Team Heterogeneity on Effectiveness Accordingly Team Management

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Abstract

This study mainly presented influencing factors of science and technology innovation team effectiveness and their relationships. The questionnaire method has been used to survey team members from the innovation and entrepreneurship teams at Taiyuan Institute of Technology of China, to explore the factors affecting team effectiveness; clarify the relationship between team heterogeneity and team effectiveness; establish the internal mechanism of team heterogeneity affecting team effectiveness and explore mediating mechanisms affecting team effectiveness. Through quantitative analysis, it is found that team heterogeneity and team interaction among team factors have an impact on team effectiveness. Based on the findings, conclusions are drew. Team heterogeneity not only directly affects team effectiveness, but also indirectly affects team effectiveness through team interaction.

Keywords: Team Heterogeneity, Team Management, Effectiveness

Introduction

A team is not a group of people mechanically combined together, but an organization with a clear division of labor and an organic combination of them (Robbins, S.,2014). Any team is composed of a variety of members, each of whom has different values, ways of thinking, and plays different roles in the team. Team heterogeneity refers to the diversity of characteristics among team members (Peng & Chen, 2014). The role of team heterogeneity is positive (Hou & Yang, 2016). Good team interaction can increase team communication, enhance cohesion, mobilize the enthusiasm and initiative of team members, resolve conflicts and work together to achieve work goals. The team itself is relatively independent and has its own code of conduct and action plan (Xiao, 2006). Team management means that managers

must coordinate others and cause groups to work together to achieve the set goals. (Shi, 2019). There are relatively few studies on the effectiveness of college students' innovative and entrepreneurial teams. In order to promote the development of innovation education, China has launched “the education and training program for outstanding engineers” (Liu & Zhang, 2014). As a flexible team organization, college students' science and technology innovation team should be further paid more and more attention and more in-depth research.

To sum up, with the continuous implementation of the policy of mass innovation and entrepreneurship, college students have become an emerging force for innovation and entrepreneurship. The main purpose of this paper is to building a high-quality team of college students, exploring the internal mechanism of team heterogeneity, team interaction and team effectiveness, which is a new attempt in the field of college students' team and also hopes to directly promote the improvement of the effectiveness of college students' scientific and technological innovation team.

Research Objectives

1. To explore the factors affecting team effectiveness.
2. To clarify the relationship between team heterogeneity and team effectiveness.
3. To establish the internal mechanism of team heterogeneity and team interaction affecting team effectiveness..

Conceptual Framework

The author defines the research conceptual framework based on the theory of team management. The details are as follows.

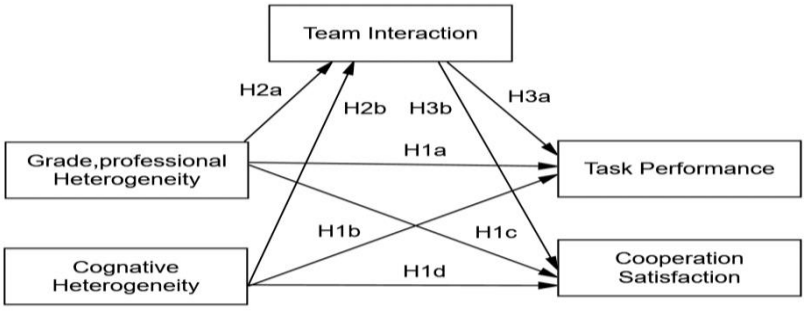


Figure1 Conceptual Framework

Source: Original research

Research Hypothesis

H1: Team heterogeneity has a positive impact on team effectiveness.

H1a: Grade, professional heterogeneity has a positive effect on task performance.

H1b: Cognitive heterogeneity has a positive effect on task performance.

H1c: Grade, major heterogeneity has positive influence on cooperation satisfaction.

H1d: Cognitive heterogeneity has a positive effect on cooperation satisfaction.

H2: Team heterogeneity has a positive effect on team interaction.

H2a: Grade, major heterogeneity has positive influence on team interaction.

H2b: Cognitive heterogeneity has a positive effect on team interaction.

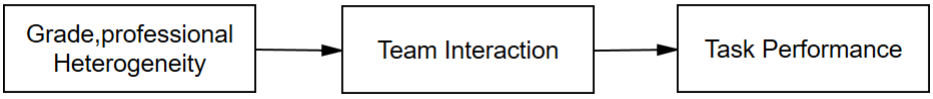
H3: Team interaction has positive influence on team effectiveness.

