

## **Research Hot Spots and Trends on the Growth Environment of Young S&T Talents in China: CiteSpace Visual Analysis Based on Chinese Literature**

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**Abstract.** The central talent work conference in 2021 proposed to implement the strategy of strengthening the country with talents in the new era, and pointed out the need to cultivate a large number of high-quality young S&T talents with both political integrity and ability, and create a good environment for talent growth. Young S&T talents are a new force for achieving original innovation breakthroughs, technological self-reliance, and building a world power in science and technology. A good growth environment helps stimulate the innovative vitality of young S&T talents. Based on CNKI and WANFANG database, uses CiteSpace 6.1.R6 software, this paper has searched and selected 362 literature research results related to the growth environment of young S&T talents published by Chinese scholars from 2002 to 2022, to analyze and present the current situation, hot spots, and trends of the research on the growth environment of young S&T talents. On this basis, this paper composed the concept of young S&T talents and their growth environment, and summarized the dimensions of the growth environment of young S&T talents from four perspectives: structural level, social perspective, talent ecosystem and supporting body. This paper proposes that in the future, we can carry out in-depth exploration from the dynamic tracking and empirical research of the growth environment of young S&T talents, aiming to provide theoretical reference for optimizing the growth environment of young S&T talents.

**Keywords:** young S&T talents; growth environment; bibliometric analysis; CiteSpace

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## 1. Introduction

At a time of unprecedented changes in the past hundred years, China is facing major challenges such as prominent weaknesses in basic scientific research and the lack of major original innovation achievements. Report of the 20th National Congress of the Communist Party of China points out that "in-depth implementation of the strategy of strengthening the country, adhere to respect for labor, respect for knowledge, talent, creativity; improve the strategic layout of talent, accelerate the construction of the world's major talent centers and innovation heights, and focus on forming a comparative advantage in international competition for talent, to gather all aspects of outstanding talent to the cause of the Party and the people ". Original innovation is the high point of science and technology competition, and the essence of science and technology competition is talent competition. The history of science and technology shows that talents are most creative when they are 25-45 years old, and major scientific contributions are often made by scientists at a young age. The average age of the completers of China's 2019 National Natural Science Award-winning achievements was 44, and the average age of the youngest team was only 35. Youth is the "golden period" when talents are most active in thinking, energetic and innovative. Young S&T talents are the driving force for achieving breakthroughs in original innovation. At present, young S&T talents have to bear the pressure of life such as raising children, but also to face the pressure of personal career choice and career competition. Problems such as lack of high-level research platform, insufficient research funding support, difficult project application, small promotion space, and high life pressure are prominent. A good growth environment is the basic condition for young S&T talents to make breakthroughs in original innovation, and it is also an important element to deepen the reform of the institutional mechanism of scientific and technological talents, and it is a hot topic for scientific and technological talents management research.

In recent years, as China's attention to talents has gradually increased, local governments have also formulated policies on the cultivation and introduction of talents, and the growth environment of talents has improved compared with the past, so scholars have made new changes to the research on the growth environment of talents, and the research hotspots have also changed. In order to accurately grasp the research development history and research trend of the growth environment of young S&T talents, this paper uses the literature in China Knowledge Network (CNKI) and WANFANG database as the research basis, and with the help of Citespace 6.1.R6 software, visualizes and analyzes the research literature on the growth environment of young S&T talents in China from multiple perspectives, explores the research trend, research hotspots and development trend of the growth environment of young S&T talents in China, and summarizes the research trend of the growth environment of young S&T talents in China. The study will explore the research trends, hot spots and development trends of the growth environment of young S&T talents in China, summarize the structural dimensions and the research deficiencies of the growth environment of young S&T talents in China, and provide research ideas for optimizing the growth environment of young S&T talents.

### 1.1. Bibliometric analysis

CiteSpace software system is a technology text mining and visualization software developed by Dr. Chen C [1] based on JAVA, which is used to measure and analyze scientific literature data. It is widely used in the field of library and intelligence, management, science and technology policy, and more and more scholars are favored [2].

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Compared with similar software, it has a faster update frequency, which makes the reliability of the analysis results of the software has been substantially improved. Therefore, this paper adopts CiteSpace 6.1.R6 software to conduct an econometric analysis of the literature on the growth environment of young S&T talents in China.

### 1.2. Literature search

This paper refers to the literature search process used in the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) statement proposed by Moher et al. [3], and makes appropriate adjustments to complete the literature search and collection.

First, the literature search was conducted using the CNKI and WANFANG database as the main sources, selected “young scientific and technological talents”, “Young talents”, “growth environment”, “environment” as the main topics for advanced search, and the search date was December 31, 2022. This paper did not restrict the subject areas, and the sample covered young S&T talents in the fields of medicine, finance, industry, and education. The time interval of the literature search was 2002-2022. The reason why this paper chooses 2002 as the starting point of literature search on the growth environment of young scientific and technological talents is that the General Office of the Central Committee of the Communist Party of China and The State Council first proposed “The Implementation of the Strategy of Strengthening the Country by Talents in the Outline of the National Talent Team Construction Plan for 2002-2005” issued in 2002. Secondly, because the number of dissertations retrieved is small, the retrieved dissertations are less relevant to the topic of this paper, and Gardner [4] believed that the conference papers lacked peer review and rigor. Therefore, master's degree dissertations and conference papers were excluded from this paper. Finally, in order to ensure the consistency of the analysis and the research questions, this paper eliminates the literature that is not related to the growth environment of young S&T talents by reading the literature abstracts and obtaining 314 papers from CNKI and 163 papers from WANFANG database, totaling 477 papers. On this basis, 115 duplicate and invalid documents in CNKI and WANFANG database were deleted, and finally 362 valid Chinese documents were used to carry out the subsequent knowledge graph analysis.

