World Journal of Educational Research
ISSN 2375-9771 (Print) ISSN 2333-5998 (Online)
Vol. 13, No. 2, 2026
www.scholink.org/ojs/index.php/wjer

Original Paper

Research on Current Dilemmas and Quality Improvement Paths of Science Education in Town and Township Primary Schools

Shuangyu Sheng[1*], Wuyue Ling[1], & Xinyan Xie[1]

[1] Zhejiang Normal University, Jinhua, Zhejiang, China

[*] Corresponding Author

Received: January 02, 2026 Accepted: February 29, 2026 Online Published: March 24, 2026

doi:10.22158/wjer.v13n2p21 URL: http://dx.doi.org/10.22158/wjer.v13n2p21

Abstract

This study focuses on town and township primary schools in Zhejiang Province to explore the implementation of the "Science Education Plus" policy. First, it analyzes the policy's evolutionary traits and reveals academic research trends and urban-rural disparities via bibliometric methods. Second, it assesses implementation from policy promotion, curriculum innovation, resource allocation, and social coordination, identifying issues like "campaign-style" promotion lacking long-term mechanisms, superficial curriculum reform, the Matthew effect in resource distribution, and fragmented social collaboration.Field research at Chisong Town's H Primary School highlights four core pain points: structural mismatches between curriculum resources and content, inefficient teaching methods and faculty, weak science education atmosphere, and insufficient educational informatization and intelligence. Accordingly, it proposes optimizations: building a "localized" science service system, innovating implementation models, creating resource aggregation mechanisms, and establishing a UGSHE collaborative education paradigm. These offer a replicable solution to break the urban-rural dual structure, advance rural education revitalization, nurture early-stage scientific talents, and uphold educational equity and the national innovation-driven development strategy.

Keywords

science education plus, town and township primary schools, educational equity, collaborative education

1. Introduction

Against the dual background of the increasingly fierce global scientific and technological competition and the growing demand for the cultivation of innovative talents in China, the basic education in our country is experiencing a historic shift from knowledge-oriented to literacy-oriented, and the introduction and implementation of the “Science Education Plus” policy have become the core starting point for this transformation. In May 2023, the Ministry of Education and 17 other ministries and commissions jointly issued the Opinions on Strengthening the Work of Science Education in Primary and Secondary Schools in the New Era, which elevated science education to the national strategic level for the first time, clearly put forward the core goal of doing a good job in the Science Education Plus in the context of the “Double Reduction” policy, and defined the direction for the reform and development of science education in primary and secondary schools.

Under the urban-rural dual structure, town and township primary schools, as an important carrier of rural education, their development level of science education is directly related to the realization of educational equity and the cultivation of rural innovative talents, but they have become a weak link in the implementation of the “Science Education Plus” policy. From the perspective of research, the existing achievements mostly focus on developed urban areas, with a serious shortage of targeted research on town and township primary schools and prominent homogeneous problems in regional research, making it difficult to form practical guidance plans adapted to township scenarios.

In this context, this study takes town and township primary schools in Zhejiang Province as research samples to systematically explore the implementation status, core pain points and quality improvement strategies of the “Science Education Plus”. It is not only an in-depth response to the practical implementation of the science education policy for primary and secondary schools in the new era, but also an inevitable choice to break the development dilemma of rural science education, promote educational equity, and serve the rural revitalization and science and technology power strategy.

1.1 Research Background

1.1.1 Policy Evolution

The introduction of the Science Education Plus policy marks a historic shift of China’s basic education from knowledge-oriented to literacy-oriented. In May 2023, the Ministry of Education and 17 other ministries and commissions jointly issued the Opinions on Strengthening the Work of Science Education in Primary and Secondary Schools in the New Era, which elevated science education to the national strategic level for the first time and clearly put forward the core goal of “doing a good job in the Science Education Plus in the context of the ‘Double Reduction’ policy in education”[1]. The policy requires solving the problems of insufficient resources and single form of traditional science education through curriculum integration, resource integration, technological empowerment and other means. This decision is both a response to the intensification of global scientific and technological competition and an active solution to the shortage of innovative talents in China.

The policy promotion shows the characteristics of a “three-step jump”: 2023 is the period of strategic breakthrough; 2024 has entered the period of in-depth implementation, the Ministry of Education has set up a national expert committee on science education in primary and secondary schools to promote the implementation of the systems of “science vice principal” and “science counselor”; 2025 has shifted to quality improvement, proposing to “build a science education system led by the government, with schools taking the main responsibility and social coordination". Data show that in the two years of policy implementation, the number of literatures related to "Science Education Plus" in databases such as CNKI and Wanfang has increased by 37%, and the proportion of papers in core journals has reached 28%, indicating a significant rise in the academic research popularity in this field Figure 1, Figure 2.

