An Environmental Approach to Cultivating Science and Technology Talents in the Guangdong-Hong Kong-Macao Greater Bay Area

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Abstract

In order to construct a structural equation model for developing the science and technology talents in the Guangdong-Hong Kong-Macao Greater Bay Area (GBA), this paper first explains the connotation of science and technology talents, and then proposes hypotheses based on the interaction between the environmental factors and their interrelationships. An online questionnaire survey is carried out with 205 participants based in the Guangdong-Hong Kong-Macao Greater Bay Area, trying to provide relevant data to support the main arguments in the paper. The results show that the regional economic environment has no significant effect on the development of science and technology talents, while other factors such as regional science and technology (RST), regional education(RED), regional social living(RSL) and regional innovation culture (RIC) have positive and significant effects. Such findings can provide guidance and reference not only for improving the environment for the development of science and technology talents, but also for optimizing the innovation of entrepreneurship in GBA. This will have great implications for the related organizations and institutions in China to well manage, cultivate and develop the science and technology talents.

Keywords: Guangdong-Hong Kong-Macao Greater Bay Area, Science and technology talents, An environmental approach

1. Introduction

The Guangdong-Hong Kong-Macao Greater Bay Area (the Greater Bay Area (or GBA) for short), an important region that promotes the rapid development of China's economy, is the fourth largest bay area in the world. As part of the 13th Five-Year Plan, the construction of

GBA is an important national economic development strategy for China, aiming to build it into the world-class bay area and the first-class city cluster. To construct and develop the first-class great bay, science and technology talents have a crucial role to play.

Unluckily, there is no unified definition for science and technology talents in academia. Most scholars agree that people usually engaged in scientific research, engineering design, technology development, scientific technology service, management and promotion, etc. can be considered as the science and technology talents. As is known to all, the development of science and technology talents not only depends on their own efforts and struggle, but also needs a favorable environment (Huang T. & Huang W. L., 2015), especially one with international technological innovation. Talent development environment, a concept with rich connotation, contains all external factors related to talent development. Many studies have attempted to construct a series of evaluation system of talent development environment from the macroscopic level, but few studied the influencing factors favorable to developing science and technology talents from the microscopic level.

Being the primary resource for social development, Talent is also one of the most important source of national competitiveness, promoting economic development. Different countries, regions with different politics, economy, society, and culture need to create different environments for talent development. Previous studies both from qualitative and quantitative perspectives indicate that the environment is of great importance of for talent development (Zheng, Y. H. & Lu Y. X., 2022). At the macro level, talent environment can be broadly defined. However, the index included in the evaluation system of talent development environment are mostly selected from the macro dimensions, with analytic hierarchy process (AHP) evaluation and level-by-level equal-weight method being dominant in academia. Such a system is subjective and not so convincing, so empirical research will take the lead for future research.

There is also an urgent need to identify the related extrinsic factors in the context of the social and environmental challenges in the 21st century. Through an empirical study conducted in the GBA environmental settings, this study sought to explore the influencing factors that affect the development of science and technology talents, hoping to improve the environment for developing science and technology talents, and contributing to the exploration and research on the cultivation and management of such talents in GBA. Five hypotheses have been made as follows:

Hypothesis 1: Regional economy has a positive effect on environment for cultivating the science and technology talents.

Hypothesis 2: Regional science and technology has a positive effect on environment for cultivating the science and technology talents.

Hypothesis 3: Regional innovation culture has a positive effect on environment for cultivating the science and technology talents.

Hypothesis 4: Regional education has a positive effect on environment for cultivating the science and technology talents.

Hypothesis 5: Regional social living has a positive effect on environment for cultivating the science and technology talents.

2. Previous Research and the Theoretic Framework: Science and Technology Talent, Development Environment

In China talent market, science and technology talents refer to people who have specialized knowledge and skills, and engaged in scientific or technological work. They are highly creative and have made great contributions to society, using their imagination and scientific spirit of exploration in the development of science and technology and human progress (Liu M.C., 1987). These talents include famous scholars and experts in engineering and technology, economic management, scientific research, scientific and technological education, etc (Gao R. & Wang B., 2022; Xin R.T., 2007).