### 1.3. Graph analysis

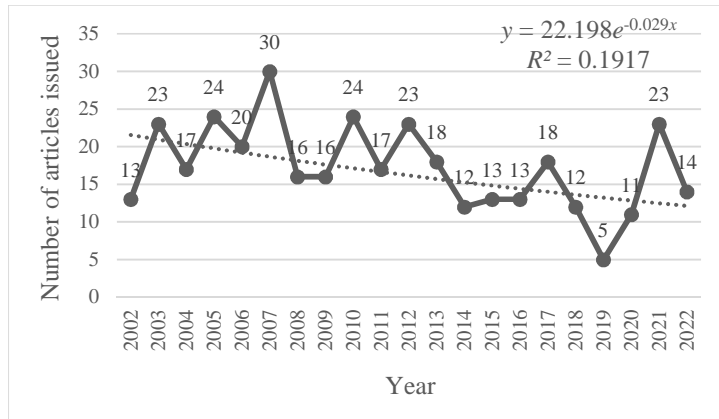
#### 1.3.1. Analysis of research dynamics

##### (1) Publication trend

A line chart is drawn based on the literature search results of the research on the growth environment of young scientific and technological talents in China, as shown in Figure 1. Among them, the formed exponential trend model is:

$$y = 22.198e^{-0.029x} \quad (1)$$

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**Figure 1: Publication Trends**

In Eq. 1),  $y$  is the cumulative number of publications and  $x$  is the year. It can be seen that the literature output of the research on the growth environment of young S&T talents in China from 2002 to 2022 shows an overall fluctuating trend ( $R^2=0.1917$  indicates a low fit and fluctuating data). According to the documents about talent strategies and decisions made in China from 2002, with reference to Sun [5], China's talent strengthening strategy is divided into the proposed stage (1978-2002), the formation stage (2003-2009), the enhancement stage (2010-2020), and enhancement stage (since 2021). In this paper, the annual publication trend of young S&T talents growth environment is divided into three stages using 2009 and 2020 as the boundary: 2002-2009 is the stage of young S&T talents growth environment creation, the volume of publication in this stage fluctuates widely, and the average annual publication is 19.8 articles; 2010-2020 is the stage of young The growth environment optimization stage(2010-2020), with less fluctuation and an annual average of 15.2 articles, and the growth environment reshaping stage from 2021 to 2022, when new research directions emerge due to the strategy of strengthening the country with talents in the new era.

First, the growth environment creation stage (2002-2009). China joined the World Trade Organization in 2001, while facing the problem of shortage of senior talents. In 2002, China first proposed the principle of the Party managing talents and the strategy on developing a quality workforce. From 2002, China set up a coordinating group to study talent work. In 2003, the first National Talent Work Conference was held and “the Decision on Further Strengthening Talent Work” was issued, and in 2007, the 17th National Congress of the Communist Party of China identified the strategy of strengthening the country by talents as one of the three basic strategies. At this stage, the core of China's talent strategy is to solve the problem of a small number of talents. The literature on talent growth environment published mainly focuses on creating an environment conducive to talent growth. For example, Wu[6] made a statistical analysis of the growth conditions of the academicians of the two academies selected in China before 2001 and examined the micro, medium and macro environmental factors affecting the success of academicians; Lin[7] explored the problem of ecological environment construction for the growth and development of scientific and technological talents; Tian[8] believed that the existence of intolerance in education would hinder the cultivation of innovative talents and put forward to education tolerance to create the environment for the growth of talents.

Second, the growth environment optimization stage (2010-2020), the second national

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talent work conference held in 2010, promulgated “the outline of the National Medium and Long-term Talent Development Plan (2010-2020)”, the 18th and 19th National Congresses of the Communist Party of China emphasized the importance of talents and proposed to accelerate the layout of talent priority development. The major judgment that talent is an important strategic resource was made. At this stage, China's guarantee system about talents has been basically sound, mainly focusing on improving the quality and core competence of talents and solving the problems that restrict the constraints of talent development. Therefore, the published literature on growth environment research is aimed at optimizing the talent guarantee system and creating a good growth environment for innovative talents, highly skilled talents and outstanding scientific and technological talents. For example, the relevant literature focuses on the cultivation of young S&T talents, people pay too much attention to innovation input and ignore scientific quality or spirit such as academic level and professional ethics, Zhang[9] found that scientific spirit plays a mediating role between external influences such as innovation task design, innovation input, innovation environment, innovation organization atmosphere and innovation behavior, and the lack of scientific spirit is a constraint on the innovation behavior of young S&T talents. Zhu [10] pointed out that in the growth process of young S&T talents, there are problems such as obstruction of access to scientific research resources, "bubbling" of scientific research results, and insufficient guarantee of incentive system, and non-profit organizations and third-party service platforms for the growth of young S&T talents should be introduced, so as to enhance the connection between the scientific research work of young S&T talents and the needs of society.

