Research on the Impact of School-Enterprise Cooperation on the Training Effect of Engineering Talents

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Abstract. This paper took the high-tech enterprises with school-enterprise cooperation project in Shandong Province as the research object to explore the influence of three factors, including school-enterprise cooperation input, school-enterprise cooperation output and environmental support, on the training effect of engineering talents. Striving to propose corresponding improvement measures to eliminate cooperation barriers, break discipline barriers, and improve training results. Regression analysis was used to test the influence on the training effect of engineering talents. Bootstrapping and hierarchical regression were used to test the mediating effect of main body behavior and the regulating effect of cooperation model. It was found that all three factors had a significant positive effect on the cultivation effect, the main behavior had a significant mediation effect and the school-enterprise cooperation model has a positive regulatory effect. It proposed the establishment of strategic alliances and guarantee mechanisms to ensure the cultivation effect.

1. Introduction

In the international context of the new industrialization, high-level engineering talents are important parts of human resource guarantee for China to build an innovation-oriented country. Cooperation between the two training subjects of school and enterprise is to foster the training of engineering talents. With the in-depth development of the technological revolution and increasingly fierce international competition, this model needs to be reformed to meet the requirements of the development of the new industrial revolution. Based on the original quality of engineering talents, it will further improve the knowledge integration and global vision. [1]

The existing engineering talent training mechanism is based on the school-enterprise cooperation model, which mainly studies the cooperation model between higher vocational colleges and enterprises, and lacks relevant research focusing on the engineering talent training effect, technological innovation ability and scientific management ability as the standard for engineering students' training effect. [2]

Therefore, combined with the current situation of scarcity of high-level engineering talents in China, this paper would focus on studying the effect of cooperation on the cultivation of such talents through quantitative analysis.

2. Research Hypotheses

2.1. The Effect of School-Enterprise Cooperation on Talent Training

The school-enterprise cooperation is that the two main bodies of talent cultivation gather according to a certain internal relationship. Such regional gathering of talents will change the spatial layout of regional technology, knowledge capital, and human capital; promote deep-level collaboration in regional innovation activities. At the same time, good environmental support will increase the confidence of cooperation between schools and enterprises, which is conducive to the cultivation of engineering,
scientific and technological personnel with high efficiency and high quality. The cultivated technological achievements can be transformed into productivity only under the high degree. A high number of patent applications guarantee the subsequent development of cooperation.

H1: School-enterprise cooperation investment has a positive impact on the training effect of engineering talents.

H2: The Environmental support of school-enterprise cooperation has a positive impact on the training effect of engineering talents.

H3: School-enterprise cooperation output has a positive impact on the training effect of engineering talents.

2.2. The Mediating Role of Subject Behavior on the Relationship between School-Enterprise Cooperation and Talent Training Effect

In the process of school-enterprise cooperation, universities invest resources in knowledge, technology, and patents; companies provide equipment, places, and funds. These resources can not only directly promote the improvement of personnel training results, but also through the improvement of the partners' own capabilities affect training quality. The patent works produced by the cooperation are more conducive to being transformed into commercial products under the condition that parties have anti-risk capabilities, the economic benefits obtained improve the effect.

H4: The behavior of school-enterprise cooperation has a mediating effect on the relationship between cooperation investment and the training effect of engineering talents.

H5: The behavior of school-enterprise cooperation has a mediating effect on the relationship between environmental support and the training of engineering talents.

H6: The behavior of school-enterprise cooperation has a mediating effect on the relationship between the cooperation output and the training effect of engineering talents.

2.3. Moderating Effect of Cooperation Mode on the Relationship between School-Enterprise Cooperation and Talent Training Effect

Strengthening the cooperative relationship between the two parties of cooperation will more directly help the cooperation subjects to understand each other's internal conditions, which is good to trust in the long-term cooperative partnership between the two parties. The increase of school-enterprise cooperation input and the convenience of resource sharing for output promote the cooperation process towards expectations, thereby improving the effect of cooperation.