H3a: Team interaction has a positive effect on task performance.

H3b: Team interaction has positive influence on cooperation satisfaction.

H4: Team interaction plays a positive mediating role between team heterogeneity and team effectiveness.

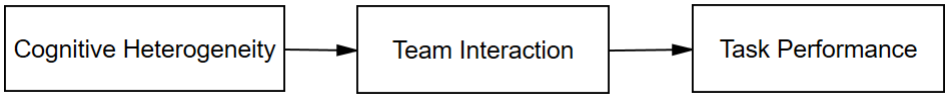
H4a: Team interaction plays a positive mediating role between grade, major heterogeneity and task performance.



H4a

Figure 2 Conceptual model of H4a

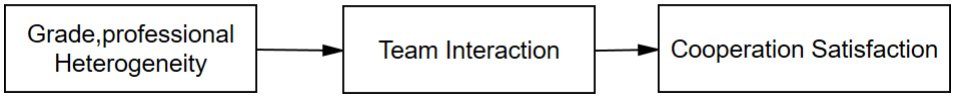
H4b: Team interaction plays a positive mediating role between cognitive heterogeneity and task performance.



H4b

Figure 3 Conceptual model of H4b

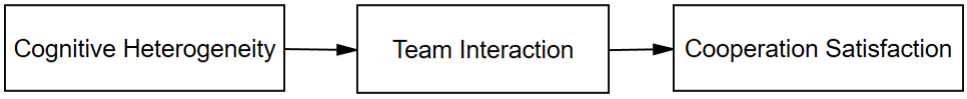
H4c: Team interaction plays a positive mediating role between grade, professional heterogeneity and cooperation satisfaction.



H4c

Figure 4 Conceptual model of H4c

H4d: Team interaction plays a positive mediating role between cognitive heterogeneity and cooperation satisfaction.



H4d

Figure 5 Conceptual model of H4d

Research Methodology

Research Design. The research strategy of this study was quantitative. Firstly, determine and measure research variables. Secondly, explore the relationship among research variables, the hypotheses are verified by questionnaire survey and structural equation model. Thirdly, according to the verified hypothesis, the path to promote the team effectiveness of college students is proposed. The reliability and validity of the scale were passed.

Population and sample size. The finite population is the innovation and entrepreneurship team of all college students in Taiyuan Institute of Technology, roughly 12000. Random sampling method will be used. The sample of the questionnaire survey are 410 team members from the innovation and entrepreneurship team of all college students in Taiyuan Institute of Technology.

Research Method. The questionnaire survey is used. In the questionnaire, a five-point likert measurement method has been used. The reliability and validity of questionnaire is rational. The specific form of the questionnaire is star, and the time for answering the questionnaire is 10-15 minutes. Three variables have been measured, including Team Effectiveness (TE) (Chen & Yang, 2015), Team Heterogeneity (TH) (Zou, 2017), Team Interaction (TI) (Bai, 2018).

Expected Finding

Reliability Analysis. Cronbach's Alpha coefficient is used to test the internal consistency reliability of the scale. Cronbach's Alpha coefficient above 0.7 indicates good internal consistency reliability. The overall reliability of team heterogeneity scale, team interaction scale and team effectiveness scale are respectively 0.848, 0.933 and 0.786. CITC results show that the test results are not lower than 0.5. All the above indicators meet the requirements, indicating that the scales have a high level of reliability.

Confirmatory Factor Analysis. The team heterogeneity scale includes grade, speciality heterogeneity(GSH) and cognitive heterogeneity(CH), which are measured by 5 and 3 observed questions respectively. The aggregation validity test of the model is shown in Table1, and the fitting indexes of the model all meet the reference standards, indicating that the model fitting is acceptable. The normalized factor loading λ values of all observed variables are greater than 0.5. The CR values of grade, professional heterogeneity and cognitive heterogeneity are 0.797 and 0.791 respectively, which are higher than the critical value of 0.7. The AVE values are 0.442 and 0.559, which are close to or greater than the critical value of 0.5. This indicates that the aggregation validity of team heterogeneity scale is good.

In addition, the team heterogeneity scale is a multidimensional scale, and its discriminant validity is also tested in the study, as shown in Table2. The square root values of AVE of each potential variable are shown in bold on the diagonal. It can be found that the square root value of AVE of each potential variable is close to the correlation coefficient between AVE and other potential variables, indicating that the scale of team heterogeneity has good discriminative validity.

