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Original Paper

Research on the Development Mode and Implementation Path of Science and Technology Innovation Study Tourism Resources

Liyong Zong[1*] & Enhao Chen[1]

[1] School of Publishing, University of Shanghai for Science and Technology, Shanghai, China

[*] Corresponding Author

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Abstract

Based on resource integration theory, stakeholder theory, and experience economy theory, this paper adopts Qualitative Comparative Analysis (QCA) to analyze 44 typical science and technology creation study projects in a group mode, and explore their successful paths and internal mechanisms. It is found that the success model of science and technology innovation study tour is characterized by three differentiated paths: high resource-strong cooperation type, theme-focused-communication type, and culture-technology integration type. The analysis of necessary conditions shows that the proportion of practical activities is≥ 50%, The common bottom line to decide whether the project is successful consist of the science and technology innovation theme fitting with local industries, specialized teacher deployment, and safety management system certification are. The study verifies the reliability of the findings through counterfactual analysis and robustness tests. It proposes hierarchical policy recommendations: Sci-Tech advantage regions should strengthen cross-sectoral collaboration mechanisms, and culture and tourism resource adventaged regions can adopt asset-light operation strategies through Sci-Tech empowerment. These findings provide empirical support for constructing a theoretical system of science and technology innovation study tourism with Chinese characteristics, as well as a scientific basis for the optimal allocation of resources in practice.

Keywords

science and technology study tour, Qualitative Comparative Analysis (QCA), resource integration, grouping paths

1. Background

In recent years, with the deepening of the concept of quality education, science and technology innovation study tour has become a new trend in the integration and development of education and tourism. On November 30, 2016, the Ministry of Education and other ten departments issued the "Opinions on Promoting Study Tour for Elementary and Middle School Students", pointing out that: study tour for elementary and middle school students is a combination of out-of-school educational activities and travel experiences, which are organized and arranged by the education departments and schools in a planned way, and carried out through group travel and centralized accommodation and food service, and that they are an innovative form of articulation of school education and out-of-school education, an important content of education and teaching, and an effective way of comprehensive practice and nurturing of human beings (Ministry of Education of the People's Republic of China et al. Opinions on Promoting Study Travel for Primary and Secondary School Students, 2017, pp. 42-45). However, in the process of actual promotion, the development of science and technology study tourism still faces many challenges, such as a single development mode, a weak synergistic mechanism, and insufficient sustainable development capacity. Therefore, systematically identifying and analyzing the key factors affect the effectiveness of its development and construct a scientific development model and are of great practical value and theoretical significance for realizing its long-term operation. This paper selects 44 science and technology innovation study bases or science and technology innovation study tour programs that have begun to operate in recent years in China as samples, and conducts a qualitative comparative analysis of the different factors that influence whether the development mode and implementation path of science and innovation study tourism resources can be successful or not.

2. Literature Review

Currently available research mainly focuses on the product design, operation mechanism, and educational effectiveness of study tour, especially in the integration of resources, curriculum content development, school-enterprise collaboration, and other aspects of a series of theoretical models and practical recommendations. There are mainly the following aspects: first, exploring the methods to improve the educational effectiveness of science and technology innovation study tourism resources. As reported by Fan Zhaohui, the Ministry of Culture and Tourism has recently launched a pilot study tour base quality enhancement project to improve the quality of study tour bases, which will lead to the local construction of a study tour development ecology "Major achievement" with a "small incision" (Fan, Z. H., 2025). The secret of Hubei high-quality study tour lies in the innovative development model, the release of the multiplier effect, to provide protection for the study of the healthy development of the tourism industry. Zhang Yulian pointed out that Hefei gathered science and technology, humanities, and historical resources, which is the foundation of science study. Hefei may take the "Oriental super ring" big IP as the leading engine, build the national science study tour brand benchmark. It also launched six brands of high-quality science and technology tours around “Hefei’s unique scientific and technological resources” to create IP in vertical fields, connecting Hefei’s science museums, colleges and universities, scientific research institutes, high-tech industrial parks, and nature protection areas, and constructing many science tours to form a science study tour network with comprehensive coverage and rich content (Zhang, Y. L., 2024).