Third, the growth environment reshaping stage (2021-2022), the convening of the central talent work conference in 2021, put forward the in-depth implementation of the new era of talent strengthening strategy, accelerate the construction of the world's important talent center and innovation highland, require China's talent career towards the world-class level. In 2022, the literature output of the research on the growth environment of young S&T talents in China shows a declining trend, which indicates that due to the proposal of the strategy of strengthening talent in the new era, new considerations and requirements are put forward for the current talent training and research. The main studies in this stage include Zhou et al. [11], who drawing on the talent policies of developed countries, proposed the optimization suggestions of strengthening the funding and expanding the scope of funding, establishing a long-term and stable support mechanism, and creating a cultural environment for talents to explore freely; Liu et al. [12], based on the “triple helix theory”, constructed a mechanism to stimulate the innovation vitality of young S&T talents for 2035.

### (2) Authors of the paper

The visual analysis of authors in this paper can clarify the cooperative relationship between the core teams of major authors and researchers of the existing literature on the growth environment of young S&T talents. The cooperation network of posting authors drawn according to the sample data is shown in Figure 2, and the cooperation network consists of 487 nodes and 279 connecting lines. In terms of author co-occurrence frequency, scholars with more research results on the growth environment of young S&T talents include Xiangqian Zhang(4 articles) and Youyi Tian(3 articles), followed by scholars who published 2 articles, such as Zhigui Shan, Haiyan Zhang, Dianyuan Wu, and Shaowei Rui.

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From the perspective of cooperation network, the density of authors' cooperation network is 0.002 4, which indicates that the current research on talent growth environment in China is relatively scattered and no core research team has been formed yet, probably because there are more paths to study talent growth environment and the characteristics of talent growth environment in each region or field are different.



Figure 2: Collaborative network of authors

(3) Publication organization



Figure 3: Cooperation network of research institutions

CiteSpace software was used to analyze the cooperation network based on the research institutions of the sample data, as shown in Figure 3, the network consists of 346 nodes and 80 connecting lines. From Figure 3, it can be seen that the institutions with more issuing articles include Southwest University (4 articles), Nanjing Institute of Political Science (4 articles), Institute of Science and Technology Strategic Consulting of Chinese Academy of Sciences (3 articles), Personnel Bureau of Chinese Academy of Sciences (3 articles), and Huazhong Normal University (3 articles). The density of cooperation network of issuing institutions is 0.001 3. Among all issuing institutions, the Personnel Bureau of Chinese Academy of Sciences has exchange and cooperation relationship with the Institute of Science and Technology Strategy and Consulting of Chinese Academy of Sciences and

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the School of Public Policy and Management of Chinese Academy of Sciences University. However, there are some other institutions that conduct research as independent institutions, such as the Department of Education of Southwest University, the School of Marx of Southwest University, and the School of Politics and Public Administration of Southwest University, and Shanghai Jiao Tong University, the Shanghai Institute of Public Administration and Human Resources, and the Shanghai Institute of Science, etc. All of these institutions have researched the talent environment and are relatively close to each other geographically, but no cooperative relationship has been formed between the institutions.

#### (4) Posting Journals

**Table 1:** Overview of journals publishing

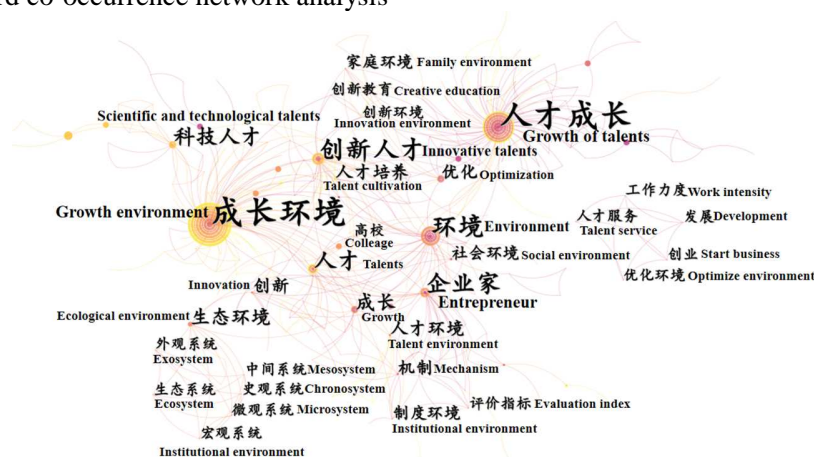
Num	Journals	Quantities	Journal Rank	Issuing Unit
1	Chinese Talents	10	AMI Extensions	Chinese personnel press
2	Science and Technology Management Research	8	Core journals of Peking University	Guangdong Institute of Science and Technology Management
3	Talent Exploitation	6	General journals	Shanghai Talent Research Association
4	China Youth Study	6	Core journals of Peking University	China Youth Research Center; China Youth and Children Research Association
5	Forum on Science and Technology in China	5	Core journals of Peking University	China Academy of Science and Technology Development Strategy
6	Human Resource Development	5	General journals	Henan Provincial Institute of Administration Science
7	Chinese Academy of Sciences	5	Core journals of Peking University	Chinese Academy of Sciences
8	Scientific & Technological Progress and Policy	4	Core journals of Peking University	Hubei Institute of Science and Technology Information
9	Chinese Journal of Medical Science Research	4	JST	Chinese Medical Association
10	Management Human resource development of China	4	Core journals of Peking University	China Human Resource Development Research Society

This paper makes a statistical analysis of the published journals of the sample literature, and the statistical results can reflect the quality of the current research on the

growth environment of young S&T talents. According to statistics, the journals with more publications include “China Talents”, “Science and Technology Management Research”, “Talent Development”, etc. The specific publication profiles are shown in Table 1, the top ten journals in terms of the number of articles published have 57 articles, accounting for 15.7% of the retrieved literature. Although the research on talent growth environment has formed rich results, large number of articles published in high-level academic journals still needs to be improved.