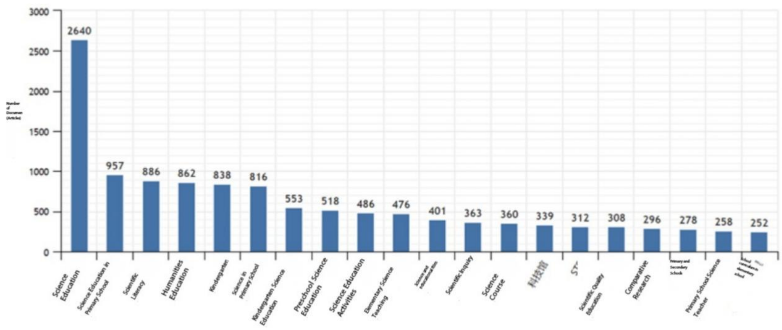

Figure 1. Distribution of Relevant Themes Retrieved with Keywords such as "Science Education Plus"

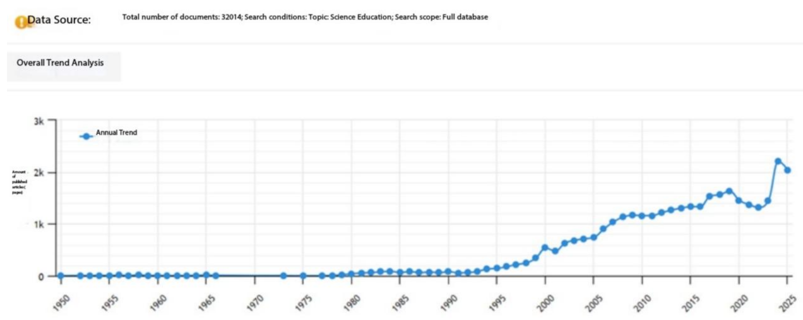

Figure 2. Publication Volume of Literatures Retrieved with Keywords Such as "Science Education Plus"

1.1.2 Policy Implementation Status

1.1.2.1 "Campaign-style" Characteristics of Policy Promotion and Lack of Long-term Mechanism

Since the release of the Opinions on Strengthening the Work of Science Education in Primary and Secondary Schools in the New Era in 2023, the policy implementation has shown significant "campaign-style" characteristics. Data from the Ministry of Education shows that the number of national science education experimental zones increased by 250% from 2023 to 2024, and the number of experimental schools exceeded 994 (General Office of the Ministry of Education, 2025). Although this rapid expansion reflects the policy execution capacity, it also exposes the problem of the lack of a long-term mechanism. For example, although Aksu City in Xinjiang has equipped 662 full-time science teachers, the professional matching rate of teachers in rural schools is only 7.1%, and 46.5% are part-time teachers from liberal arts majors (Education Bureau of Aksu City, 2025). This "quantity over quality" promotion method has led to the "floating" phenomenon in policy implementation, making it difficult to form a sustainable development ecosystem.

1.1.2.2 Superficial Curriculum Innovation and Disconnection from Core Literacy

Curriculum reform is the core starting point for policy implementation, but the existing innovations mostly stay at the formal level. For example, Professor Nashon from the University of British Columbia pointed out that an ideal STEM education focuses on the mutual influence between knowledge of different disciplines, how the invention of knowledge in one discipline affects another, and how the development of one discipline is based on the principles and progress of other disciplines (Li, 2014). However, in reality, limited by single-disciplinary knowledge and pedagogical knowledge, only a very small number of primary and secondary school teachers can carry out high-quality interdisciplinary theme learning activities (Ryu, Mentzer, & Knobloch, 2019). Scholars such as Cheng Wei pointed out that under the constraints of basic class hours and fixed curriculum structure, formal classrooms are often unable to provide sufficient time for students to conduct in-depth practical exploration and knowledge transformation (Cheng, Yang, Tang et al., 2024). This kind of innovation that “changes the form but not the essence” is essentially a reflection of teachers’ deviated understanding of core literacy - most teachers believe that the “Science Education Plus” is equivalent to increasing class hours, rather than improving thinking quality.

1.1.2.3 Matthew Effect in Resource Allocation and Urban-Rural Gap

The policy emphasizes the need to build an integrated “1+N” science education curriculum system for primary, secondary and tertiary education as a whole. “1” refers to the national compulsory courses for primary and secondary school students, and “N” refers to local courses and school-based courses (including extended courses), club activities, after-school services and extracurricular practices, etc. It strengthens the organic connection between academic stages and vigorously cultivates the core scientific literacy of primary and secondary school students (Department of Education of Zhejiang Province, 2024). However, the urban-rural dual structure has led to the continuous expansion of the supply gap. A survey in ethnic areas shows that 38.35% of schools are not equipped with science vice principals, and 22.7% face a shortage of professional teachers (Wu, Yang, & Zhong, 2024). The gap in the coverage rate of digital resources between urban and rural areas in Zhejiang Province reaches 45 percentage points, and the obsolescence rate of experimental equipment in rural schools exceeds 35%. This gap is particularly prominent in after-school services. At present, the science education in after-school services still has problems such as narrow educational content, single teaching form, lack of teaching resources and single evaluation standard (Zheng, Zhang, Wang et al., 2023).

