicit knowledge heterogeneity has a significant positive effect on innovation performance.

H1b: The pseudo tacit knowledge heterogeneity has a significant positive effect on innovation performance.

H1c: The true tacit knowledge heterogeneity has a significant negative impact on innovation performance.

Knowledge sharing that the behavior of the knowledge exchange and transformation can effectively solve the problems or complete the tasks (Wang & Noe, 2010). Soekijad et al. think that the heterogeneity of knowledge will promote the exchange and perspective of communication (Soekijad & Andeiesse, 2003). Ni Xudong and Li Xianan suggest that greater the knowledge heterogeneity is, richer the knowledge resources is in the innovation team. So the team will have more chance to knowledge sharing (Li & Ni, 2012). The research of Sun Kai shows that if the innovation team has great degree of knowledge heterogeneity, it will have more need to share

knowledge (Sun, Liu, & Liu, 2016). Besides, the true tacit knowledge heterogeneity is difficulty for members to understand, so it may form the information communication obstacle which have some adverse effects on team knowledge sharing.

To sum up, put forward the following hypothesis:

H2: Knowledge heterogeneity has a significant impact on knowledge sharing.

H2a: Explicit knowledge heterogeneity has a significant positive effect on knowledge sharing.

H2b:The pseudo tacit knowledge heterogeneity has a significant positive effect on knowledge sharing.

H2c: The true tacit knowledge heterogeneity has a significant negative impact on knowledge sharing.

The full knowledge exchange and communication among team members can effectively transform the large amount of knowledge resources to the innovation results (Van Knippenberg, De Dreu, & Homan, 2004). Ginkel Van confirms that the heterogeneous teams with full knowledge sharing may have higher decision quality (Van Ginkel & Van Knippenberg, 2003). Hou Nan believes that only when the team members are willing to share their knowledge, can the team's resources be fully utilized and is it good for innovation performance improving (Hou, Yang, & Dai, 2016). As a result, knowledge sharing is an integral part of the innovation process, which plays an important role in innovation performance.

To sum up, put forward the following hypothesis:

H3: Knowledge sharing has a significant positive impact on innovation performance.

Based on the above elaboration, it is not difficult to find in the team knowledge sharing may be an important process when transforming different individual knowledge into team knowledge.

Therefore, put forward the following hypothesis:

H4: Knowledge sharing plays an intermediary role between knowledge heterogeneity and innovation performance.

H4a: Knowledge sharing plays an intermediary role between explicit knowledge heterogeneity and innovation performance.

H4b: Knowledge sharing plays an intermediary role between pseudo tacit knowledge heterogeneity and innovation performance.

H4c: Knowledge sharing plays an intermediary role between true tacit knowledge heterogeneity and innovation performance.

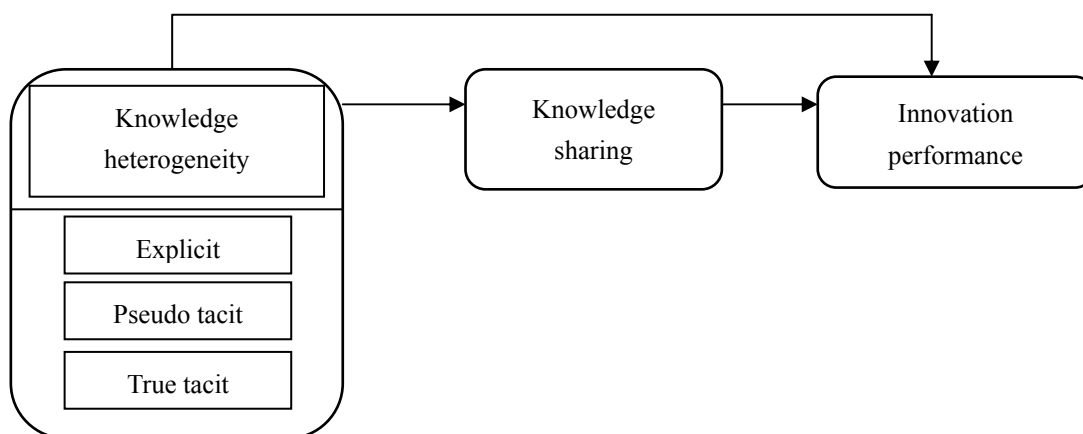The preliminary conceptual model is showed in Figure 1.



Figure 1. A preliminary conceptual model

## 3. Research Design

The innovation teams are composed of college students with common development goals, exploring to transform the knowledge into practice. Their features are autonomy, openness, complementary and innovative (Li & Gan,

2014). For the convenience of data collection, this study is mainly aimed at the innovation teams who has attended the "Challenge Cup" competitions. These teams have the following characteristics: interdisciplinary, combination of Arts and Science, not familiar with each other and have low degree of information in the early establishment, task interdependence which needs close cooperation (Li & Zhang, 2007). 130 teams from some universities in Jiangsu Province has participated in this survey and each team has 2 members to fill in the questionnaire. Questionnaire has two versions: paper and network. After releasing, filling and recycling, finally 204 valid questionnaires, 102 sets are collected.