H7: The cooperation mode has a positive regulating effect on the relationship between school-enterprise cooperative investment and cooperative training effect.

H8: The cooperation mode has a positive regulating effect on the relationship between school-enterprise cooperation environment support and training effect.

H9: The cooperation mode has a positive regulating effect on the relationship between school-enterprise cooperation output and cooperation training effect.

The cooperation mode has a positive regulating effect on the training effect. The main behavior plays an intermediary role in the process of the main effect. The strengthening of the main behavior promotes the improvement of the training effect and the cooperation mode can regulate this process. By adjusting the relationship between cooperation input, output, environmental support and subject behavior, it affects the training effect. People have the technical expertise in the field of engineering technology, which can master the knowledge and make a greater contribution to society.3

H10: The cooperation mode has a positive regulating effect on the relationship between school-enterprise cooperation investment and subject behavior.

H11: The cooperation mode has a positive regulating effect on the relationship between the support of school-enterprise cooperation environment and the behavior of the cooperation subject.
H12: The cooperation model has a positive regulating effect on the relationship between school-enterprise cooperation output and the behavior of the cooperation subject. Based on the above assumptions, a hypothetical model diagram is obtained, as shown in Figure 1.

Figure 1. Hypothetical Model Diagram.

3. Empirical Design of the Impact of School-Enterprise Cooperation on the Training of Engineering Talents

3.1. Data Collection

High-tech enterprises with experience of cooperation in Shandong Province were selected as the research objects. Through the alumni, friends, and the person in charge of school-enterprise cooperation, the electronic version of the questionnaire was sent to the company's relevant technology or project leaders. In order to ensure the scientific nature of the questionnaire, fully considered the scale of the survey sample, the industry and other factors, and tracked every link of the survey to ensure the timely and effective recovery of the sample. A total of 500 questionnaires were issued and 249 were recovered. After some questionnaires were eliminated, a total of 214 valid questionnaires were recovered, with an effective recovery rate of 85.9%.

3.2. Statistics Analysis

Table 1. Descriptive Statistics.

| variable | item | N   | Mean | Standard deviation | ES  | CI  | CO  | CE  | BS  | CM  |
|----------|------|-----|------|--------------------|-----|-----|-----|-----|-----|-----|
| ES       | ES1  | 214 | 3.79 | 0.782              |     |     |     |     |     |     |
|          | ES2  | 214 | 4.06 | 0.874              |     |     |     |     |     |     |
|          | ES3  | 214 | 3.81 | 0.800              |     |     |     |     |     |     |
|          | ES4  | 214 | 3.61 | 0.959              |     |     |     |     |     |     |
|          | CI1  | 214 | 3.64 | 0.933              |     |     |     |     |     |     |
|          | CI2  | 214 | 3.92 | 0.906              |     |     |     |     |     |     |
|          | CI3  | 214 | 3.63 | 1.013              |     |     |     |     |     |     |
|          | CI4  | 214 | 3.36 | 1.108              |     |     |     |     |     |     |
|          | CI5  | 214 | 3.99 | 0.751              |     |     |     |     |     |     |
|          | CI6  | 214 | 3.85 | 0.970              |     |     |     |     |     |     |
|          | CI1  | 214 | 3.66 | 0.941              |     |     |     |     |     |     |
|          | CI2  | 214 | 3.98 | 0.843              |     |     |     |     |     |     |
|          | CI3  | 214 | 3.67 | 0.907              |     |     |     |     |     |     |
|          | CI4  | 214 | 3.00 | 0.852              |     |     |     |     |     |     |
|          | CI5  | 214 | 4.00 | 0.890              |     |     |     |     |     |     |
|          | CE1  | 214 | 3.74 | 0.889              |     |     |     |     |     |     |
|          | CE2  | 214 | 3.46 | 1.06               |     |     |     |     |     |     |
|          | CE3  | 214 | 4.2  | 0.738              |     |     |     |     |     |     |
|          | CE4  | 214 | 3.61 | 1                 |     |     |     |     |     |     |
|          | BS1  | 214 | 3.81 | 1.038              |     |     |     |     |     |     |
|          | BS2  | 214 | 3.59 | 1.047              |     |     |     |     |     |     |
|          | BS3  | 214 | 3.66 | 0.874              |     |     |     |     |     |     |
|          | BS4  | 214 | 4.01 | 0.918              |     |     |     |     |     |     |
|          | UICM1| 214 | 3.58 | 1.052              |     |     |     |     |     |     |
|          | UICM2| 214 | 3.41 | 1.094              |     |     |     |     |     |     |
|          | UICM3| 214 | 4.04 | 0.757              |     |     |     |     |     |     |
|          | UICM4| 214 | 3.9  | 0.959              |     |     |     |     |     |     |
|          | UICM5| 214 | 4.04 | 0.757              |     |     |     |     |     |     |
|          | UICM6| 214 | 3.9  | 0.959              |     |     |     |     |     |     |