1.1.2.4 Fragmented Social Coordination and Mechanism Obstruction

The integration of social resources related to science education is an important path for policy implementation, but there are still fragmented problems in practice. For example, the Zhejiang Museum of Natural History receives more than 3.21 million visitors throughout the year, but the data of the group serving town and village primary schools is unknown (Zhejiang Museum of Natural History, 2025). Although some science courses are oriented to primary and secondary school students, the curriculum design does not take into account the cognitive characteristics of the basic education stage, resulting in a low participation rate. In addition, enterprises lack motivation to participate in science education, and this interest imbalance restricts the in-depth integration of social resources.

1.1.3 Research Status

1.1.3.1 "Policy Dependence" and Lack of Innovation in Theoretical Research

The existing research shows obvious characteristics of "policy dependence", mostly focusing on policy interpretation and path design, and lacking in-depth exploration of the essential laws of science education. For example, Sun Youpeng's research emphasizes the driving role of policies on science education, but does not touch on the internal connection between science education and children's cognitive development (Sun, 2024). Yang Shuran's policy interpretation also fails to deeply explore the philosophical connection between the "Science Education Plus" and quality-oriented education (Yang, 2022). This lack of theoretical innovation makes it difficult for research to break through the policy framework and form an independent academic discourse system.

1.1.3.2 Superficial Data in Empirical Research and Insufficient Explanatory Power

Empirical research mostly relies on questionnaires and interviews, lacking long-term tracking and in-depth case analysis of the implementation of the Science Education Plus in town and village primary schools. For example, although the research of Zhu Jing and Jiang Xuefeng points out the impact of scientists' participation on primary school students' scientific literacy, it does not reveal the sustainability and boundary conditions of this impact (Zhu & Jiang, 2024). In the teacher survey by Guo Congbin and others, only the correlation between professional background and teaching ability is concerned, and the interaction mechanism between the beliefs and teaching practices of science teachers in town and village primary schools is not involved (Guo, Wu, Sha, & Chen, 2024). Teachers' teaching practice is not only affected by their professional background, but may also be closely related to local school culture, social support and other factors (Fan & Wei, 2023). This phenomenon of "superficial data" weakens the explanatory power and practical guiding value of the research. Some existing studies ignore these factors, leading to one-sided conclusions.

1.1.3.3 Homogenization of Regional Research and Neglect of Differentiation

Through the visual analysis of literature data from CNKI, Wanfang and other databases, the research on the Science Education Plus mostly focuses on primary schools in developed areas, with obvious insufficient attention to primary schools in town and village areas Figure 3.

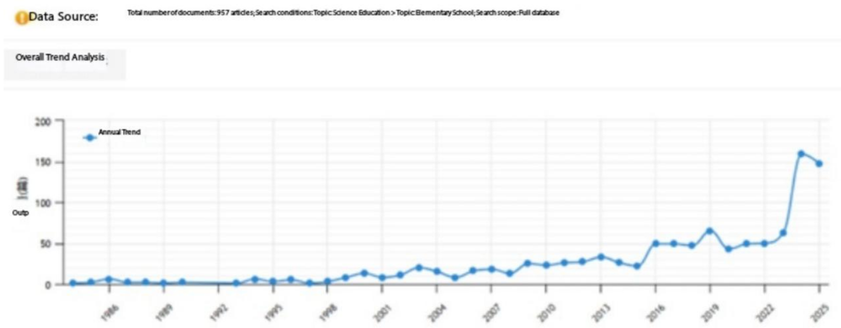

Figure 3. Number of Literatures Retrieved with Keywords such as "Primary School" and "Science Education"

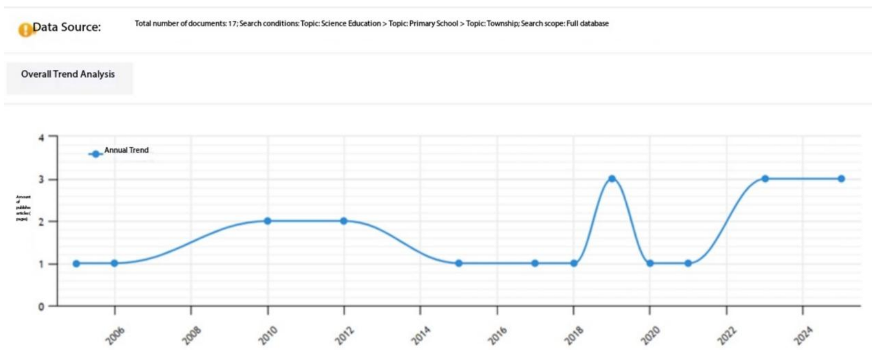

Figure 4. Number of Literatures Retrieved with the Additional Keyword "Township"

Data shows that under the keywords of "science education" and "primary school", the number of literatures reaches more than 900, while the number of literatures is only 17 after adding keywords such as "town and village", "township" and "county". This unbalanced research distribution leads to the lack of pertinence of policy recommendations. The "museum-school cooperation" model mentioned earlier is difficult to replicate in underdeveloped rural areas due to resource scarcity Figure 4.