The basic information of the sample is as follows: Men accounted for 56.76%, girls accounted for 43.24%. Freshmen accounted for 8.85%, 36.42% is the sophomores, the junior students accounted for 38.20%, 5.63% is the senior students, and the graduate student accounted for 10.9%. About team size, most teams are 5-6 people, the proportion reached 53.35%, 7-8 people accounted for 25.54%, 9-10 accounted for 21.11%.

All the measurement scales are from the previous mature scale and the Likert5 points scoring method was adopted. Table 1 shows the details.

Table 1. Summary of variables

| Variable | DIMENSION | Cronbach's Alpha |
|---|---|---|
| Independent variables: knowledge heterogeneity | explicit ($X_1$) | 0.887 |
| | pseudo tacit ($X_2$) | 0.812 |
| | true tacit ($X_3$) | 0.770 |
| Mediator variable: | knowledge sharing(W) | 0.911 |
| Dependent variables: | innovation performance(Y) | 0.890 |

From the table, all the Cronbach's Alpha are greater 0.7. So we can know, the reliability of each measurement scale is completely satisfied which is necessary for the further analysis.

All scales are from the mature scales, thus exploratory factor analysis (EFA) is not needed. Because the reliabilities of all scales met the requirement, it is only necessary to carry out confirmatory factor analysis (CFA). The CFA results show that all the factor loading are between 0.47~0.91. The absolute fit index is $\chi 2/df< 2$, RMSEA<0.08 and the relative index are NFI> 0.9, IFI> 0.9, CFI> 0.9. On the whole, the model fits better.

After finishing the basic test, a preliminary analysis of the study variables should be carried out. Pearson correlation coefficient is always used to test the correlation. The correlation coefficient value ought to be between -1 to 1. Over zero means the positive correlation, otherwise it means the negative correlation. TableⅡ shows the results of correlation test.

Table 2. The results of correlation test

| variable | X1 | X2 | X3 | W | Y |
|---|---|---|---|---|---|
| X1 explicit | 1 | | | | |
| X2 pseudo tacit | .428** | 1 | | | |
| X3 true tacit | -.422** | -.263** | 1 | | |
| W knowledge sharing | .535** | .412** | -.433** | 1 | |
| Y innovation performance | .568** | .486** | -.474** | .573** | 1 |

PS: ** indicates a significant correlation at the 0.01 level (two tailed tests), *indicates a significant correlation in the 0.1 (two tailed test)

Table 2 shows that the correlation coefficients of three dimensions of knowledge heterogeneity and innovation performance are 0.568, 0.486, -0.474, and all P are less than 0.01. So H1a, H1b, H1c hypothesis is verified, which also further proves the establishment of H1. As the same, the correlation coefficients of three dimensions of knowledge heterogeneity and knowledge sharing are 0.535, 0.412, -0.433, and all P are less than 0.01. This also means H2a, H2b, H2c are verified, and H2 is established. Because the correlation coefficient of knowledge

sharing and innovation performance is 0.573, and P<0.01, H3 is verified too. Based on the above, in order to verify whether the hypothesis that knowledge sharing has the mediating effect is established, the next section will use AMOS software to test the mediating effect.

## 4. Data Analysis and Results

The concept system and test procedure of mediation proposed by Baron and Kenny are widely accepted by scholars (Iacobucci & Li, 2012). The specific test steps are: (1) Construct regression model with independent variables and dependent variables 1: Y=cX+e1, the coefficient c should be significant; (2) Construct regression model with independent variables and intermediary variables 2: M=aX+e2, the coefficient a should be significant; (3) construct regression model with independent variables, dependent variables and intermediary variables 3: Y=c'X+bM+e3, the coefficient b should be significant; (4) the last step is to compare c' and c; On the basis of the first three conditions be met, if the c' is reduced and no significant, there is a complete mediation effect; If c' has reduced but still significant, then it indicates that there is a partial intermediary effect.