Valid N (list status): 214

*** p<0.01, ** p<0.05, * p<0.1
Based on the 214 valid questionnaires, this study conducted a descriptive statistical analysis to describe the characteristics of the sample data. Table 1 shows some basic characteristics of the sample data. Indicating environmental support (ES), cooperative input (CI), cooperative output (CO), training effect (CE), subject behavior (BS), and cooperation model (UICM) and other variable samples have better dispersion degree. By analyzing the Pearson correlation coefficient, indicating the strength of the correlative relationship. It can be seen that the independent variable environmental support, cooperative input, cooperative output and the training effect of the dependent variable show a positive correlation, which are significant at the level of 0.01. There is a positive correlation between cooperative input and environmental support. The behavior of intermediary variables has a positive correlation with ES, CO, CI and TE. There is no significant correlation between the cooperative model and other variables. These correlations reflect a trend of influence and cannot favor complex relationships between variables.

In order to avoid the problem of multiple collinearity among variables that makes the independent variable unable to effectively explain the dependent variable, this study conducted a multicollinearity test between variables. The result of collinearity diagnosis is shown in Table 2: One of eigenvalues was less than 0.01, and the condition indicators corresponding to all eigenvalues were less than 30. The tolerance between variables was much greater than 0.1, the coefficient of VIF was not greater than 10, indicating that there is no serious multicollinearity between the variables.

### 3.3. Validity Test

Cronbach's and CICT indicators were used to verify the CR value. This paper used the data obtained from the recovery questionnaire for reliability analysis, and used SPSS 19.0 software to analyze each variable. The Cronbach's $\alpha$ reliability coefficient for the 28 items on the scale was 0.789. Cronbach's reliability coefficients for ES, CI, CO, CE, BS, and cooperation model (UICM) were 0.868, 0.905, 0.878, 0.799, 0.912, and 0.911. The reliability coefficient $\alpha$ values were higher than 0.7, indicating that the reliability of the research data is high. For "item deleted alpha coefficient", the reliability coefficient values of the deleted analytical items have not improved significantly, and are all lower than the Cronbach's alpha value of the variable. It indicates that all the items should be retained. For the "CITC value", the values corresponding to the analysis items were all higher than 0.5, which indicates that there is a good correlation between the analysis items, and the reliability level is good. The combined reliability CR value was calculated using the CFA method; the observed CR values were all above 0.8. So this study has good reliability.