The second is to explore the operation mechanism of science and innovation study tours. For example, Lin Xiaoxiao and others have proposed the practical path of establishing a study tour department, compiling a study management system, evaluating various types of resources at the base, constructing standards for science study tours, docking with primary and secondary schools in depth, and fully carrying out analysis of the learning situation (Lin, X. X., Yang, C. J., & Zhu, D. Z., 2024, pp. 64-71). Xu Yufeng and others outlined that local universities have explored new paths to improve the education quality of study practice through the virtual teaching and research office empowering elementary school study and practice, the sharing of study and learning resources and platform construction with elementary school, as well as the development of cross-disciplinary comprehensive practice courses (Xu, Y. F., Pan, F. L., & Zeng, H. H., 2024, pp. 132-135).

Third, the design of the route of science and innovation research and study tourism products. Wu Haiying et al. designed the Rising Wings - Industrial Civilization Route: Yumen Oilfield Red Tourism Scenic Spot - Jiayuguan Jiuquan Iron and Steel (Group) Co. -Jiuquan Satellite Launch Center - Jinchuan National Mining Park - Jinchang “Mars 1” base, where students can learn about the achievements of Gansu as an old industrial base in China's industrial history and cultivate an interest in science (Wu, H. Y., Zheng, B. K., Luo, Q. Y. et al., 2024, pp. 76-80). Based on the concept of STEAM, Chen Hongling et al. took the non-heritage study trip curriculum teaching design of the Dong wooden building construction techniques as main content to help students explore the “magic” of architecture, through the hands of the Dong wooden building models, in-depth understanding of the nodes between the components, understanding the mystery of mortise and tenon structure. It also helps students to understand the “power” of science and technology by using the Internet, multimedia, and other information technology platforms to provide students with video materials for advanced study and CAD software for drawing (Chen, H. L., Ding, Q., & Li, W. J., 2024, pp. 93-104).

However, most of these studies focus on empirical summaries or case studies and lack a systematic analysis of variable interactions and exploration of pathway mechanisms. To address this shortcoming, this study intends to introduce the resource integration theory, stakeholder theory and experience economy theory as the basis of analysis, identify the influencing factors from multiple dimensions, and it is necessary to use Qualitative Comparative Analysis (QCA) as the main method to explore the path of influence of different combinations of factors on the effect of the development model.

3. Research Problems

Combined with the above research related review, it is found that the field of the development mode and implementation path of science and technology innovation study tourism resources has been involved in different fields such as geography, tourism, science and technology innovation, etc., but there are fewer studies to analyze the influencing factors of the development and operation of successful science and technology innovation study tourism resources and the dissemination mechanism behind them from the perspective of communication, and the research hypotheses of this paper are as follows:

(i) Are there certain factors that are necessary for the success of the development and operation of science and technology innovation study tourism resources? If so, what are the specific ones?

(ii) Is there a combination of certain factors that influence the success of the development and operation of science and technology innovation study tourism resources?

(iii) Why are these factors influencing in their roles? What is the mechanism of action behind them?

4. Research Methodology

4.1 Research Methodology

In terms of research methodology, this study adopts the Qualitative Comparative Analysis (QCA) method proposed by Charles C. Ragin in 1987, which is based on set theory and Boolean algebra, and identifies different combinations of conditions leading to a particular outcome by systematically comparing samples of medium-sized cases (usually 20-60) (John Fisk (1987/2005). Television Culture). Such a QCA is particularly suitable for analyzing complex social phenomena such as science and technology innovation study tourism, as it can deal with multifactorial concurrent causality, capture the similar characteristics of condition combinations, and identify asymmetries in causality.

As a method for small and medium-sized sample analysis, QCA can effectively identify the nonlinear combination effect between conditional variables, which is suitable for research in emerging fields. QCA is particularly suitable for exploring the effects of multiple factors (e.g., policy, resources, technology, and management) on the success or failure of study tours in different combinations, as the development of study tours involves the interaction of multiple factors (e.g., policy, resources, technology, and management).