The science and technology talents, or the "high-level" talents, are usually considered as the best of the best with business expertise, management skills and coordination ability. With excellent performance in organizations, they are able to call on their own team to achieve common goals (Yan W., et. al, 2022). Being highly educated, these science and technology talents have basically better than normal performance in personal quality and ideological morality. Most of them have their own unique values and pay great attention to the realization of self-worth. They have ability to innovate, to explore new science, new knowledge, new world and find the objective laws of nature. For them, serving and contributing to the development of the society is their ultimate goal.

Research on environment for cultivating talents started in the early 21st century, and the previous studies indicated that environment has an important role to play in talent development and aggregation. There is a positive correlation between talents and environment (Chu Q. F., et al., 2003); favourable talent development environment can not only solve the problem of brain drain, but also attract talents (Ni P.F. & Zhang Y., 2010). Qualitative view show that the "five-in-one" evaluation system, i.e. economic, political, cultural, social and ecological factors are the most suitable influencing factors to the development of talents (Si J. W. & Chen J. J., 2015). Some other scholars proposed that the incentive system, talent flow system, intellectual property protection system, scientific research system and innovation cultural system have positive effect on the establishment of the science and technology talent development environment (Li X., et al., 2018). There is a tendency that the multi-angle optimization strategy will take the lead in improving the development environment. Learning from the overseas experience in innovation and entrepreneurship environment construction, we can see that optimizing the industrial environment can provide guarantee for talent development (Lin D. M. & Lu J. Y., 2015). Therefore it is necessary to improve our awareness of constructing an optimal environment for talent development, and our willingness to reform at the university level so as to increase incomes of science and technology talents in colleges and universities in China ((Tian X.G., et al., 2017). This will have great implications for practicing the green development plan, i.e. to encourage creative development, to grasp the connotation of shared development, and to optimize the ecological environment for talent development both at the national level and provincial level (Li X.H. & Xia W. J., 2020).

Quantitative research from aboard show that recent research on talent development tend to focus on environment selection, talent gathering and talent flow. Research on regional inclusiveness, diversity and nightlife culture have an impact on the talent development

environment. Statistic data show that the higher the regional cultural inclusiveness, the more conducive it is for gathering talents (Floria. R., 2002). Creativity and innovation are two most important factors for a city to gather talents. The higher the innovation driving force of the city is, the more likely it is to attract talents) Esen U. & Ataya O., 2020). Many other factors such as macro environment, talent policy, science and technology investment also affect talent gathering(Barlow Liz., 2006). Therefore the development of talents is closely related to the recognition degree of scientific and technological achievements, human input, welfare factors in the region wherein the talents are located (Garavan Thomas N., et al, 2012). It can be said that the talents flow is influenced by such comprehensive factors as incentive policies, talent participation, knowledge sharing, learning and growth opportunities, which in turn would have great impact on how talents choose their final destination (Shahi T., et al., 2020). Though the social, economic and political environment plays a crucial role in talent flow(Zhao J. & Sheng Y., 2014), the preference of talent flow in different situations varies with politics, economy, culture and family environment (Rindoks, A., 2011).

Based on what has been discussed above, we choose to explore how various factors influence the cultivation of the science and technology talents in China. By integrating such factors as regional economy, regional social living, regional science and technology, regional education and regional innovation culture, we form our theoretic framework (as shown in Figure 1), trying to show these factors interact with one another to achieve an optimal model for cultivating the science and technology talents.
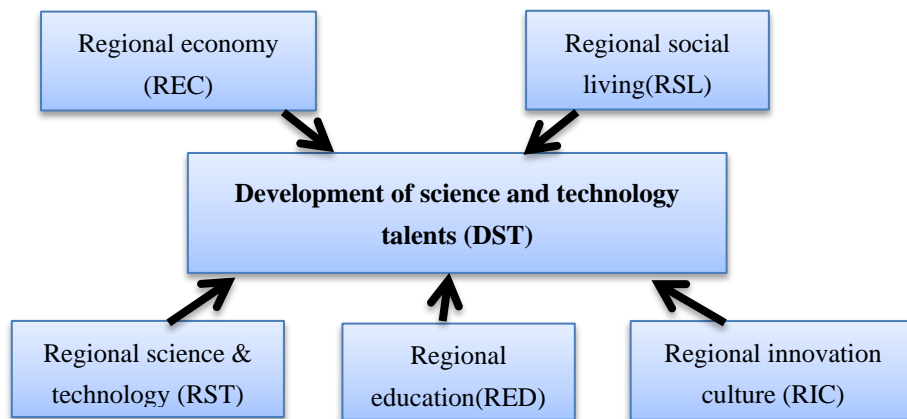
Figure 1. Theoretic framework of this research