Table 1 Team Heterogeneity Formal Scale Aggregation Validity Test

Latent Variables	Observational Variables	λ	S.E.	C.R.	CR	AVE
Grade, Speciality Heterogeneity	GSH1	.77	-	-	.797	.442
	GSH2	.66	.067	12.278		
	GSH3	.65	.075	12.115		
	GSH4	.63	.068	11.721		
	GSH5	.60	.083	11.239		
Cognitive Heterogeneity	CH7	.76	-	-	.791	.559
	CH8	.78	.045	13.737		
	CH9	.70	.053	12.746		
Overall Fitting Indexes	χ2/df (<3)=2.494, RMSEA (<0.08)=0.061,RMR (<0.05) =0.018, GFI (>0.9)=0.973, AGFI (>0.9)=0.949, CFI (>0.9)=0.974, NFI (>0.9)=0.958, TLI (>0.9)=0.962					

Table 2 The Team Heterogeneity Scale Discriminative Validity Test

Latent Variables	Grade, Professional Heterogeneity	Cognitive Heterogeneity
Grade, Speciality Heterogeneity	.665	
Cognitive Heterogeneity	.76	.748

Similarly, aggregation validity and discriminant validity of team interaction scale and team effectiveness scale are good.

Correlation Analysis between Variables. Descriptive statistical analysis is conducted for each research variable, as shown in Table3. The results showed that grade, speciality heterogeneity (GSH) and cognitive heterogeneity (CH) are positively correlated with team effectiveness (TE), task performance (TP) and cooperation satisfaction (CS). The overall correlation coefficient between team heterogeneity (TH) and team effectiveness is 0.686 ($P<0.01$). Grade, speciality heterogeneity and cognitive heterogeneity is positively correlated with team interaction (TI) and its dimensions, including team communication(TCOM), team cooperation(TCOO) and team cohesion(TCOH). Team interaction has significant positive correlation with team effectiveness and its dimensions.

Table 3 Descriptive Statistical Analysis and Correlation Analysis of Study Variables

	Mean	Std.	TH	GSH	CH	TI	TCOM	TCOO	TCOH	TE	TP	CS
TH	4.009	0.492	1									
GSH	4.043	0.480	.914**	1								
CH	3.952	0.665	.873**	.601**	1							
TI	3.853	0.612	.686**	.587**	.648**	1						
TCOM	3.813	0.746	.601**	.518**	.564**	.902**	1					
TCOO	3.780	0.710	.503**	.398**	.514**	.786**	.591**	1				
TCOH	3.929	0.652	.649**	.568**	.597**	.888**	.651**	.625**	1			
TE	3.982	0.555	.687**	.610**	.621**	.651**	.536**	.473**	.658**	1		
TP	3.949	0.634	.627**	.548**	.578**	.581**	.458**	.451**	.594**	.883**	1	
CS	4.014	0.625	.583**	.527**	.516**	.565**	.485**	.381**	.565**	.879**	.552**	1

Analysis of the Direct Effects of Team Heterogeneity on Team Effectiveness. The results showed that grade, specialty heterogeneity and cognitive heterogeneity have a positive

direct impact on task performance and cooperation satisfaction of the two dimensions of team effectiveness. After AMOS operation, the fitting results of the model are as follows: χ2/df=4.437, RMSEA=0.092, RMR=0.094, GFI=0.911, AGFI=0.871, CFI=0.872, NFI=0.842, TLI=0.841. Each fitting index reaches the fitting standard, indicating that the model fit well. Figure 2 shows that the standardized factor loading of the observed variables range from 0.55 to 0.80, both greater than 0.5. The standardized path coefficient of grade, specialty heterogeneity and cognitive heterogeneity on task performance are 0.55 (P <0.001) and 0.59 (P <0.001), respectively. The normalized path coefficient of grade, specialty heterogeneity and cognitive heterogeneity on cooperation satisfaction are 0.55 (P <0.001) and 0.48 (P <0.001), respectively. Each dimension of team heterogeneity has a significant positive impact on each dimension of team effectiveness, and cognitive heterogeneity has the greatest impact on task performance. Based on the above results, hypotheses H1a, H1b, H1c and H1d have been verified.