4.2 Study Case Selection

In this study, 44 representative science and technology innovation study tour programs are selected as case samples using the (fsQCA) research methodology. The data sources include government documents, annual reports of the programs, questionnaire surveys, and interview records, and they cover a variety of dimensions such as types of resources, curriculum structure, teacher deployment, safety and security, and publicity methods. For example, Songzi No. 9 Space Branch Library was recognized as an excellent case of "New Public Cultural Space in Hubei Province in 2024" (Jingzhou city culture and tourism bureau. Provincial excellent case! Songzi a place selected. [EB/OL].2025-01-15[2025-06-20]), Mars No. 1 Base was officially included in the "China Camp Education Industry Directory" (Pescadores. Heavyweight |Mars 1 base is officially included in the "China Camp Education Industry Directory"! [EB/OL].2023-03-15[2025-06-20]), and Azure Hefei Advanced Manufacturing Base was selected as an industrial tourism demonstration base in Anhui Province in 2024 (China Industrial News Network. Hefei adds a new provincial industrial tourism demonstration base. [eb/ol].2025-02-07[2025-06-20]). The specifics of the sample cases are shown in Table 1 below:

Table 1. Names of Science and Technology Innovation Study Tour Programs and Their Core Science and Technology Innovation Resources

No.	Project Name	Core Science and Innovation Resources
1	Public Science Day on Hefei Science Island	All-superconducting tokamak device, steady state strong magnetic field
2	Yunnan Tsiba Biodiversity Study	Southwest China Wildlife Germplasm Resource Bank
3	Songzi 9 Space Exploration Center	Shenzhou Return Module VR, Astronaut Training Simulation
4	Mars 1 Base Study Program	Mars survival scenario simulation, physical building replica, sci-fi realm creation
5	Dunhuang: Digital Dunhuang Immersion Exhibition	Dunhuang Cave digitization results, 3D printing replica caves, VR virtual roaming system
6	Baoguo Temple Ancient Architecture Museum (Ningbo)	Wooden Architecture, Mortise and Tenon Technology
7	Hefei Aviation Science Museum "The Sky is Wide Let's Fly" Study	Aviation knowledge, VR simulation driving
8	Anhui Science and Technology Museum, Azalea Automobile Advanced Manufacturing Center One-day Study	New Energy Vehicle Production Line, Intelligent Welding Robot, Battery Pack Assembly Workshop
9	KU Xunfei AI Experience Center	Intelligent Voice Interaction System, AI Virtual Anchor, Educational Robots
10	BYD New Energy Vehicle Study Center	Electric Vehicle Three Electric Systems, Blade Battery Production Line, Intelligent Driving System
11	Huawei Songshan Lake Science Park	5G technology, smart city demonstration
12	DJI Drone Study (Shenzhen)	Drone Programming, Aerial Photography Practice
14	Daqing Red Study	Oil battle site, immersive oil extraction experience

15	Qitaihe "Science Popularization Study Tour Exploring Champion City"	Ice and snow sports, championship culture
16	Silk Road Information Port "Future on the Cloud" Youth Science Practice Camp	Digital Recovery, AI Painting Lab
17	Guangzhou Hong Kong-Zhuhai-Macao Bridge Study Tour	Bridge Engineering Practice, Builder Interaction
18	"Eye in the Sky" FAST Study Tour	500-meter aperture spherical radio telescope, pulsar search system
19	Three Rivers Ancient Town "Science and Technology+ Non-Legacy" Study Program	Water curtain light and shadow, 3D holographic technology
20	Hong Kong Youth Study on the State of Shenzhen (ESG) activity	New Energy Power Generation System, Smart City Management System, Green Building Technology
21	Wuhan University School of Remote Sensing	Satellite Remote Sensing Data Processing System, Unmanned Aerial Survey Equipment, Geographic Information System
22	Hefei University of Technology	Medical Robotics and Intelligent Medical Health System Laboratory
23	Luogang Park Study Tour	Aviation and Aerospace; 3D Laser Giant Screen Film and TV Multi-color Display Technology
24	Anhui Innovation Museum Quantum Frontier Science and Technology Popularization Study	Quantum Technology
25	Hefei Intelligent Robotics Research Institute Science Popularization Research Base	Intelligent Robot
26	Hefei Origin Quantum Computing Popular Science Education Base Research and Study	Hefei Origin Quantum Computing Popular Science Education Base
27	China Sound Valley AI Study	Artificial Intelligence
28	Shenqiu "Steel Industrial Park" Study	Big Data Technology Steel Production Line
29	WISCO Cultural Tourism Zone Study	5G Steelmaking Manipulation
30	Harbin Institute of Technology Shenzhen Campus "Science and Technology Pilot of the Future" Study Program	Bionic Flapping Wing Flying Robot Technology
31	Jijinhuichuan-Nickel City Earth Study Tour	Mining; Aerospace; Weightless Flight Simulation
32	Chongqing Research Institute "Into the Chinese Academy of Sciences" Study Tour	Robotics Innovation Laboratory
33	Zhumadian Science and Technology Museum	Digital Science and Technology
34	Cold Lake Mars Camp	Simulated Mars Landing Experience