### 1.3.2. Research hotspots and trends

#### (1) Keyword co-occurrence network analysis



**Figure 4:** Keyword co-occurrence network

Keywords coalesce the main core information of an article. The study of high-frequency keywords can effectively grasp the cutting-edge trend of the research field. The keywords appearing in 362 documents were analyzed by CiteSpace, and a keyword co-occurrence network containing 423 nodes, 668 connected lines and a network density of 0.007 5 was obtained, as shown in Figure 4, in which the larger the circular nodes indicate the higher frequency of keywords appearing, and it is easy to see that growth environment, talent growth, environment, entrepreneur, innovation talent, talent, science and technology talent, and Innovation and other high-frequency words are the hot topics of the current research on the growth environment of young S&T talents.

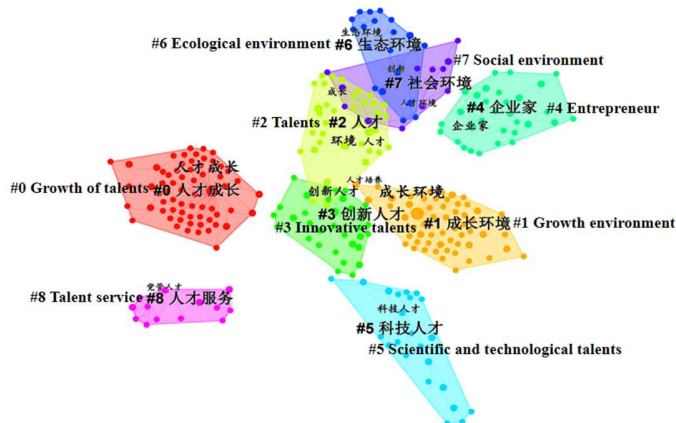
#### (2) Keyword clustering analysis

The keyword clustering view can represent the structural characteristics between clusters, and the clarity of the network structure and clustering in CiteSpace is measured by two indicators, the module value (Q value) and the average profile value (S value), usually the Q value is in the [0, 1) interval, when  $Q > 0.3$  means that the delineated clustering structure is significant, and when  $S \geq 0.7$  means that the clustering is efficient and convincing[13]. The keyword clustering network obtained from the sample data is shown in Figure 5, and in this paper,  $Q = 0.767 4$  and  $S = 0.938 3$ , indicating that the clustering structure is significant and the clustering results are reasonable. The cluster takes talent growth and growth environment as the core, and extends to innovative talents, entrepreneurs, scientific and technological talents, ecological environment, social environment, talent services, etc., which indicates that the research in the field of growth



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environment of young S&T talents in China is mainly focused on these aspects.



**Figure 5:** Keyword clustering network

(3) Analysis of research hotspots

**Table 2:** Top 20 keywords in the research ranking of growth environment

Keywords	Year	Strength	Begin	End	2002-2022
Talent growth	2002	3.66	2002	2005	****_-----
Healthy growth	2002	1.73	2002	2007	*****_-----
Environment	2002	3.08	2004	2007	--****_-----
Organizational environment	2002	1.72	2004	2005	--*_-----
Human resources	2002	1.45	2004	2007	--****_-----
Military personnel	2002	1.16	2004	2009	--*****_-----
Ecological environment	2002	2.22	2008	2011	-----****_-----
Innovative talent	2002	1.58	2008	2013	-----*****_-----
Institutional environment	2002	1.35	2008	2015	-----*****_-----
Innovate	2002	1.21	2010	2013	-----****_-----
Optimize	2002	1.14	2010	2013	-----****_-----
Person with ability	2002	1.92	2012	2015	-----****_-----
Countermeasure study	2012	1.13	2012	2013	-----**_-----
Scientific and technological talents	2002	2.53	2014	2019	-----*****_-----
Growth environment	2002	1.98	2014	2017	-----****_-----
Colleges and universities	2002	1.53	2014	2019	-----*****_-----
Policy support	2002	1.25	2014	2015	-----**_-----
Innovation vitality	2002	1.33	2016	2022	----- *****
Optimization game	2002	1.23	2016	2019	-----****_-----
Restrictive factor	2002	1.15	2016	2021	-----*****_-----

Note: "-" indicates the year in which the keyword appeared, "\*" indicates the year of

emergence.

Burst terms indicate keywords that have been widely followed over a period of time, and can indicate cutting-edge issues in the research field. The intensity of a keyword is used to indicate that it has been a hot topic of research in a certain period of time, and the higher the intensity, the greater the influence of the keyword. In this paper, the top 20 emergent words are ranked according to the strength of the emergent words and the starting time of the keyword mutation, as shown in Table 2. From the perspective of the emergence intensity, the strongest emergent keyword is talent growth, which emerged in 2002, while the emergent keyword in the same period is health growth. The strongest keyword was environment, which emerged in 2004, and the keywords that emerged in the same period were organizational environment, talent resources and military talent. From the perspective of the emergence time, the longest duration of research on the institutional environment was from 2008 to 2015, followed by the research on innovation dynamics, which started from 2016 to 2022 and is expected to continue to maintain a certain intensity in the next few years, with the keywords that emerged in the same period being optimization measures and constraints.