3. Research Methods

3.1 Scope of the Study

The GBA is the primary place for gathering high-level talents in China, so respondents were selected from these area in this study. Empirical data collection was performed in Rensis Likert 5-point scale, the respondents are provided with a scale that has a number or brief description associated with each category. The variables in the scale are of six categories, i.e. regional economy, regional science and technology, regional innovation cultural, regional education, regional social living, and development of science and technology talents. Each variable includes at least three items, and these secondary indicators are based on the mature

scale from Lin & Lu (2015), Zhao Y.H.(2022). Modifications have been applied in this research, as illustrated in Table 1.

Table 1. Scale of talent development environment assessment indicators

The primary Indicators	The secondary Indicators	Symbol	Variable assignment
Regional economy（REC）	The total economic volume	X1	1=very important; 2=important; 3=neither important nor unimportant; 4=unimportant; 5=very unimportant.
	GDP per capital	X2	
	Sustained economic growth rate	X3	
	Per capital disposable income of urban workers	X4	
Regional science and technology(RST)	Annual expenditure on science and technology awards	X5	
	Number of registered scientific and technological achievements	X6	
	Local science and technology expenditures	X7	
	Scientific research on fixed asset investment	X8	
Regional innovation cultural(RIC)	Number of local high-tech enterprises	X9	
	Total number of patents granted	X10	
	One-time start-up subsidy	X11	
Regional education(RED)	Number of primary and high schools	X12	
	Local government education policy	X13	
	Number of research institutions	X14	
	Number of higher education institutions	X15	
Regional social living(RSL)	Social security coverage	X16	
	Per capital living area	X17	
	Number of Public Libraries	X18	
	Local CPI (Consumption Index)	X19	
Development of science and technology talents (DST)	Better high personal quality and ideological morality	X20	1=strongly disagree; 2=disagree; 3=neither agree nor disagree; 4=agree; 5=strongly agree.
	Better pursue the realization of their own value	X21	
	Better promote the ability of scientific and technological innovation	X22	
	Better promote the spirit of teamwork	X23	
	Better shape the comprehensive professional quality	X24	

3.2 Data Collection

Data collection was conducted through a online questionnaire composed of questions related to the variables of the research. Before the formal investigation, a pilot study was conducted to test the reliability and validity of the scale. The authors collected a non-probabilistic and convenient sample composed by graduates and postgraduates respondents in Guangdong, Hong Kong and Macao Greater Bay Area. A total of 40 pre-survey questionnaires were issued, 35 of them were valid, with an effective recovery rate of 81.48%. Cronbach's alpha coefficient was used to measure all questions in the preliminary survey, and the value was 0.980, indicating that the questionnaire was highly reliable.

The final questionnaire was made available by electronic means and submitted to QuestionStar. It was authorized and administered by the QuestionStar Company, and was distributed to the respondents from October, 2021 to March, 2022. We obtained a total 269 responses, among which 205 were valid, since 64 respondents answered "NO" to the question

"Are you familiar with the Greater Bay Area?" The effective rate of the questionnaires was 76.21%.

3.3 Data Analysis

3.3.1 Sample Profile

The sample consisted of 205 citizens with 111 females and 94 males. These respondents are mainly bachelor degree holders (118), followed by 51 postgraduates, 34 college diploma or below, and 2 respondents with PhD degree. As for income, the majority of was in a group of incomes between 150,000RMB and 250,000RMB annual. These data are detailed in Table 2.

Table 2. sample profile. (N-205)

	Variables	N	Percentage
Gender	Male	94	45.85
	Female	111	54.15
Education	College diploma or below	34	16.59
	Bachelor	118	57.56
	Postgraduate	51	24.88
	PhD	2	0.98
Annual household income (ten thousand yuan)	<15	72	35.12
	15-25	105	51.22
	≧25	28	13.66
The city lived	Guangdong cities	114	55.61
	Hong Kong	80	39.02
	Macao	11	5.37

3.3.2 Reliability and Validity

Cronbach's alpha was used to check the reliability and consistency of the variables in each item. It was found from the reliability statistics chart that the Cronbach's alpha of each variable were higher than 0.7. More specifically, REC(α=0.825), RST(α=0.834), RIC(α=0.791), RED(α=0.851), RSL (α=0.819), and DST (α=0.864) indicate that the scales have sufficient internal consistency.