For further analysis, this section will use the AMOS22.0 to draw a whole model (Figure 2). All the coefficients of the 6 paths in the whole model reach significant levels, which indicate that the model is of good quality.
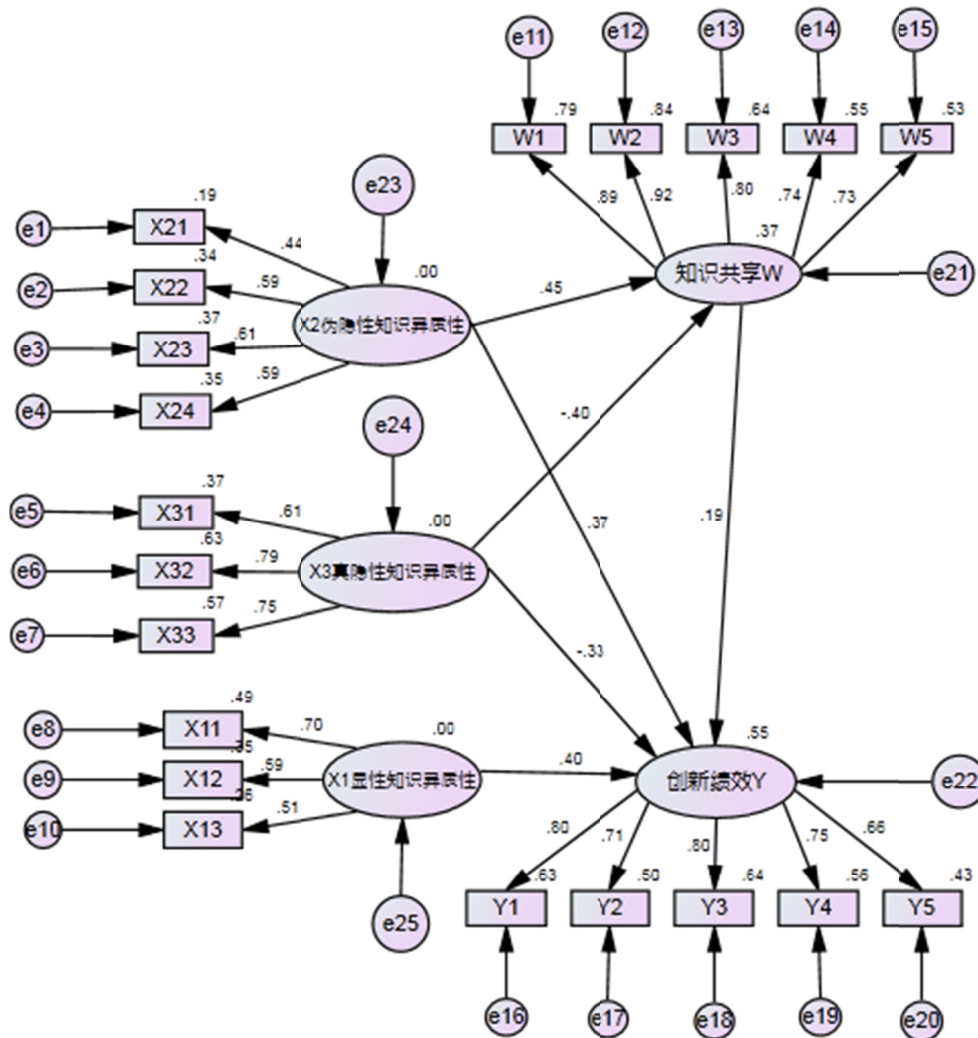


Figure 2. All paths analyses of intermediary effect

Figure 2 shows that the mediating effect of knowledge sharing between explicit knowledge heterogeneity and innovation performance is not significant. A possible explanation is that explicit knowledge heterogeneity the main differences among the professional knowledge, skills and so on can easily lead to the professional division

of labor, and make the different professional members be responsible for the different modules of the work. This makes no explicit knowledge sharing between members. In general, the explicit knowledge heterogeneity has a direct positive effect on the innovation performance. Knowledge sharing has no mediating effect between explicit knowledge heterogeneity and innovation performance. In addition, knowledge sharing plays a partial intermediary role between the pseudo tacit knowledge heterogeneity and the innovation performance, the true tacit knowledge heterogeneity and the innovation performance. In other words, the pseudo tacit knowledge heterogeneity and the true tacit knowledge heterogeneity not only affect the innovation performance directly, but also affect the innovation performance through knowledge sharing.

## 5. Conclusion and Prospect

Innovation is an interactive learning process, and diversity is an important condition for promoting innovation. The diversity of knowledge is the basis of innovation and the members' interaction and cooperation is the key to improve the innovation performance. Through the questionnaire survey, collecting the relevant data, and analyzing, this research find that explicit knowledge heterogeneity influences the innovation performance directly and positively. Moreover, the two kinds of tacit knowledge heterogeneity have both direct and indirect effect on innovation performance. These effects are all negative. On these conditions, the mediation models are established.

Although this study is based on many previous researches, due to the limitation of research ability and other resources there are still some deficiencies. First of all, there are many factors that affect the innovation performance. In the future it is necessary to enrich the numbers of intermediary variables. Secondly, because of the limitations of research funds and energy, the scope of questionnaire investigation is limited. Expanding the sample range and enriching the capacity of the sample is also needed. Finally, the data used in this study just reveal the static phenomenon. Researchers may try to use sequential tracking method to explore the dynamic evolution of innovation team operation and research the influence factors in different periods.

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