In summary, this paper takes 362 journal documents in China Knowledge Network and WANFANG database from 2002-2022 as the analysis sample, and uses CiteSpace to sort out the current situation of research on the growth environment of young S&T talents in China, and draws the following conclusions: (1) from the number of articles issued, the number of literature on the growth environment of young S&T talents in China is influenced by China's talent policy, roughly divided into three stages, and it is expected that after 2022, with the introduction and implementation of the strategy of strengthening the country with talents in the new era, the literature published in this field will be enhanced. (2) In terms of publishing authors, institutions and journals, the current research teams or institutions targeting the talent growth environment are not concentrated enough, and the degree of cooperation between publishing authors is low, without forming a core group of authors for talent growth environment research. At the same time, although China has made some achievements in research on talent growth environment, there is still a need to strengthen high-level academic journal papers. (3) From the key words co-occurrence, the hot spots of research at this stage in China are mainly focused on the research of social environment, organizational environment, institutional environment and ecological environment for the growth of innovative young S&T talents. (4) From the keyword emergence, the innovative vitality of talents, factors restricting the development of talents and optimization measures are the key directions for future research.

## **2. Definition of young S &T talents**

### **2.1. Science and Technology Talents**

“The National Medium and Long-term Science and Technology Talent Development Plan (2010-2020)” issued by the Ministry of Science and Technology defines science and technology talents as workers who have certain professional knowledge or expertise, engage in creative science and technology activities, and contribute to the cause of science and technology and economic and social development [14]. They mainly include people engaged in scientific research, engineering design and technology development, science and technology services, science and technology management, science and technology popularization and other work in science and technology activities. Some scholars have given the concept of scientific and technological talents for their own research fields. Wu

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et al. [15] believe that scientific and technological talents are those who have unique insights into scientific and technological knowledge and special scientific and technological talents, who can generate creativity through individual knowledge, skills and talent, who can recreate science and technology and promote social and economic development; Qu et al. [16] believe that strategic scientific and technological talents are those who have good strategic thinking and innovation ability, who are engaged in scientific and technological innovation activities in the relevant According to Ji[17], high-level agricultural science and technology talents refer to those who focus on a certain agricultural science and technology field and engage in scientific and technological innovation, and play a fundamental, strategic and decisive role in the development of modern agriculture.

### 2.2. Young science and technology talents

In 1953, Lehman [18] suggested that scientists usually make important scientific contributions under the age of 40. 1979, Zhao [19], a famous scholar in China, used statistical methods to analyze the age distribution of scientists in various countries when they made contributions and concluded that the best age range for outstanding scientists to make significant contributions was between 25 and 45 years old, with the best peak. -The best age for the first contribution is about 33 years old. Chinese scholar Huangfu [20] verified the "optimal age zone for science creation" by analyzing the number of citations of relevant scientific papers in SCI in 1998, that is, the optimal age zone for outstanding scientists to make significant contributions is between 25 and 45 years old.

Therefore, Chinese scholars have both defined the upper age limit of young S&T talents as below 35 years old, such as Feng et al. [21], who believe that young S&T talents are those who are 35 years old or below ( $\leq 35$  years old), have received good education and academic training, and have a strong sense of innovation, outstanding scientific and academic level, and the potential for innovative development. The upper age limit is also defined as around 45 years old. For example, Jiao et al. [22] collectively referred to researchers under 44 years old as young scientists and technicians according to the characteristics of agricultural research workers. Gan et al. [23] defined scientific and technological talents under the age of 45 as young S&T talents.

There is also a lack of unified criteria for the lower age limit of young S&T talents. Lv et al. [24] consider young scientific and technological innovation talents to be scientific research subjects aged between 18 and 45 years old, with good innovation and scientific research ability, who can directly participate in scientific research activities and contribute to scientific and technological development and social progress. Rui[25] defined young S&T innovation talents as those who have started their doctoral or independent scientific research career within 10 years from the three dimensions of age, characteristics and scope, with an upper limit of 45 years old, and with strong scientific and technological innovation ability, learning ability, problem-solving ability and broad knowledge system, mainly including master's and doctoral students with innovation potential and young S&T workers in universities, institutions and enterprises.

In 2011, the National Natural Science Foundation of China (NSFC) published "The International Assessment Report on the Performance of Science Foundation Grants and Management", which included the "age of research" as a condition for project funding and

defined the age of research as the number of years since obtaining a PhD [26]. Niu et al. [27] defined research age as the number of years of independent scientific research in a field after receiving a PhD. Chen [28], by collating the distribution of physiological age and scientific research age of "excellent youth" recipients, suggested that it would be more reasonable and humane to use scientific research age than physiological age in relevant talent programs, and suggested introducing scientific research age criteria.

### **3. Connotations and dimensions of the growth environment for young S & T talents**

In recent years, China's urgent demand for talents and the increasingly fierce competition for talents have led some scholars to embark on a study of the growth environment for talents. In terms of the conceptual definition and dimensional division of the growth environment, scholars have analyzed and researched from different perspectives, providing a research basis for assessing and optimizing the growth environment of talents.