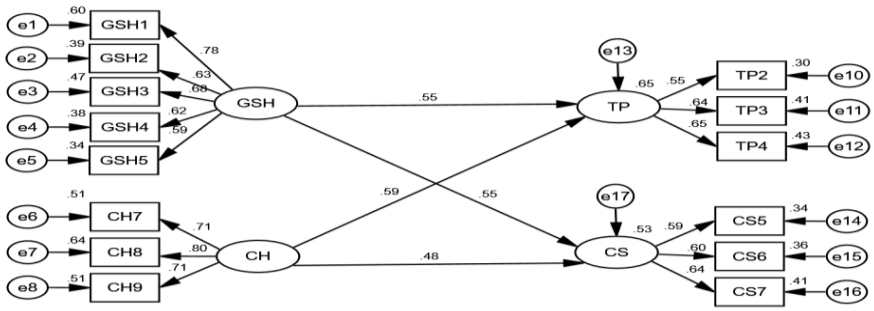


Figure 6 The direct influence model of team heterogeneity on team effectiveness
(The normalized path coefficients are shown in the figure, with P values less than 0.001)

Mediating Effect Analysis of Team Interaction. The results also showed that team heterogeneity not only directly affects team effectiveness, but also indirectly affects team effectiveness through team interaction. Based on IPO process theory, this study suggests that team interaction can play a mediating role in the relationship between team heterogeneity and team effectiveness. Because the second-order three-factor model is an exact variant and has the same fitness as the first-order model, this paper uses the second-order three-factor model of team interaction to replace the first-order model. Based on the research hypothesis proposed above, a structural equation model is constructed in this section. After calculation, the fitting index is χ2/ DF =2.528, RMSEA=0.061, RMR=0.080, GFI=0.867, AGFI=0.842, CFI=0.909, NFI=0.858, TLI=0.899. From the fitting results, the fitting degree is acceptable, as shown in Figure 3. Grade, professional heterogeneity and cognitive heterogeneity have a significant

positive impact on team interaction, and the standardized path coefficients are 0.48 (P <0.001) and 0.60 (P <0.001), respectively, hypotheses H2a and H2b are verified. Team interaction has a significant positive impact on task performance and cooperation satisfaction, with the standardized path coefficients being 0.37 (P <0.001) and 0.42 (P <0.001), respectively, hypotheses H3a and H3b have been verified. After considering the mediating variables of team interaction, grade, professional heterogeneity and cognitive heterogeneity still have a significant positive effect on task performance, and the standardized path coefficients are 0.37 (P <0.001) and 0.34, which are lower than those of the direct influence model (0.55 and 0.59). Grade, professional heterogeneity and cognitive heterogeneity still have a significant positive effect on cooperation satisfaction, and the standardized path coefficients are 0.35 (P <0.001) and 0.20, which are lower than those of the direct influence model (0.55 and 0.48). Considering the above research results, the mediating variable team interaction plays a partial mediating role in the relationship between team heterogeneity and team effectiveness to some extent.

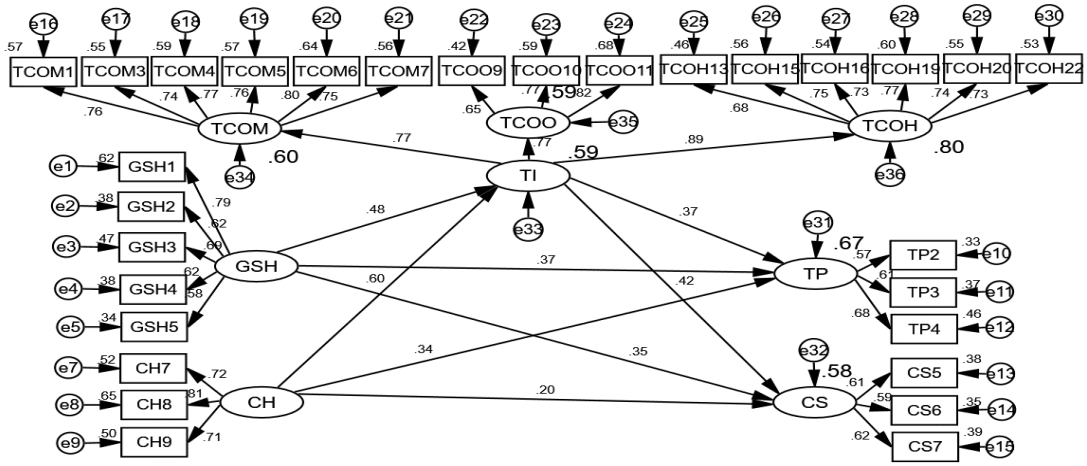


Figure 7 A mediating role model of team heterogeneity on team effectiveness

The test of the significance of the mediating effect of team interaction. Table 7 shows that the mediating effect value of grade, professional heterogeneity and cognitive heterogeneity on task performance through team interaction are respectively 0.178 (0.48×0.37) and 0.222 (0.60×0.37). The 95% confidence interval of Bootstrap test are CI (0.2209, 0.4035) and CI (0.1529, 0.2958), excluding 0, indicating that the mediation paths "grade, professional heterogeneity ⟶ team interaction ⟶ task performance" and "cognitive heterogeneity ⟶ team interaction ⟶ task performance" are significant. The mediating effect value of grade, professional heterogeneity and cognitive heterogeneity on cooperation satisfaction through