1.1.3.4 Singularization of Evaluation Research and Deviation from Literacy Orientation

The reform of the scientific literacy evaluation system is a key link in policy implementation, but the existing research mostly focuses on examination evaluation, ignoring the core literacy orientation. Although the research of Zhang Yang and Hu Weiping proposes a diversified evaluation method, it does not establish an operable index system (Zhang & Hu, 2024). In Li Qiqi's research on curriculum standards, the evaluation dimensions and methods of core scientific literacy in science education are not clearly defined (Li, 2024). This singularization of the evaluation system leads to a deviation between policy goals and practical effects. The existing research on the definition of scientific literacy still stays at the explicit level such as knowledge and ability, ignoring the implicit dimensions such as scientific attitude and values. Most evaluation tools only measure the degree of knowledge mastery, while neglecting core literacy such as critical thinking and innovative spirit. These core literacy are precisely indispensable for cultivating "future scientists". One-sided evaluation dimensions easily lead teachers to still focus on knowledge imparting in practice.

1.2 Research Significance

1.2.1 Constructing a New Theoretical Paradigm of Rural Science Education

In-depth implementing the important expositions on education by General Secretary and based on the overall situation of the rural revitalization strategy, this study for the first time incorporates the "Science Education Plus" and the cultivation of "future scientists" into a systematic theoretical framework. By building the "Science + N + 1" innovation model (Science + N is the after-school service system, and 1 is the digital information database), it creatively puts forward the "five-in-one" development path, deeply integrates modern scientific principles with local cultural resources, and forms a rural science education theoretical system with Chinese characteristics.

1.2.2 Opening up a New Path for the Cultivation of Scientific Literacy

The research innovatively proposes a "five-in-one" cultivation system of "university-society-government-family-student". Through measures such as after-school activities of the Science Education Plus and the development of after-school activities, the cultivation of core literacy is integrated into the whole process of curriculum design, technological empowerment and social practice, providing a replicable practical paradigm for the transformation of science education from "knowledge-oriented" to "literacy-oriented" in the new era.

1.2.3 Promoting Educational Equity and Optimizing the Allocation of Educational Resources

Educational equity is an important cornerstone of social equity. However, the gap in educational resources still exists between urban and rural areas and between different regions. The research on the improvement of science education helps narrow the gap in educational resources between urban and rural areas and regions, and promote the realization of educational equity. Through the standardization of science courses and the rational allocation of teaching resources, all students, especially those in rural and remote areas, can enjoy high-quality science education.

1.3 Research Methods and Technical Route

1.3.1 Research Methods

1.3.1.1 Literature Research Method

To understand the ideas, approaches and methods of the Science Education Plus, and summarize the existing deficiencies in primary school science education. In the field research, the implementation of the Science Education Plus in each township is further understood by combining the local science education policy bulletins, school bulletin board information, school-based curriculum plans and practical activity records. By browsing literature materials with keywords such as "Science Education Plus", "primary school science education", "rural education" and "future scientists" on CNKI and various websites as reference materials, a research report on the rural Science Education Plus with both theoretical depth and practical orientation is finally formed.

1.3.1.2 In-depth Interview Method

Focusing on the key influencing mechanisms of the cultivation of "future science educators" in town and village primary schools, an interview framework is constructed according to the research objectives. A total of 28 people including county-level education administrators, rural science backbone teachers, potential student representatives and local science popularization volunteers are selected for interviews through stratified purposive sampling. It focuses on analyzing the coupling relationship between the development of local resources, curriculum implementation efficiency and teachers' professional development, and exploring the institutional obstacles and endogenous motivation in the growth track of science educators.

1.3.1.3 Questionnaire Analysis Method

Differentiated measurement tools are developed for primary school students, parents and normal university students. The questionnaire for primary school students focuses on the scientific inquiry behavior model and school-based curriculum experience, and uses latent class analysis to identify the characteristic groups of literacy development; the parent questionnaire focuses on investigating the family's investment in scientific resources and community education support; the normal university student questionnaire evaluates the curriculum design ability through the teaching situation simulation module, and refines the core quality elements of future science educators. SPSS and NVivo are used for mixed data analysis to reveal the collaborative mechanism of rural science education subjects and the training path of teaching staff, providing empirical evidence for building a "home-school-community" linked growth ecosystem for science educators.