The scale can also be used to test the content and structural validity. All the scales used in this study are mature scales adopted or adjusted by domestic experts in related fields and verified by small sample pre-investigation, so the content validity of the scale is good. Data analysis shows that the value of KMO-MSA Barlett's Test of all variables conforms with the criteria of validity test ($\geq$ 0.6). the significance probability values of Bartlett sphere test results of all the variables are less than 0. 05, indicating that the scale is suitable for factor analysis. The explanatory rate of factor cumulative variation of each variable is more than 77%, and the factor load is greater than 0.5, indicating that the definition of each variable in this study is reasonable.These results show that the measurement indicators for all the latent variables are valid and reliable to be used for inferential analysis.

Reliability Statistics	
Cronbach's Alpha	N of Items
.971	24

Scale Statistics

Mean	Variance	Std. Deviation
64.19	450.965	21.236

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.961
Bartlett's Test of Sphericity	Approx. Chi-Square	4181.942
	df	276
	Sig.	.000

Total Variance Explained			
	Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %
1	14.431	60.131	60.131
2	1.126	4.693	64.823
3	.951	3.963	68.786
4	.795	3.314	72.100
5	.680	2.834	74.934
6	.621	2.587	77.521

3.3.3 Model Estimation and Revision

R statistical software was used to select ordered Logistic regression and use Enter (entry method) to substitute all variables into the ordered Logistic measurement model constructed in this measurement section. Parameter test results of the initial model show that the model has multi... ...ral equa... ...as show...
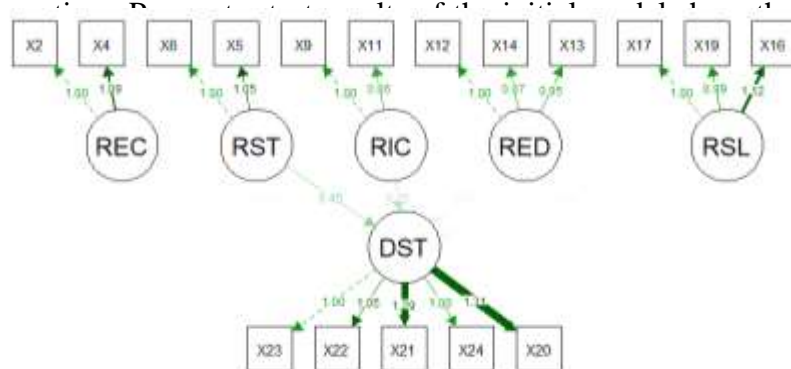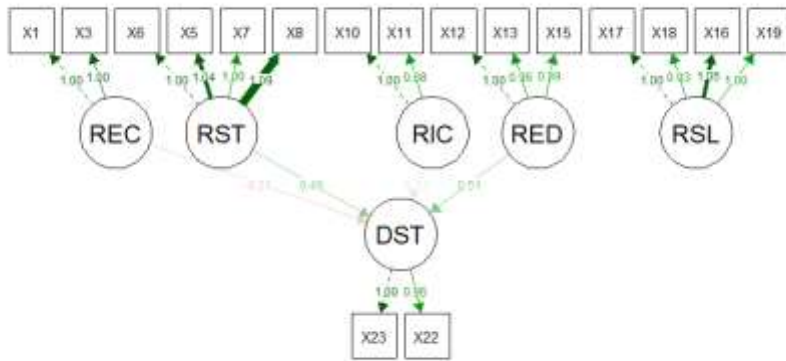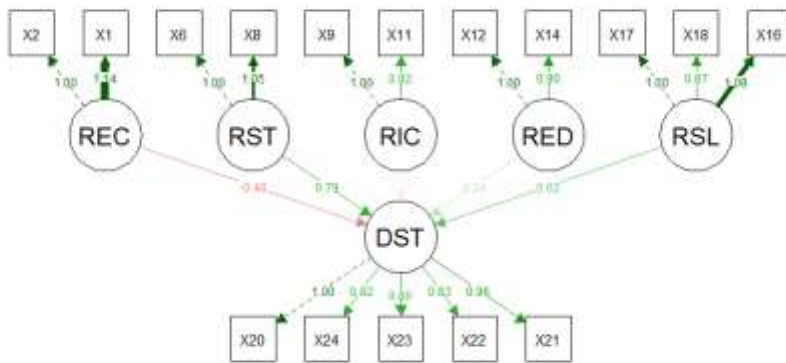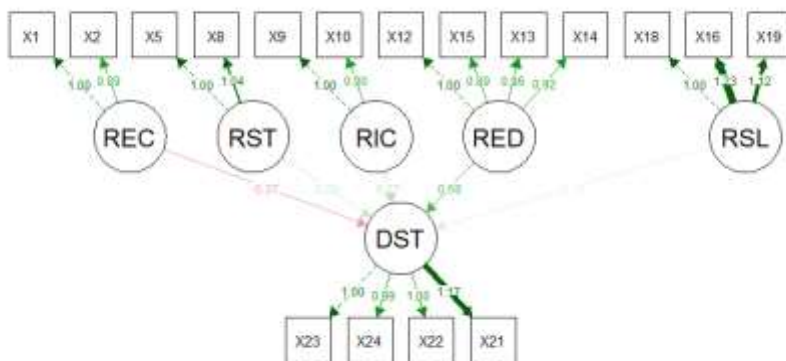