### 4. Empirical Analysis of the Impact of School-Enterprise Cooperation on the Training Effect of Engineering Talents

#### 4.1. Analysis of Main Effects

Different from correlation analysis, regression analysis can more accurately reflect the influence of independent variables on dependent variables. This paper took school-enterprise cooperation ES, CI, CO as independent variables, and took the training effect of engineering talents as dependent variables to conduct multiple linear regression. The results are shown in table 3: The cooperation investment has a
significant positive impact on the talent training effect \( (\beta = 0.344) \), it shows that the higher the school-enterprise cooperation investment, the better the talent training effect. The environment support has a significant positive impact on the training effect of engineering talents. The output of school-enterprise cooperation has a significant positive effect on the effect of talent training, but the effect is slightly weaker than the first two variables. If we simply rank the influence of independent variables on the training effect, the impact of cooperation input is the biggest, followed by environmental support, and the impact of cooperation output is gradually decreasing. Their changes affected 34.4%, 31.5%, and 18.4% of the change of talent training effect respectively. Therefore, H1, H2 and H3 are assumed to be valid.

Table 3. Multiple Linear Regression Coefficient Table.

|  | coefficient1 | model2 | model2 | model2 |
|---|-------------|--------|--------|--------|
| trade | 0.121       | 0.136* | 0.076* | 0.131  |
| OS  | 0.020       | 0.012  | -0.019 | 0.017  |
| ES  | 0.008       | 0.001  | -0.032 | 0.015  |
| CI  | 0.344***    |        |        |        |
| ES  |             | 0.315***|        |        |

4.2. Analysis of the Mediation Effect of Behavioral Agents

By 5000 bootstrap samples (setting 95% confidence interval), the main body behavior is significantly related to the talent training effect \( (\beta = 0.2401, P = 0.0024) \); the indirect effect of cooperation input on the training effect is significant, and the 95% confidence interval did not include 0 \( (LIci = 0.0114, ULCI = 0.0992) \), so it can be considered that the main body behavior is in the cooperation output. The intermediary effect is significant with the effect of personnel training, and the size of the intermediary effect was 0.0426; the direct effect of controlling the intermediary variable cooperation input on the training effect is significant, the interval \( (LIci = 0.0851, ULCI = 0.2703) \) did not contain 0, which shows that the main behavior plays a part of intermediary role between the cooperation input and the effect of Engineering Science and technology personnel training.

By taking the subject behavior as the intermediary variable, the environment support as the independent variable, and the training effect as the dependent variable, the bootstrapping intermediary effect test was carried out and the conclusion is that after controlling the environment support, the subject behavior is significantly related to the talent training effect \( (\beta = 0.2654, P = 0.0007) \); the role of the intermediary path shows that the indirect effect of the environment support on the training effect is significant, and the 95% confidence interval did not include 0 \( (LIci = 0.0107, ULCI = 0.0877) \), so it can be considered that the intermediary effect of subject behavior between cooperation output and talent training effect is significant, the size of the intermediary effect was 0.0385; after controlling the intermediary variable, the direct impact of environmental support on talent training effect is significant, and the interval \( (LIci = 0.0717, ULCI = 0.2619) \) did not contain 0, indicating that the subject behavior in environmental support and engineering technicians play a part of intermediary role in the relationship of training effect.

The same test was carried out with the behavior of the main body of school-enterprise cooperation as the intermediary variable, the output of cooperation as the independent variable and the effect of personnel training as the dependent variable. After controlling the output of cooperation, the main behavior is significantly related to the effect of talent training \( (\beta = 0.3037, P = 0.0001) \). The 95% confidence interval did not include 0 \( (LIci = 0.0028, ULCI = 0.0839) \). Therefore, it can be considered that the intermediary effect of subject behavior between cooperative output and talent training effect is significant, and the size of the intermediary effect was 0.0306. In addition, the main body behavior is controlled and the direct effect of cooperation output on talent training effect is not significant. The
interval contained 0 (llici = -0.0043, ULCI = 0.1879), so the main body behavior plays a completely intermediary role in the relationship between cooperation output and the training effect.