36	Shanghai Synchrotron Light Source	Third Generation Synchrotron Light Source
37	Chinese Academy of Sciences Tibetan Plateau Glacier Research	Glacier Monitoring
38	Wuhu Science and Technology Museum “two museums linkage” research and study	Aerospace, Mechanics
39	Spring Equinox Project “Science Popularization Study at NUST”	Artificial Intelligence Laboratory, Nanomaterials Preparation Platform, Biosafety Laboratory
40	Nampi Eco-agricultural Experiment Station of the Chinese Academy of Sciences (CAS)	Nampi Station Wheat Regional Experiment, Underground Water Level Observation, Salt Plant Potting Experiment Area, and Long-term Positioning Experiment
41	Study on the bridge over the Damling River in Guizhou	Fine structure analysis and mechanical load-bearing experiment of a suspension bridge
42	Study of Liyang Aviation Exhibition Center	Model airplane assembling, drone test flight
43	Beidou Xihongqiao Base Study	Satellite Navigation Technology
44	Minhang District Engineering Practice Wisdom Learning Club (Engine, Chip) Activity	AI Robot, Engine Assembly; Chip

4.3 Design of Influencing Variables

This study combines the dimensions of resource integration theory, stakeholder theory, and experience economy theory for variable design. Diao Liping pointed out that, based on Marshall et al.’s research on cluster competitiveness (advantage) and the idea of resource integration theory, the theory of resource “integration” can be expressed as the mechanism of resource agglomeration, division of labor and cooperation, and sharing of knowledge and technology, which refers to the agglomeration of science and technology innovation study tourism resources in this study, division of labor cooperation, and sharing mechanism (Diao, L. P., 2025, pp. 84-87); Yangming Zhang pointed out that in the facility period of projects, stakeholder management is one of the key factors for success or failure of project because it involves multiple organizations and individuals in the various stages of the project’s interests, powers and responsibilities that are intertwined with each other in a complex way, generating dynamic changes. And it also emphasizes the importance of cooperation between all parties (Zhang, Y. M., 2025, pp. 1-7); Pine and Gilmore suggest that the experience economy needs to create immersion value through interactive, scenario-based design, emphasizing the value of “participatory learning” (B. Joseph Pine, & James H. Gilmore, 2016). Therefore, the antecedent variables of this study will be developed from the four dimensions of resource integration, curriculum design, implementation guarantee, and publicity and promotion. For example, the resource integration dimension includes the abundance of science and technology innovation resources and whether the cross-sectoral cooperation mechanism is perfect; the curriculum design dimension focuses on the proportion of practical activities and whether the curriculum content fits the local science and technology theme; the implementation guarantee involves the establishment of professional teachers and safety systems; and the publicity and promotion focuses on the coverage of the all-media marketing and the effect of word-of-mouth among the users. The outcome variables are the sustainability of the program, i.e., the number of years of operation and the scale of hospitality as the evaluation criteria.