1.3.1.4 Case Analysis Method

This study selects H Primary School in Chisong Town, Jinhua City as a typical case school. Combined with the school's foundation and actual needs for science education implementation, through classroom observation, semi-structured interviews with teachers and students, analysis of students' practical works and other methods, it tracks and records the actual development, problems encountered and changes in students' learning behaviors in curriculum implementation, sorts out and summarizes the effective experiences and deficiencies in curriculum design and teaching implementation, and finally forms a reference model for the implementation of rural primary school science education courses that is adaptable and easy to implement.

1.3.2 Technical Route

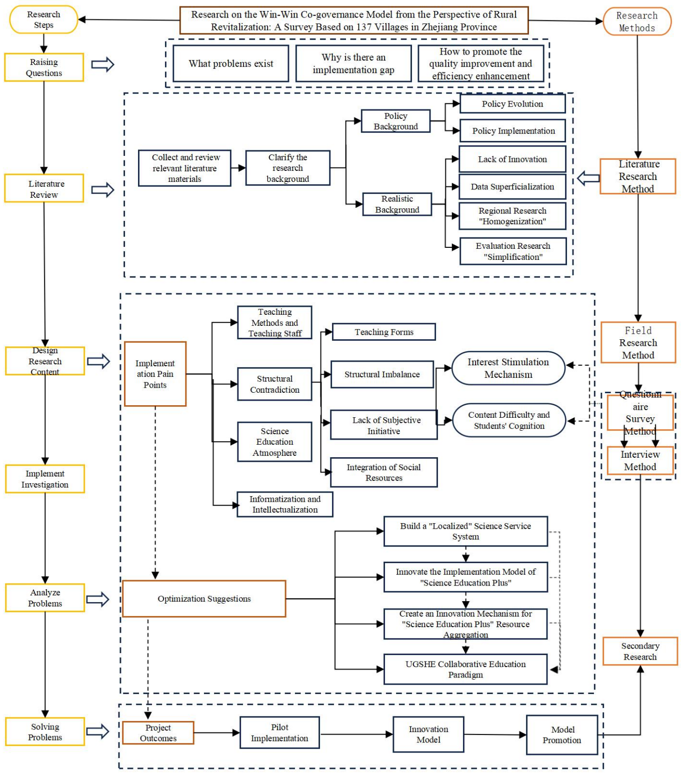

Figure 5. Technical Route Chart

2. Development Status and Practical Pain Points

2.1 Structural Contradiction between Curriculum Resources and Teaching Content

2.1.1 Single Teaching Form

The shortage of curriculum resources also limits the richness of teaching content. The science courses in many schools only rely on textbooks and a small amount of experimental materials, lacking diversified teaching resources, which makes the teaching content and form relatively single and difficult to stimulate students' desire for inquiry and innovative thinking Table 1.

Table 1. Weekly Science Class Hours in Township Primary Schools

Weekly Science Class Hours	Percentage (%)
1 class	26.87
2 classes	27.61
3 classes	23.13
4 or more classes	18.66
No science classes	3.73

2.1.2 Structural Imbalance in Curriculum Supply

There is a deviation between the class hour allocation and policy requirements. At this stage, the popularization of science education in H Primary School has initially taken shape, but the balance and popularization of its science education still fail to fully meet the students' needs, and the rationality of the science curriculum setting needs to be improved. The survey shows that the weekly class hours of science courses in H Primary School present an "olive-shaped" distribution, with 27.61% of schools having 2 class hours per week, but 3.73% of schools still do not offer science courses, and 18.66% of schools have 4 or more class hours per week Table 2.

Table 2. Reasons for Primary School Students' Lack of Interest in Science Courses

Reasons for Lack of Interest	Percentage (%)
Science class content is too difficult to understand	42.86
Science experiment procedures are too complex	40.82
Science classes lack interactivity	28.57
No interest in science topics	40.83
Science courses are less attractive than other subjects	30.61
Other	8.16

2.1.3 Students' Lack of Subjective Initiative in Courses

Survey data shows that 42.86% of students think the "content is too difficult to understand" and 30.61% think the "course is not attractive enough". The phenomenon of cognitive load overload reflects problems such as knowledge ladder fault and insufficient interdisciplinary integration, and there is a vicious circle of "high cognitive load → low learning motivation".

As shown in the survey, 28.57% of students point out the "lack of interactivity", which is caused by the overemphasis on knowledge imparting in teaching methods while ignoring the necessary teacher-student interaction and communication, as well as the single teaching method leading to the decline of students' learning interest. This further indicates that to promote the development of primary school science education, it is necessary to make the content design and teaching methods more in line with the actual needs of students to improve their participation and interest, and avoid the "single teaching method" as much as possible.