#### **3.1. Connotation of the growth environment of young S & T talents**

The dimensional division of the growth environment is conducive to the evaluation of the talent growth environment. At present, there are more articles exploring the dimensions of the talent growth environment and the evaluation system, but very few have formed relevant theories and given clear definitions. As the cultivation of scientific and technological talents not only requires a long period of accumulation of experience, but also requires various resources and environments conducive to the growth of talents from all sectors of society, such as government, universities, enterprises and institutions. Therefore, scholars generally believe that the growth environment of young S&T talents is a complex or sum of external environments that affect the growth and development of talents. For example, Bao et al. [29] consider the talent environment as a comprehensive environment covering various aspects such as human capital investment, talent transaction, life security, entrepreneurial development and career. Zhu et al. [30] believe that the ecological environment for the growth of outstanding scientific and technological talents is the sum of all external conditions that affect the survival and development of outstanding scientific and technological talents. Zhi et al. [31] attributed the growth environment of innovative scientific and technological talents in high-tech industrial clusters to the sum of various factors that interconnect and influence the organizations and individuals in the macro-regional environment, meso-cluster environment and micro-enterprise environment of high-tech industrial clusters in each stage of their growth, potential development and self-worth realization. Liang et al. [32] believe that the development environment of high-level scientific and technological talents refers to the sum of various material and spiritual conditions closely related to the growth and development of high-level scientific and technological talents, which is a comprehensive system involving political, economic, social, scientific and technological, cultural and institutional aspects. According to Wang et al. [33], the growth environment of scientific and technological talents is a combination of various external factors that affect the retention, ability and innovation activities of scientific and technological talents in all stages of their growth. According to Jiao et al. [34], the growth environment of young agricultural science and technology talents is the sum of several external factors that are closely related to the growth of young agricultural science and technology talents.

According to "The China Science and Technology Talent Development Report (2020)", during the 13th Five-Year Plan, the number of R&D personnel in China will grow rapidly, from 3.878 million in 2016 to 5.092 million in 2020[35]. New policies have been

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introduced across the country to bring in talent, and significant breakthroughs have been made in both talent evaluation index systems and talent incentive policies. However, President Xi Jinping stressed at the 2021 Central Conference on Talent that China's current reform of the institutional mechanism for talent development is not deep enough, and lacks an institutional mechanism for talent development with Chinese characteristics and comparative advantages in international competition. The strategy of strengthening the country with talents in the new era requires the creation of an environment that recognizes, loves, respects and uses talents, creates good conditions for talents to study their business, and creates a good atmosphere in the whole society that encourages bold innovation, courageous innovation and tolerance of innovation.

Therefore, based on the research results of scholars, combined with the requirements of China's new era talent strengthening strategy and the current shortcomings of China's talent cultivation and development, this paper argues that the growth environment of young S&T talents refers to the system of political, economic, social, cultural atmosphere and other elements that affect the process involved in the growth of talents and the realization of their self-worth. The definition mainly contains three layers of meaning: First, the growth environment of young S&T talents is an organic system that starts from the education of talents and influences the formation of hard and soft power of talents; second, the growth environment of young S&T talents is a complex that includes the interaction between talents and society, others and surrounding organizations; third, the growth environment of young S&T talents plays a role in making scientific contributions and realizing self-worth of young S&T talents.

**Table 3:** The division of the growth environment dimensions for young S&T talents in China

Angle	Author	Time	Growth Environment Sub-dimension		
			Macro environment	meso-environment	microenvironment
Structure	Luo H.T.	2003	Overall environment	Natural environment and social environment	Natural resources, natural media, natural nutrition, economic environment, political environment and cultural environment
	Liu C.N.	2013	Industrial development, scientific research system, talent policy, industry-university-research cooperation mechanism	-	Project support, management mechanism, academic atmosphere, teamwork

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Angle	Author	Time	Growth Environment Sub-dimension	
	Zhi X.T.	2013	The economic, cultural, policy, scientific and technological environment of the subordinate administrative region	Cluster economic status, cluster learning mechanism, cluster innovation atmosphere, cluster living environment
	Jiao X.	2017	Socio-economic and technological development level, historical and cultural background, etc.	The important external factors influencing the innovation ability of young agricultural scientific and technological talents
			External environment	Internal environment
	Xie S.X.	2004	Nature, politics, culture, economy and knowledge	Organizational structure, interpersonal relations, academic leaders, working conditions, academic atmosphere, professional personality
	Jiang X.X	2011	Social acceptance, mechanism and system, policy and system, public opinion direction	Management system, development platform, treatment standards, experience opportunities
	Wu J.H.	2017	Political environment, economic environment, cultural environment, scientific research environment, natural environment	Personal environment, family environment, educational environment and enterprise organization environment
	Chen G.Y.	2020	Organization training subsystem, post training subsystem, team training subsystem	Emotion motivation subsystem, intelligence base subsystem, knowledge ability subsystem
	Rui S.W.	2022	Talent and others (mentors, friends), institutions (platforms), environment (society)	Age, ability, motivation