In the specific analysis process, a necessary condition analysis will be conducted to identify the factors that are indispensable to the success of the program; then a combination of conditions will be analyzed to refine the typical success paths, and the counterfactual logic will be used to verify the robustness of the model. The study expects to identify several efficient combinations of development models, such as "high-quality scientific and technological resources + cross-sectoral collaboration + all-media publicity" or "local university linkage + thematic industry fit + complete safety and security mechanism", and explain their success from the perspectives of logic, organization and collaboration of resource allocation. They also explained the inner mechanism of their success from the perspectives of logic, organization and collaboration of resource allocation.

5. Data Analysis and Results

5.1 Assignment of QCA Variables

According to the above data and its importance of the reference case and considering the contingency utility of each variable relative to the outcome variable, the settings of each variable are as follows in Table 2:

5.1.1 Antecedent Variables

Table 2. Antecedent Variable Assignment and Description

Variable category	Specific variables	Assignment Logic
Resource Integration	Science and innovation resource richness	High (≥3 types of resources) = 1, low = 0
	Cross-sectoral cooperation mechanism	Government-enterprise-school agreement = 1, otherwise = 0
Curriculum Design	Percentage of practical activities	Experimental/interactive programs ≥50% = 1, otherwise = 0
	Science and technology theme relevance	Match between curriculum and local industry/research direction = 1, otherwise = 0
Implementation	Specialized Faculty Allocation	Equipped with scientific researchers or professional tutors =

Variable category	Specific variables	Assignment Logic
Guarantee		1, otherwise = 0
Publicity and Promotion	Safety Management System	Passing the national research and study safety certification = 1, otherwise = 0
	All-media marketing coverage	Microblogging/shaking voice/offline activity linkage = 1, otherwise = 0
	Spontaneous audience dissemination (word of mouth)	Social media topic volume ≥100,000 = 1, otherwise = 0

5.1.2 Outcome Variables

The latest Summer Tourism Market Monitoring Report 2023 released by China Tourism Research Institute pointed out that after the adjustment of epidemic prevention and control policies, the tourism market in 2023 showed a significant recovery trend, in which the parent-child and study tourism segments performed particularly well and became an important engine leading the industry to revive. Therefore, this study adopts the composite indicator (years of operation × average annual growth rate) composite indicator to indicate sustainability. If the operation is ≥3 years and the average annual growth rate is ≥15%, then the value is 1. If the operation is not long enough or the growth is stagnant, then the value is 0. Add the NPS (net recommendation value) to measure the willingness of students to participate in the second time to indicate the effect of education: if the NPS ≥ 70% of the benchmark value of NPS in the education category, then the value is 1, and if the NPS < 70%, then the value is 0.

5.1.3 Program Success Criteria

Judge whether the project is successful according to sustainability and industry influence. If the annual reception is ≥ 10,000 people, the project operation is ≥ 3 years, and obtains the certification of the study base at the provincial level or above, it is regarded as the success of the project, otherwise, it is unsuccessful.

5.2 QCA Data Analysis Results

5.2.1 Univariate Analysis

The necessity of each antecedent variable to the outcome variable (success=1) was tested using fsQCA 3.0 software, and the consistency threshold was set at 0.9:

Table 3. Results of Necessity Analysis

Antecedent Variables	Consistency (Consistency)	Coverage (Coverage)
Richness of science and innovation resources	0.82	0.75
Cross-sectoral cooperation mechanism	0.65	0.68
Percentage of practical activities	0.95	0.91
Science and Technology Theme Relevance	0.98	0.89
Specialized Faculty Staffing	1.00	0.85
Safety management system	0.93	0.82
All-media marketing coverage	0.58	0.62
Audience Spontaneous Communication	0.42	0.55

From the above table, it can be learned that the proportion of practical activities, the relevance of scientific and technological themes, the allocation of specialized teachers, and the consistency of the safety management system ≥ 0.9 are the core necessary conditions for the success of science and technology innovation study tour programs. Non-essential variables such as resource richness and publicity and promotion need to be combined with other conditions to play a role.

5.2.2 Conditional Combination Analysis

Conditional combination analysis was continued for the variables. The variables were assigned values based on the results designed in Table 3 above, and the truth table was obtained through the analysis of the fsQCA software. Based on the truth table, the analysis of the condition combination was carried out and some of the results obtained are shown in Table 4 below.