2.2 Insufficient Overall Efficiency of Teaching Methods and Teaching Staff

Table 3. Primary School Students' Perception of the Role of Science Courses

Perceived Role of Science Courses	Percentage (%)
Accumulate more scientific knowledge	58.96
Cultivate experimental skills	44.03

Foster logical and innovative thinking	36.57
Facilitate autonomous learning	24.63
Satisfy curiosity about science	49.25
Gain clearer understanding of personal interests and strengths	22.39
Help clarify career direction	18.66
Other	0.75
No help	8.21

Data shows that only 8.21% of students think that science courses are not helpful to them, and the remaining students all think that science courses are helpful to them. The main help lies in accumulating more scientific knowledge, satisfying curiosity about science and cultivating experimental skills, with the proportions of the three being 58.96%, 49.25% and 44.03% respectively, and the proportions of other help are roughly the same Table 3.

This indicates that the current science courses are generally recognized and valued by students, and certain achievements have been made in the development of science education, but some students still have insufficient cognition and attention to science courses, that is, the development of science education at this stage still needs continuous efforts. On the one hand, teaching parties need to reflect on whether the curriculum content is too theoretical, focusing on "memory-understanding" level activities while ignoring "analysis-creation" level; on the other hand, the single teaching method may also lead to some students being unable to integrate into the classroom.

2.3 Prominent Shortcomings in the Science Education Atmosphere

Table 4. Primary School Students' Expectations for School Science Education Development

Expected Resources & Activities	Percentage (%)
More experimental equipment and materials	75.37
Abundant science books and magazines	52.99
Online science learning platforms or video courses	44.78
Regular scientific practical activities	58.96
Science lectures	32.84

Table 5. Areas for Improvement in Current Science Education from Primary School Students' Perspective

Suggestions for Improvement	Percentage (%)
Increase the number of science classes	33.58
Update and add experimental equipment	53.73
Enrich the content of science courses	55.97

Provide more time for experiments	63.43
Establish more scientific projects and research activities	46.27
Provide more scientific education resources and materials	35.82
Other	2.99

The shortage of science education resources is an important factor affecting the quality of science education. The survey shows that 63.43% of students think that science courses lack experimental time, and 75.37% of students hope that schools can provide more experimental equipment and materials Table 4,Table 5. This indicates that students have a strong demand for scientific experiments and practical activities, and hope to deeply understand and explore scientific knowledge through hands-on operation. However, the allocation of science education resources in some schools is unreasonable, with obsolete and insufficient experimental equipment, which is difficult to meet the students' learning needs. This shortage of resources not only restricts the cultivation of students' practical ability, but also affects the interest and effectiveness of science education.

In addition, the shortage of science education resources is also reflected in the curriculum content and teaching methods. The current science curriculum content is relatively single, lacking close combination with real life, which is difficult to stimulate students' learning interest. In terms of teaching methods, the traditional lecture-based teaching still dominates, lacking heuristic, inquiry-based and interactive teaching methods, leading to low student participation in the classroom and poor learning effects. This single teaching model is difficult to meet the diverse learning needs of students and is not conducive to the all-round development of students' scientific literacy.

2.4 Lack of Educational Informatization and Intellectualization

The research finds that the informatization transformation of current primary school science education is facing a dilemma of "triple disconnection".

First of all, there is a generational gap between hardware configuration and teaching needs. Although multimedia equipment is basically popularized, most classrooms only stay at the PPT demonstration level and fail to realize in-depth applications such as virtual reality (VR) and augmented reality (AR). Secondly, teachers' ability to use information technology is relatively limited, failing to make full use of information technology to enrich teaching content and improve teaching effects, and there is a capacity gap between digital literacy and technological innovation requirements. The research data of this group shows that only 29.7% of science teachers can proficiently use interactive teaching software. In addition, the digitalization and networking level of science education resources is low, and students find it difficult to obtain rich scientific learning resources through network platforms, which restricts the development of their autonomous learning and inquiry ability.

3. Optimization Path for Town and Township Primary Schools to Implement the "Science

Education Plus"

3.1 Build a "Localized" Science Service System

Figure 6. Creative Chemistry: Colorful Effervescent Tablets

Figure 7. Creative Model: Aircraft Carrier Construction

First, establish a two-tier service system of "county-level overall planning + school-based implementation", formulate an overall plan for the "Science Education Plus" service system serving primary school students in towns and villages, clarify the goals, content, methods and evaluation system of doing a good job in the Science Education Plus, and build a scientific, systematic and perfect science education service system. Second, on the premise of fully understanding the local implementation of the "Science Education Plus" and available resources, carry out after-school service activities with the help of local cultural auditoriums and other venues to make up for the existing shortcomings of science education in local primary schools. Third, fully link and rely on volunteer organizations to form a sustainable and developable circular model locally Figure 6, Figure 7.