Figure 1
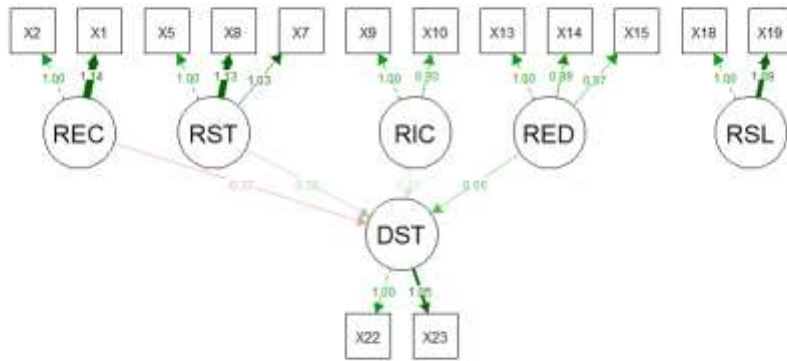
Figure 2

Figure 3

Figure 4

Figure 5

It is worth mentioning that although each influencing factors except regional economy can significantly influence the development of science and technology talents. After screening from structural equation, it is interestingly found that when we put all the influencing factors together, each secondary indicator has a completely different impact on the different competencies of the technology talent. Figure 1 shows that 12 secondary indicators have significant effect on the talents' personal quality and ideological character. These indicators also strongly impact talents in better pursuing the realization of their own value. Figure 2 consisting of 17 secondary indicators, includes respectively the annual expenditure on science and technology awards and scientific research on fixed asset investment from regional science and technology environment, and social security coverage from regional social living environment have more effect on the development of science and technology talents rather than other influencing factors, it also posited in Figure 4; regression result reject H1 that regional economy have no effect on the development of science and technology talents, however, in Figure 3, the economic volume of a certain region will still play a role in the development of talents, this situation is also illustrated in Figure 5.

3.3.4 Results

The results of the regression analysis performed to test the hypotheses are shown in Table 3. The model summary indicate that at lease one factors would affect the development environment of the science and technology talents (P=0.000<0.05). This finding is consistent with the findings in the literature review.

Table 3. results of regression analysis

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig.F Change	Durbin-Watson
1	.954[a]	.911	.908	.27463	.911	401.046	5	197	.000	1.810

Model Summary[b]

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	151.240	5	30.248	401.046	.000[b]
	Residual	14.858	197	.075		
	Total	166.099	202			

a. Dependent Variable: DST

b. Predictors: (Constant), RST, RIC, REC, RED, RSL

Coefficients[a]								
		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.117	.062		1.890	.060		
	REC	.046	.046	.047	1.007	.315	.205	4.874
	RED	.279	.058	.284	4.851	.000	.132	7.572
	RST	.345	.054	.365	6.373	.000	.138	7.225
	RIC	.012	.046	.012	.249	.034	.192	5.205
	RSL	.275	.055	.285	4.980	.000	.138	7.226

As stated previously, H1 was designed to test the relationship between regional economy(REC) and development of science and technology talents(DST). Regression results show that regional economy has no effect on the development of the science and technology talents ($P=0.315>0.05$), so H1 is rejected. This finding is consistent with the above finding from the structural equation. The development of the science and technology talents promotes the rapid development of regional economy, but the development of regional economy does not necessarily promote the development of science and technology talents. Of course, we do not rule out the argument that the economic development will make labor force shift.