Table 4. Proportion of Events Covered By Each Combination of Conditions for the Variables

Path analysis	Conditional Combination Formula	Consistency	Original Coverage	Unique Coverage
High Resource-Strong Collaborative	ABCF¬G	0.96	0.32	0.18
Theme Focused-Communication	¬ACDEG*H	0.93	0.28	0.28 0.12
Culture-Technology	¬A¬BCDE*F	0.89	0.21	0.09

Integration				
Simplified Solution	CDE*F	0.94	0.68	------------ -----------

Note. A=Science and innovation resource richness, B=Cross-sectoral cooperation, C=Practical activities, D=Science and technology theme relevance, E=Professional faculty, F=Safety management, G=All-media marketing, H=Audience dissemination; * denotes a logical “with” and ¬ denotes a logical “without”; * denotes a logical “with” and ¬ denotes a logical “without”. * denotes logical “with” and ¬ denotes logical “without”.

Among the four science and technology research projects in the collection site, the original coverage of the “high resources-strong cooperation type” pathway is 0.32, implying that about 32% of the successful cases are in line with this combination pattern, while its unique coverage of 0.18 indicates that 18% of them can only be interpreted by this pathway, which highlights the irreplaceability of the scarce scientific and technological resources with the collaboration of the government, enterprises, and schools. In contrast, although the original coverage of the culture-technology fusion type is lower at 0.21, That its unique coverage of 0.09 reveals the unique value of differentiation in tradition resource advantage areas through “safety certification of study activities + practical science and technology implantation”. The simplicity of 0.68 indicates that there are multiple concurrent causes and consequences for the success of science and technology innovation study tour, and regions with different resource endowments can flexibly choose the appropriate path - either relying on the strong combination of scarce resources, or leveraging on cultural IP light asset operation, but all need to adhere to the common bottom line of “hands-on activities + professional teachers + safety management”. This provides a hierarchical support basis for policy development, which can strengthen cross-sectoral collaboration incentives for scientific and technological highlands, and focus on the construction of standards for science and technology-enabled traditional culture for cultural and tourism advantage zones.

5.2.3 Counterfactual Analysis and Robustness Test

The study selects typical counterfactuals such as BYD’s new energy vehicle study tour, which is high in resources but low in sustainability, and WISCO’s cultural tourism zone study tour, which is strong in practice but failed, for in-depth case comparison, and finds that the former is inefficient in utilizing resources due to the lack of cross-sectoral cooperation mechanisms, and the latter is difficult to form a closed loop of educational value due to insufficient scientific and technological thematic relevance, which confirms the core conditions in the paths of “high resources-strong cooperation-type” and “theme-focused-type”. This result confirms the necessity of the core conditions in the “high resources-strong cooperation” and “theme focus” paths. In terms of robustness testing, the study adopts a dual validation strategy: firstly, by adjusting the calibration anchor point, the full affiliation threshold of "science and technology innovation resource richness" is raised from 3 to 5 categories, and it is found that the consistency of the high-resource pathway remains above 0.92, which confirms that the core conclusions are not sensitive to changes in the calibration standard; then, by using the sample segmentation method, 20% of the cases are randomly excluded from the re-analysis, and the original coverage of the key pathway fluctuations were less than 5%. Together, these test results indicate that the success path model constructed in this study has significant statistical robustness and practical generalization ability, and can provide differentiated policy references for regions at different stages of development.

6. Research Conclusion and Discussion

6.1 Establishing Differentiated Regional Support Policies to Accurately Empower the Development of Science and Technology Innovation Study Tour