3.2 Innovate the Implementation Model of the "Science Education Plus"

Science education should adopt diversified teaching models, including inquiry-based learning, project-based learning, situational simulation teaching, etc., to enhance the interest and interactivity of courses. On the basis of school-based science courses, the research team integrates other disciplines (e.g., “Science + Engineering”: guiding students to build models by hand). At the same time, schools should strengthen cooperation with families and society to form a joint force for science education and jointly solve the coordination problems in science education.

3.3 Resource Aggregation and Innovation Mechanism

Figure 8. Science and Technology Broadens Horizons

Systematically construct a collaborative innovation network of internal and external science education resources for schools, and form a three-dimensional resource project including modules such as scientific inquiry, science popularization lectures and cutting-edge science and technology experience camps through carriers such as museum-school co-constructed courses and institute-school joint laboratories. In particular, set up the “Future Scientists Nursery Program”, transform the resources of national key laboratories into innovative projects for basic education, improve the early identification and cultivation mechanism of top innovative talents, and reserve high-quality students for the national strategic scientific and technological strength Figure 8.

3.4 UGSHE Collaborative Education Paradigm

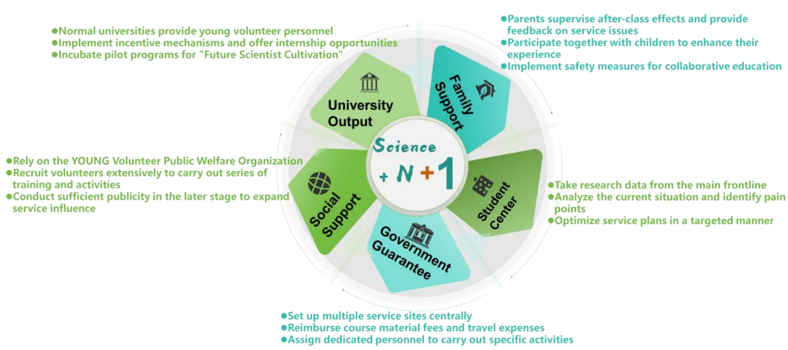

Figure 9. The "Science + N + 1" Collaborative Education Paradigm

Construct a "five-in-one" science education community of University-Government-Student-Home-Enterprise (UGSHE) Figure 9. Implement the "double tutor system" home-school cooperation plan, develop a certification system for university science education volunteer services, and establish a government-led cloud platform for monitoring the quality standards of science education. Implement the "Enlightenment Program for Future Science Educators", and through the two-way empowerment of curriculum immersion and practical training, systematically shape their scientific spirit and educator character in the critical period of the formation of teenagers' scientific concepts, so as to realize the step-by-step development of the literacy of reserve scientific and technological talents.

4. Conclusion

Taking town and township primary schools in Zhejiang Province as the research object, this study conducts a systematic exploration on the implementation status and quality improvement strategies of the "Science Education Plus". Through policy combing, literature analysis and field research on H Primary School in Chisong Town, Jinhua City, it clarifies the core problems and optimization paths for the development of science education in town and township primary schools, and provides practical references for breaking the urban-rural dual structure of science education and promoting the high-quality development of rural science education. The study finds that since the implementation of the "Science Education Plus" policy, it has achieved phased promotion from strategic breakthrough to quality improvement, but its implementation in town and township primary schools presents multiple dilemmas: the policy promotion has "campaign-style" characteristics and lacks a long-term mechanism, curriculum innovation is superficial and disconnected from the cultivation of core literacy, the Matthew effect in resource allocation widens the urban-rural gap, social coordination is fragmented and lacks in-depth integration. At the same time, there are specific pain points such as lagging textbook iteration, insufficient professional ability of teaching staff, weak science education atmosphere, and low level of informatization and intellectualization. The policy dependence, regional homogenization and single evaluation of existing research further lead to the lack of adapted theoretical and practical guidance for science education in town and township primary schools.

Based on the research results, the "Science + N + 1" education model and the university-government-student-family-society "five-in-one" collaborative education paradigm constructed in this study provide a systematic framework for improving the quality of science education in town and township primary schools. Strategies such as the localized science service system, interdisciplinary implementation model and resource aggregation innovation mechanism are accurately adapted to the resource endowments of town and township primary schools; innovative measures such as the construction of cloud database and the development of personalized resource packages have realized the upgrading of science education from standardized supply to precise service, effectively made up for the resource shortcomings of town and township primary schools, and provided a feasible path for narrowing the urban-rural science education gap and deepening the connotation of educational equity.