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Angle	Author	Time	Growth Environment Sub-dimension
Society Angle	Zhao Q.X.	2004	Natural environment, political environment, cultural environment, economic environment, information environment
	Bao H.	2007	Talent economic environment, talent entrepreneurship environment, talent science and technology education environment, talent living environment and talent market environment
	Jiao Q.L.	2012	Working environment, economic environment, incentive environment, development environment, humanistic environment
	Liang W.Q.	2014	Economy, technology, society, life, nature and talent markets
	Hou J.R.	2014	Socio-economic quality, economy and city size, higher education development
	Gan S.L.	2021	Economic environment, living environment, working environment, training environment, incentive environment, evaluation environment
Talent Ecosystem	Zhu D.M.	2004	Social material environment: economic geographical environment, human geographical environment, population resource environment
	Zhu Z.Z.	2011	Social and cultural environment: social and economic environment, social and political environment, social and cultural environment
	Han J.	2011	Macro environment: the political, economic, social and other micro environment of the region and above where the talents are located: the ecological environment of talents inside the enterprise, including the local environment of the organization where the talents are located and below
	Wang Z.M.	2011	Public opinion environment, material foundation environment, institutional mechanism guarantee environment, mental and psychological power support environment
	Liu R.B.	2014	Science and technology development environment, science and technology itself environment, open system environment, guarantee harmonious environment and living space environment
	Tan X.Y.	2022	Institutional environment, market environment, investment and financing environment, innovation environment, business environment, entrepreneurial culture, public services
Supporting Body	Wang J.C.	2015	Enterprise support, government support, universities and research institutions support, social service agencies support

Note: This paper is compiled

### 3.2. Young S &T talents' growth environment dimension division

The existing literature broadly divides the dimensions of the growth environment of young S&T talents from four perspectives: structural level, social perspective, talent ecosystem and supporting body perspective. Among them, the structural level perspective includes both macro, medium and micro environments, as well as external and internal environments; from the social perspective, it includes political, economic, cultural and ideological factors; while the division of the growth environment dimension based on the talent ecosystem perspective emphasizes the use of ecological concepts to study the talent environment and analyze the dynamic development balance among the influencing factors; the support perspective is divided according to the main body of resource input, the details of which are shown in Table 3.

(1) From the structural level, the talent growth environment is divided into two categories, one of which is the macro, medium and micro environment, and the other is the internal and external environment. Firstly, from the macro, medium and micro environments, scholars generally believe that the macro environment plays a leading role and is the overall environment of the region where the talents are located; the medium environment plays the role of connecting the macro environment and the micro environment; and the micro environment is mainly related to the personal development of the talents. For example, Luo [36] believes that the macro environment of talents is the overall regional environment, the medium environment includes the natural environment and the social environment, and the subsystems of the medium environment constitute the micro environment. With reference to the vertical structure view, Zhi[31] argued that the macro-regional environment of innovative S&T talents refers to the economic, humanistic, policy, scientific and technological environment of the administrative region to which they are subordinated; the meso-cluster environment refers to the environment of the high-tech industrial cluster in which the enterprises to which the talents work influence their growth; and the micro-enterprise environment mainly includes corporate culture, corporate human resource management, and working environment. According to Jiao et al. [34], the macro environment of young agricultural science and technology talents mainly includes factors such as the level of socio-economic and technological development, historical and cultural background; the development and demand of the medium environment agricultural industry is an important external factor that affects young agricultural science and technology talents' ability to exert innovation; the micro environment work environment is an important platform for young agricultural science and technology talents to learn and grow, exert their talents and realize their self-worth.

Secondly, from the internal and external environment, the internal environment is related to the growth of talents themselves, including their family environment, living environment, professional field characteristics and educational environment, etc.; the external environment is related to the development and growth of talents, and is the various factors outside the organization that affect the growth of talents, such as political environment, economic environment, humanistic environment, mechanism and system, etc. Xie[37] believes that the internal environment of the growth of S&T talents in universities refers to the sum of various organizational elements such as organizational structure, interpersonal relationships, academic leaders, working conditions, academic climate and professional personality that influence and restrict the growth of talents within scientific and technological organizations; while the external environment refers to the sum of



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various factors outside the organization that directly or indirectly influence the growth of scientific and technological talents around the management activities of the growth of scientific and technological talents. Jiang [38] defined the external environment for the growth of highly skilled talents as including social recognition, mechanisms and institutions, policies and systems, and social opinion guidance; the internal environment includes management systems, development platforms, treatment standards, and experience opportunities. Based on ecological management theory. Wu et al. [15] introduced the concept of innovation-driven and divided the innovation-driven environment for the growth of scientific and technological talents into internal environment ecosystem and external environment ecosystem, the external environment ecosystem includes political environment, economic environment, humanistic environment, scientific research environment and natural environment; the internal environment ecosystem includes personal environment, family environment, education environment and enterprise organization environment. Chen [39] decomposed the cultivation and growth of young S&T talents into internal and external systems, with the internal system including the affective motivation subsystem, the intellectual foundation subsystem, and the knowledge and ability subsystem; and the external system including the organizational cultivation subsystem, the job cultivation subsystem, and the team cultivation subsystem. Rui et al. [40] constructed a model of talent growth elements, which is divided into an internal triangle with talent itself as the core, including age, ability and motivation; and an external triangle around talent, including talent and others (mentors and friends), institutions (platforms) and environment (society).