Given the uneven distribution of science and technology innovation resources in different regions of China, differentiated regional support policies should be adopted and classification guidance strategies should be implemented to achieve optimal allocation and efficient use of resources. For regions with a high concentration of scientific and technological resources, such as Hefei and Shenzhen, it is recommended that special regulations be issued to promote in-depth cooperation among governments, enterprises, schools, and research institutions in the field of study tour. Encourage major science and technology infrastructure in these areas and support the implementation of tax breaks and other preferential policies to reduce the cost of opening up and increase the incentive to open up. At the same time, the relevant departments can set up special open subsidies to give financial support to institutions actively involved in study tour programs, and further promote the sharing and utilization of science and technology innovation resources. As for regions with rich cultural and tourism resources and deep historical heritage, relevant policy documents need to be formulated to promote the deep integration of science and technology with culture. Focus on supporting the application of VR/AR and other cutting-edge technologies in non-heritage study tour, restoring historical scenes through digital means, so that traditional culture can be presented to young people more vividly and intuitively, thus stimulating their interest in and love for traditional culture, and allowing traditional culture to take on new life and vitality in the new era.

6.2 Build a Standardized Certification System to Secure the Safety Line of Science and Technology Innovation Study Tour Programs

Safety management is the cornerstone of the success of science and technology innovation study tour programs. The lack of unified safety management standards and an effective guarantee system is one of the key factors restricting the quality improvement of study tour programs. Therefore, it is recommended that the relevant departments formulate safety certification standards for study tour bases, and incorporate key indicators such as emergency drills, insurance coverage, and teacher-to-student ratios into the scope of mandatory certification, to ensure that study bases meet the requirements in terms of hardware facilities, staffing, and safety management. At the same time, the dual protection system of "dual tutor + medical station" can be established. Dual tutor system to ensure that the study process involves both professional science and technology tutors to explain the knowledge, but also experienced education tutors to guide and supervise; the establishment of the medical station to deal with unexpected medical conditions provides a strong guarantee. In addition, the accredited study bases are provided with operating subsidies and publicity and promotion to motivate them to continuously improve their service quality and management level, to guarantee the safety and quality of science and technology innovation study tour programs in an all-around way.

6.3 Innovative Curriculum Development Mode to Cultivate Composite Talents Adapted to Future Demands

Based on the key role of scientific and technological theme relevance in study activities, it is suggested that schools and science and technology innovation enterprises cooperate to build a dual-driven curriculum design framework of "industrial needs + educational goals". In the process of developing science and innovation study resources, it is necessary to accurately match the science and technology innovation resources with the curriculum standards, deeply explore the combination of scientific and technological elements and educational content, and develop targeted and unique study activities. To this end, it is recommended that science and technology innovation practitioners and specialized teachers give full play to the professional advantages of both sides to ensure that each science and technology innovation study and study tour program closely matches the corresponding disciplinary knowledge points and ability cultivation objectives. Meanwhile, for the core element of specialized teachers, on the one hand, scientific researchers are incentivized to complete a certain number of hours of research and teaching tasks each year, to mobilize the enthusiasm of scientific researchers to participate in research and education; on the other hand, primary and middle school teachers are encouraged to go to scientific research institutes to conduct immersive training, to gain an in-depth understanding of the dynamics of the frontiers of science and technology, and to improve their own scientific and technological literacy and teaching ability, to train a group of educationally and technologically. Composite talents will be trained to provide strong talent support for the sustainable development of science and innovation research and study activities.

6.4 Construct A "Scientific and Technological Net Influencers" Communication Matrix, Innovate Evaluation and Incentive Mechanisms, and Stimulate the Vitality of Study and Learning

In the digital era, the use of new media platforms to create a linked communication model between science and technology innovation experts and study programs is an effective way to enhance the influence and participation in study activities. It is recommended that science and technology innovation study tour bases and enterprises plan a series of short videos, invite science and technology innovation experts to show the highlights and characteristics of the study tour programs on popular platforms such as Jitterbug and B Station with interesting explanations, to form a circle-breaking dissemination effect, and to attract the attention and participation of more young people. Meanwhile, personalized practical tasks and a medal reward mechanism are provided for students. Students can get the corresponding medal reward for each completed practical task, and share on social platforms to unlock more exclusive rights and interests. This digital incentive not only effectively enhances students' participation and sense of achievement, but also promotes the secondary dissemination of research activities and expands the influence of the activities. In addition, the platform can also generate personalized study reports based on students' practice data to help parents intuitively understand the effectiveness of their children's ability and to improve it in the study process, further enhancing parents' recognition and support of study activities.

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