The modular courses, practical manuals and other achievements formed in this study have been implemented in pilot schools and achieved good results, with replicable and promotable practical value; the new theoretical paradigm of rural science education constructed breaks the shackles of urban centralism and enriches the theoretical connotation of rural education revitalization and scientific literacy cultivation. However, the long-term development of the "Science Education Plus" in town and township primary schools still needs to solve problems such as an imperfect supervision system and cognitive deviations of subjects. It requires the government, schools, families and society to form a joint collaborative force, improve the quality evaluation system, and strengthen the construction of teaching staff. Only in this way can a sustainable rural science education ecosystem be built, enabling rural children to enjoy fair and high-quality science education, and cultivating rural teenage reserve forces for the construction of a science and technology power.

Acknowledgments

This paper was supported by Provincial Undergraduate Training Program on Innovation and Entrepreneurship (Number: S202510345127).

References

Cheng, W., Yang, S. T., Tang, Q. W. et al. (2024). How to Carry Out Interdisciplinary Theme Learning? Research Enlightenments from Integrated STEM Education. *Modern Educational Technology*, *34*(12), 56-64.

Department of Education of Zhejiang Province. (2025). *Opinions of the Department of Educatio n of Zhejiang Province and 13 Other Departments on Strengthening the Work of Science Education in Primary and Secondary Schools in the New Era*. https://jyt.zj.gov.cn/art/2024/1/3/art_1532973_58941579.html

Education Bureau of Aksu City. (2025). Science Education Plus · Two-Year Report | Aksu, Xin jiang: Deepening the Integration of Disciplines and Promoting the Implementation and Effe ctiveness of Science Education Work. Retrieved from http://news.china.com.cn/2025-02/20/content_117713409.htm

Fan, D. P., & Wei, Y. H. (2023). Debates on the View of the Nature of Science in Science E ducation and the Interdisciplinary HPS Teaching Approach. *Studies in Dialectics of Nature*, *39*(08), *125-130.*

General Office of the Ministry of Education of the People's Republic of China. (2025). *Circula r of the General Office of the Ministry of Education on Issuing the Guidelines for the Wo* *rk of Science Education in Primary and Secondary Schools*. Retrieved from https://www.gov.cn/zhengce/zhengceku/202501/content_7000414.htm

Guo, C. B., Wu, Y. C., Sha, J. M., & Chen, D. C. (2024). The Teacher Foundation of Science Education in Primary and Secondary Schools in China: Challenges and Countermeasures - Based on a Questionnaire Survey of 16841 Primary and Secondary School Teachers. *Journal of the Chinese Society of Education*, *2024*(06), 77-83.

Li, Q. Q. (2024). Historical Evolution and Future Prospect of Primary School Science Curriculum Standards in China. *Education Science Forum*, *2024*(14), 3-8.

Li, Y. B. (2014). Reflection on the Essence of the STEM Education Movement and Practical Problems - A Dialogue with Professor Nashon from the University of British Columbia. *Global Education Outlook*, *43*(11), 3-8.

Ministry of Education. (2023). *Doing a Good Job in the Science Education Plus in the Context of the "Double Reduction" Policy*. Retrieved from http://www.moe.gov.cn/jyb_xwfb/s5148/202306/t20230619_1064850.html

Ryu, M., Mentzer, N., & Knobloch, N. (2019). Preservice teachers' experiences of STEM integration: Challenges and implications for integrated STEM teacher preparation. *International Journal of Technology and Design Education*, (3), 42-47. https://doi.org/10.1007/s10798-018-9440-9

Sun, Y. P. (2024). Comprehensively Promoting the High-Quality Development of Basic Science Education in the New Era - A Study on General Secretary's Important Expositions on Education. *Science Education and Museums*, *2024*(01), 7-15.

Wu, N., Yang, L. C., & Zhong, C. H. (2024). Current Situation, Problems and Countermeasures of Science Education in Compulsory Education Schools in Ethnic Areas. *Chinese Ethnic Education*, *2024*(6).

Yang, S. R. (2022). Interpretation of the National "Double Reduction" Policy. *Journal of Taiyuan Urban Vocational College*, *2022*(06), 89-92.

Zhang, Y., & Hu, W. P. (2024). An Empirical Study on the New Model of Science Education Driven by Innovative Methods for Creativity Cultivation. *China Modern Educational Equipment*, *2024*(14), 23-26.

Zhejiang Museum of Natural History (2024). *2024 Annual Science Popularization Performance Self-evaluation Report of Zhejiang Museum of Natural History National Science Popularization Education Base*. Retrieved from https://www.kepuchina.cn/article/articleinfo?business_type=100&ar_id=581470.

Zheng, Y. H., Zhang, D. B., Wang, Y. Y. et al. (2023). Reform of Science Education in Basic Education Stage: Demand, Problems and Countermeasures. *Studies in Dialectics of Nature*, *2023*, *39*(10), 11-17. https://doi.org/10.19484/j.cnki.1000-8934.2023.10.013

Zhu, J., & Jiang, X. F. (2024). The Role and Function of Scientists in Science Education. *Jou* *rnal of East China Normal University (Educational Sciences Edition)*, *2024*(08), 50-63.