Hypothesis 2(H2) related to regional science and technology(RST) environment and science and technology talents, was supported as predicted ($B=0.345$; $t=6.373$; $P=0.000<0.05$), suggesting that the more development of regional science and technology, the more conducive it is to the development of the science and technology talents. Regression results related to regional innovation cultural(RIC) and the development of the science and technology talents (DST) is $B=0.012$; $t= 0.249$; $P=0.034<0.05$, which supports the positive effect suggested in H3. Regional education (RED) and the development of the science and technology talents(DST).is also supported, it is reported a positively significant relationship ($B=0.279$; $t=4.851$; $P=0.000<0.05$) as predicted. The result for regional social living(RSL) and the development of the science and technology talents(DST), $B=0.275$; $t=4.980$; $P=0.000< 0.05$) supports H5. The regression equation can be expressed as:

$Y_{DST}=0.117+0.345*RST+0.279*RED+0.275*RSL+0.012*RIC$

According to the B value of each influencing factor in the analysis data, it can be seen that B(RST)>B(RED)>B(RSL)>B(RIC). Table 4 shows the results of each hypothesis.

Table 4. results of hypotheses

Research Hypothesis	Results
H1: Regional economy has a positive effect on environment for the development of the science and technology talents.	REJECT
H2: Regional science and technology has a positive effect on environment for the development of the science and technology talents.	SUPPORT
H3: Regional innovation cultural has a positive effect on environment for the development of science and technology talents.	SUPPORT
H4: Regional education has a positive effect on environment for the development of the science and technology talents.	SUPPORT
H5: Regional social living has a positive effect on environment for the development of the science and technology talents.	SUPPORT

4. Conclusion

This research constructs an interactional model for cultivating the science and technology talents, integrating various factors such as regional science and technology, regional education, regional social living, regional innovation culture, etc. These internal and/or external factors all have a crucial role to play in that they either help construct a healthy ecological environment in a region (Hu, T. S.; Pan, S. C. & Lin, H. P., 2021), or assisting or improving conditions for developing the science and technology talents.

The empirical analysis shows that regional science and technology has the greatest degree that influence the development of the talents, which indicate that regional governments could encourage the construction of a better science and technology environment by spending more on R&D, investing more on fixed asset, and providing some other incentives (offering favourable regional education, improving the comprehensive cultural level of the local population, etc.) for cultivating and gathering the talents. As such, perfect policies and regulations toward research institutions, higher education institutions, even primary and high school could be formulated. The more advanced regional social living standard, the more obvious the phenomenon of talent gathering (Wang, G. Y., 2021). An open and welcoming culture is important in any city, region, and country which hopes to attract talent, and most importantly, retain talent(Xing H. C., 2017). A country, region would probably lose national talent, if the social, cultural, and academic environment is hostile while political instability is increasing. Increasing innovation cultural is critical to attract and retain talent. Talents' perception of the development environment of innovation culture will directly affect their enthusiasm for innovation. It is worth to say, the present work indicates regional economic does not affect the development of science and technology talents, there is no denying that the development of science and technology talents has an influential role in creating the

regional economic environment. Therefore, it is possible that regional economic is a moderating factor of the talent development environment.

In this research, we put forward the keys factor to develop the science and technology talent, so that regions can develop favorable environment for talent. Several strategies still need to be considered, including the establishment of regional special support for scientific research funds, the form of cooperation among government, industry, academia and related institution. The growth of science and technology talents depends on the environmental atmosphere of the region. Talents development at different stages requires different facilities, resources and policies to support. Therefore, improve the relevance of the system in the formulation of talent development policies, and constantly enrich scientific and technological resources, and strive to achieve perfect talents attracting mechanism. As for enterprise, it is better to combine the realization of company's interests with the career promotion channels of science and technology talents, pay attention to the rationality and scientifically of the growth planning of talents, create an innovative, harmonious and lively working environment so that enhance the sense of identity and dependence of talents.

The research uses quantitative indicators for each variable, due to the availability of index, there still have some shortages in the analysis of indicators; In terms of selection, the selected indicators do not represent the wide range of evaluation objects, some influential indicators may be overlooked; In addition, it is necessary to longer the data collection period and conduct longitudinal research due to the rapid change of environment in the future.

Statements and Declarations

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