4.3. Analysis of the Moderating Effects of the Cooperation Model

4.3.1. Analysis of the Moderating Effect of Cooperation Mode on the Main Effect

Testing the moderating effect, the condition that the moderating effect must be satisfied is that the interaction between the independent variable and the moderating variable has a significant effect on the dependent variable. According to the calculation results, the regression results show that the interaction terms of cooperation mode, cooperation input, and cooperation output have no significant effect on the talent training effect, and the adjustment effect does not exist. The interaction term between environmental support and cooperation mode has a significant impact on the training effect ($\beta = 0.162, P <0.05$), and the coefficient is positive, indicating that the level of the cooperation mode has enhanced the regulating effect on the relationship between environmental support and training effect. Therefore, suppose H8 is supported, and it is assumed that H7 and H9 do not have a school-enterprise cooperation model. There is no regulating relationship between the relationship between cooperative investment and training effect.

4.3.2. Analysis of the Moderating Effect of Cooperation Mode on the Mediation Effect

The hierarchical regression test was used to test the moderating effect of the cooperation model on the relationship between CI, ES, CO and subject behavior. This paper used industry, ownership, and scale as control variables, CI, ES and CO as independent variables, with subjective behavior as the factor. Variables were analyzed by stratified regression. Decentralize each variable before regression to prevent multicollinearity of homologous data. The regression results are shown in Table 4. According to the significance of the interaction between the independent variable and the intermediary variable (ES x UICM), we can see that the cooperation model supports environmental support and the subject. The behavioral relationship play a significant regulatory role ($\beta = 0.08, P <0.05$). The coefficient is positive, indicating that it plays a positive regulatory role. It is assumed that H11 is supported by verification. The interaction terms (CIxUICM, COxUICM) of cooperative input and output and the mode of cooperation have no significant effect on the effect of talent training, and the cooperative mode does not play a role in the relationship between the input and output of cooperation and the behavior of the subject. As to significant regulatory effect, the regulatory effect does not exist, so H10 and H12 are not established.

| Table 4. The Regulating Effect of Cooperation Model on Intermediary Effect. |
|---|---|---|---|---|
| Variable | M1 | M2 | M3 | M4 |
| Constant term | 3.61e-08 | 3.11e-08 | 3.12e-08 | 0.00530 |
| (0.0349) | (0.0340) | (0.0341) | (0.0343) |
| Industry | 0.00720 | -0.00267 | -0.00271 | -0.00390 |
| (0.0225) | (0.0222) | (0.0223) | (0.0223) |
| Ownership | -0.0214 | -0.0318 | -0.0319 | -0.0343 |
| (0.0281) | (0.0277) | (0.0278) | (0.0278) |
| Scale | 0.0586 | 0.0365 | 0.0365 | 0.0373 |
| (0.0581) | (0.0571) | (0.0573) | (0.0572) |
| UICM | 0.0056 | 0.0049 | 0.0056 | 0.0056 |
| CI | 0.178*** | 0.044*** | 0.174*** | 0.174*** |
| (0.0442) | (0.0488) | (0.0485) | (0.0485) |
| ES | 0.145*** | 0.145*** | 0.138*** | 0.138*** |
| (0.0468) | (0.0473) | (0.0475) | (0.0475) |
| CO | 0.101** | 0.1009** | 0.0975** | 0.0975** |
| (0.0475) | (0.04763) | (0.0479) | (0.0479) |
| CIxUICM | 0.0535 | 0.0535 | 0.0535 | 0.0535 |
| E SXUICM | 0.0808** | 0.0808** | 0.0808** | 0.0808** |
| COxUICM | 0.0382 | 0.0382 | 0.0382 | 0.0382 |

Dependent variable: effect of school-enterprise cooperation training
*** p<0.01, ** p<0.05, * p<0.1
5. Discussion of Results

5.1. Discussion on the Relationship between the Main Influencing Factors of School-Enterprise Cooperation and the Training Effect of Engineering Talents

The main influencing factors of school-enterprise cooperation: cooperation input, cooperation output, and environmental support have a positive impact on the cultivation of talents. It is assumed that H1, H2, and H3 indicate that school-enterprise cooperation is conducive to the training of engineering talents. In the process of cooperation, increasing the input of resources to both parties is conducive to the cultivation of high-quality engineering talents. The output of school-enterprise cooperation can stimulate the engineering talents and promote the growth of talents.