team interaction are 0.2016 (0.48×0.42) and 0.252 (0.60×0.42) respectively. The 95% confidence interval of Bootstrap test are CI (0.2101, 0.3919) and CI (0.1613, 0.3368), excluding 0, indicating that the mediation paths "grade, professional heterogeneity ⟶ team interaction ⟶cooperation satisfaction" and "cognitive heterogeneity ⟶ team interaction ⟶cooperation satisfaction" are significant.

Table 4 Bootstrap Test Results for Significance of Mediating Effects

Path	Intermediate Effect Value	95% Confidence Interval		Sig.
		Lower Limit	Upper Limit	
GSH⟶TI⟶TP	0.178	0.2209	0.4035	outstanding
CH⟶TI⟶TP	0.222	0.1529	0.2958	outstanding
GSH⟶TI⟶CS	0.2016	0.2101	0.3919	outstanding
CH⟶TI⟶CS	0.252	0.1613	0.3368	outstanding

Therefore, team interaction plays a partially mediating role in the relationship between grade, professional heterogeneity and task performance, hypothesis H4a has been verified. Similarly, Hypothesis H4b, H4c, H4d have been verified.

Discussion

1.The Direct effect of Team Heterogeneity on Team Effectiveness. From the perspective of standardized path coefficient, cognitive heterogeneity has the greatest impact on task performance, while cognitive heterogeneity has the least impact on cooperation satisfaction. This is because college students are a special group and the age difference is not very large. Although individual differences in personality may influence performance, they are not decisive. It is more the differences in perceptions and knowledge store which are generated in the later stage of the individual that cause the difference in performance. This further verifies the results of some researchers (Peng & Chen, 2014; Zou, 2017). For the college students' science and technology innovation team with large heterogeneity such as grade, specialty and cognition, the corresponding team efficiency is also high.

2.The Mediating Role of Team Interaction in the Relationship between Team Heterogeneity and Team Effectiveness. In terms of standardized path coefficient, cognitive

heterogeneity has the greatest positive effect on team interaction, followed by grade and specialty heterogeneity. This result is consistent with the previous conclusions of many scholars. Zou (2017) found that grade, major and cognitive heterogeneity would lead to more harmonious team atmosphere and higher level of interaction. Harmonious interpersonal relationship among team members and their willingness to actively share ideas and experience can motivate team members to work actively and maximize each member's subjective initiative and innovative ability, which undoubtedly plays an important role in improving team task performance and cooperation satisfaction. The results are also similar to those of previous scholars (Xia, 2017; Jingya, 2018). College students scientific and technological innovation team members attract and complement each other because of grade, specialty and cognitive heterogeneity, which promotes to form a good atmosphere, produce good interaction, motivate team members to the maximum play to the heterogeneity of diversification, and share information and resources, promote members give play to subjective initiative and creativity, ultimately benefits to the raise of task performance and cooperation satisfaction. Many scholars have found that team environment mediates the relationship between heterogeneity and effectiveness, among which team interaction is a very important mediating variable. Jingya (2018) found that team interaction played a partially mediating role in the relationship between college students' entrepreneurial team heterogeneity and team performance.

Conclusion

1.There are many influencing factors of team effectiveness, such as individual factors of team members, team factors including team heterogeneity and team interaction, school policy and environment factors, etc. This paper focuses on heterogeneity and interaction among team factors.

2.It verifies that the greater the grade, specialty and cognitive heterogeneity, the more team effectiveness will be generated.

3.The greater the heterogeneity of grade, specialty and cognition, the more favorable the formation of good team interaction.

4.Team interaction plays a significant mediating role in the relationship between team heterogeneity and team effectiveness. Specifically, team interaction plays a significant mediating role in the relationship between grade professional heterogeneity and cognitive heterogeneity and team effectiveness.

New Knowledge

1.Through qualitative research, it is found that the influencing factors of team effectiveness include individual factor, team factor and school policy environment factor.