(2) The talent growth environment is divided based on the social perspective. Li [41] argues that from a social perspective, human beings, in their survival and development, are based on their common material production and occur and constitute various connections with each other, including ideological, political, economic, cultural, scientific, moral and ethical connections, and these connections constitute the social environment for human survival and development. Some scholars have therefore classified the growth environment from a social perspective by identifying the influential factors that are linked to human survival and development. For example, Zhao [42] believes that the environment for the growth of scientific and technological talents in universities includes five aspects: natural environment, political environment, cultural environment, economic environment and information environment. Bao et al. [29] believe that the talent environment is mainly composed of and jointly determined by five sub-environments: talent economic environment, talent entrepreneurial environment, talent science and technology education environment, talent life environment and talent market environment. Jiao et al. [43] evaluated the environment of high-level scientific and technological talents from five aspects: working environment, economic environment, incentive environment, development environment and humanistic environment. Liang et al. [32] divided the environment for the development of high-level scientific and technological talents into six subsystems, including economic, scientific and technological, social, living, natural and talent market environment. Hou et al. [44] categorized the science and technology talent environment into three factors: socio-economic quality, economic and city size, and higher education development. Gan [23] evaluated the growth environment of young S&T talents in terms of economic environment, living environment, working environment, cultivating

environment, motivating environment and evaluation environment.

(3) Divide the ecological environment for talent growth from the perspective of talent ecosystem. In 2003, Shen [45] introduced the concept and concept of "ecology" to the study of talent, which is based on the idea that all ecological factors in the talent ecosystem interact with each other through information flow and material circulation. Scholars have studied the basic laws of the ecological movement of talent growth based on the basic theory of talent ecology, and have classified the ecological environment of talent growth. The study of talent growth ecology both focuses on the analysis of the connection between the environments from the perspective of temporal change and on the dynamic balance and sustainability among talent systems. For example, based on the ecosystem theory, Zhu et al. [30] divided the ecological environment for the growth of outstanding scientific and technological talents into six levels, including the micro-environment of people, things and things closely related to the survival of talents; the meso-system of the relationship or connection between two things in the micro-system; and the appearance system that has a direct impact on the micro-system in which talents live. Including the national political, economic, social, scientific and technological and natural environment, as well as from the point of view of time, the analysis of the five stages of the growth of outstanding scientific and technological talents: the initial construction of values, the cultivation of scientific and technological quality, the formation of professional ability, the stimulation of innovation ability, and the complete type of outstanding scientific and technological talents.

The talent ecosystem is a system in which individuals interact with organizations, others and society to form energy exchanges. Some scholars' delineation of the talent ecological environment emphasizes the latter, the dynamic balance and sustainability among the elements within the environment. For example, Han [46] divides talent ecological environment into macro and micro talent ecological environment, macro talent ecological environment refers to the collection of political, economic and social environmental factors in the region and above where the talent is located; micro talent ecological environment refers to an organizational or team environment, such as corporate talent ecological environment and efficient talent ecological environment. Liu [47] evaluated the social ecological environment of scientific and technological talents from five aspects: scientific and technological development environment, scientific and technological own environment, open system environment, guaranteeing harmonious environment and living space environment. Tan [48] divided the entrepreneurial ecological environment of scientific and technological talents into 7 dimensions: institutional environment, market environment, investment and financing environment, innovation environment, business environment, entrepreneurial culture and public services.

(4) In addition to their own investment and contribution to scientific research, talents have to be provided with resources by the government, enterprises, research institutions, innovation and entrepreneurship platforms and other related subjects in the process of growth. Therefore, from the perspective of supporting subjects, Wang et al. [33] divided the growth environment of scientific and technological talents into four parts: enterprise support, government support, support from universities and research institutions, and support from social service institutions.

#### **4. Limitations and future prospects**

The study of young S & T talents in China has attracted widespread attention, and a review of the literature studies related to the growth path and environment of talents, the

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construction of the evaluation index system of the growth environment of talents, the cultivation of scientific and technological talents, and the competitiveness of talents unfolded by the growth environment of young S&T talents in China, although the study of the growth environment of young S&T talents in China has formed a theoretical system and achieved some results, there is still room for further research space.

(1) Through the visual analysis of the text, we found that most of the existing studies are conducted by independent authors or independent institutions, and there is a lack of cooperation and communication among scholars. In addition, the number of articles on the growth environment of young S&T talents is low in terms of the number of articles published in these high-level journals in China. Therefore, research on the growth environment not only requires scholars to deepen the depth and improve the quality of their research, but also requires high-level academic journals to pay attention to the research on the growth environment of talents and stimulate extensive thinking in the academic community.

(2) Existing research is mainly static, neglecting the links and dynamic changes between the various factors of the growth environment. It is still common for scholars to classify the growth environment by simply lumping together the various factors that affect the growth of talent. However, innovation-driven development is a dynamic process of change, and changes in the growth environment have different impacts on talent at different stages of growth. Therefore, scholars should take into account the horizontal connection between the factors in future research, introduce a timeline, combine the law of innovation development and talent growth cycle, and study the factors affecting talent growth and development from a dynamic change perspective.

(3) Existing studies lack the process of verifying the rationality of the dimension division of growth environment. According to the sample data retrieved in this paper, most of the published articles explain the current situation, divide the growth environment dimension and put forward countermeasures from a theoretical perspective, while there are few empirical articles verifying the scientific and rational division of the growth environment dimension. The division of the growth environment of young S&T talents can help to build a reasonable evaluation index system for the growth environment of talents and improve the shortcomings of the current growth environment of talents. Therefore, the relevant research should not remain at the theoretical level, and future research should consider empirical analysis to verify the rationality of the components of the growth environment for talents from different disciplinary backgrounds, levels and industries.

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