5.2. Discussion on the Mediating Role of Subjective Behaviors on School-Enterprise Cooperation and the Training Effect of Engineering Talents

Suppose H4, H5, and H6 are held steady. The behavior of the cooperation subject plays a part of the mediating role between the cooperation investment and the training effect of engineering talents. The resources invested are the material behavior basis for a series of activities carried out by the cooperation subject. The resources guarantee the material basis for the incentive behavior of the two parties to cooperate, improve the capacity of the cooperative body, and further affect the training effect of talents. The subject's behavior plays a part of the mediating role between environmental support and the training effect of engineering talents.

5.3. Coordination Mode of Cooperation

In the analysis of the main effect of regulation, only environmental support and cultural effect have significant positive regulation. When the two parties have a clear contractual relationship and supporting cooperation mode, the platform, alliance network, policy and other environmental support can play a role in promoting the output of creative results of cooperation.

There is no significant moderating effect between the cooperation input, cooperation mode and the training effect of engineering talents. The input resources have purpose, and the mode can also be regarded as the abstract resources to promote the cooperation smoothly towards the expected goal, but if the purpose does not match the mode, the effect of the input will be weakened. Therefore, H7 and H10 are not valid. The cooperation mode embodies the characteristics of contract, goal, cultivation and coordination, which rarely affects the inherent scientific research strength of both sides in a short period of time. The cooperation mode has a low impact on the cooperation output, so H9 and H12 are not established.

6. Summary

6.1. Research Conclusions

By regression of the main effects, using the Bootstrapping test to test the mediation effect, and the hierarchical regression method to test the mediation effect. School-enterprise cooperation investment, environmental support, and cooperation output all have significant positive effects on the training of engineering talents. The behavior of school-enterprise cooperation plays a significant mediating role between the support of cooperation environment and the effect of talent training. The school-enterprise cooperation model plays a positive regulating role between the environmental support and the effect of personnel training.

This paper only studied the influence of the moderator variable of cooperation mode. With the continuous development, more moderator variables can be added in future research, such as industry characteristics, to further explore the complex mechanism of cooperation in training engineering talents.
6.2. Suggestions

6.2.1. Forming a Stable School-Enterprise Cooperation Strategic Alliance Relationship Centered on the Enterprises

Enterprises with sociality should recognize their main body status and cooperate with schools in a more open manner. This not only promotes their own technological innovation, but also lets the factors of both sides collide to promote talent training and long-term stable alliance. Each participant also maximized its own benefits, the cooperation of enterprises has more economic benefits. We should focus on the construction of cooperation platform with target universities, such as a certain degree of investment in scientific research.

Constructing a reasonable school-enterprise organizational structure and clarifying the division of labor between the school and the enterprise is conducive to clarifying the goals of both parties and promoting the efficient development of talent training. In the process of cooperation, enterprises need to establish a complete human guidance system, which can accurately inculcate industry needs, industry changes, and market orientation to university cooperation personnel. At the same time, a clear cooperation contract is signed, which enables the two parties to understand their respective interests and reduce reservations on cooperation investment due to the local interests.

6.2.2. Government Level Protection Mechanism with Policies and Regulations as the Core Support

The government needs to take into account the local interests of both sides of cooperation, build a communication platform, so that both sides can get more full cooperation information. It can be used as a leader to provide more channels for the contact of enterprises and universities, such as building Internet exchange platforms, creating cooperation industrial parks, encouraging social forces to create science and technology service intermediary organizations, etc. In addition, in order to ensure the long-term cooperation, the government should give preferential policies to enterprises when they apply for school-enterprise cooperative financial subsidy science and technology projects.

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