2.Through quantitative research, it is found that the independent variable team heterogeneity includes grade, professional heterogeneity and cognitive heterogeneity, the dependent variable team effectiveness includes task performance and cooperation satisfaction, and the mediating variable team interaction includes team communication, team coordination and team cohesion.

3.Quantitative research shows that team heterogeneity has a positive impact on team effectiveness. Team interaction partially mediates the relationship between team heterogeneity and team effectiveness. The mechanism is shown in Figure 4.

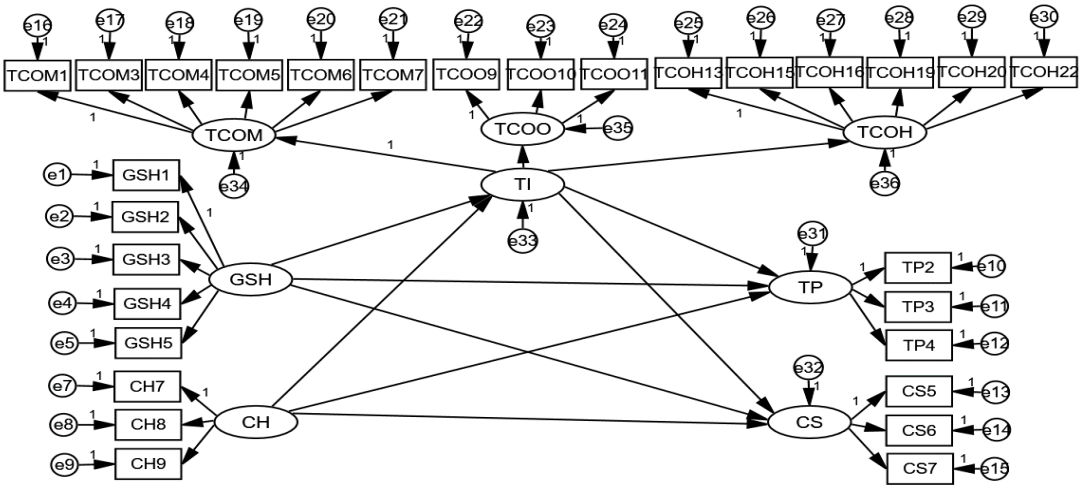


Figure 8 Effect mechanism of team heterogeneity on team effectiveness

Recommendations

1. Team construction should pay attention to the grade, specialty and cognitive heterogeneity of members

How to ensure team heterogeneity should be fully considered (Ren, Mao & Zhang, 2019). College students should pay attention to the differences in grade, professional knowledge and cognition when constructing the team of innovation and entrepreneurship training project, because these differences can bring positive promotion effect. First of all, although there is little difference in age among college students, we should try to include members from different grades in team construction. Secondly, the difference in professional knowledge background among team members is a valuable asset in team innovation.

Differences in professional knowledge help team members better understand the work they are engaged in and the tasks they undertake. When each member can give full play to their strengths and avoid shortening, the overall performance of the team will be greatly improved. Finally, when college students build their own teams, they must attach importance to the cognition of members and try their best to select those with great cognitive differences to join the team.

2. Give full play to the expanding effect of team interaction and improve the quality of team members' interaction

Teams with good communication, orderly team coordination and strong team cohesion are more conducive to the improvement of team effectiveness. First of all, good communication can not only enhance the friendship between team members, enhance the connection of social emotional bonds, reduce unnecessary conflicts and contradictions, but also conducive to team members' understanding of work objectives, promote cooperation and collaboration among members, and improve work efficiency. Secondly, team coordination is a key indicator to measure the tacit understanding of team members. Team coordination can maximize the use of resources, information, and wisdom available to each member. Finally, team cohesion is an important symbol to reflect the overall strength of a team. Strong team cohesion can increase the pride and recognition of members, and also can maximize the ability and level of members.

3. Establish a long-term mechanism for training and evaluating complex and innovative talents

Whether the innovation system from science or technology is evolving towards the direction of complex ecology, it is far from enough to rely only on the "top-down" coordination. With the emergence of innovation, the ecology of innovation system is bound to have another "bottom-up" mode, with the active participation of team members. Universities should vigorously cultivate interdisciplinary scientific research talents. The cultivation of compound innovative talents needs to start with the education of primary and secondary schools, and form an ecological chain of talent cultivation from the encouragement of higher education. To form a stable team of high-level instructors (Ren, 2018). Talent is not created, but emerges naturally. As long as we provide a good environment and mechanism, we are not afraid of failing to cultivate innovative talents.

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