

Study on the influence of social support on the effect of science education in rural primary schools

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Received 17.07.2023

Accepted 07.08.2023

Abstract: This paper analyses the influence of different social support on the effect of science education in rural primary schools, based on the data of rural primary school teachers in 5 regions of Heilongjiang Province in China. The study found that the independent effects of the five social supports such as economic support, the support of science education venues, the guidance of science education and teaching on-site, improvement training of science teacher quality, serve as a science education counsellor on the effect of science education in rural primary schools were significant. The improvement training of science teacher quality and the guidance of science education and teaching on-site still has a great influence on the effect of science education in rural primary schools under the background of different school characteristics, and under sufficient and insufficient capital of science teaching. However, the impact of economic support, the support of science education venues, serving as a science education counsellor is not significant. Therefore, in order to better provide high-quality social support for science education in rural primary schools, a multi-subject science education alliance, led by the county educational administrative departments, should be established to improve coordination and matching degree of social support resource. A science education demand evaluation system, should be established in rural primary schools, to enhance the accuracy of social support services. The quality improvement of science teachers should be taken as the core of social support to clarify the direction of social support.

Keywords: social support; rural primary school; science education; educational effect.

Acknowledgments: Fund project: National general education project of National social science fund in 2021: Study on the retention mechanism of rural teachers (Grant No. BHA210137).

For citation: Yu Haiying, Cui Yushan, Fu Haifan. Study on the influence of social support on the effect of science education in rural primary schools. *Vektor nauki Tolyattinskogo gosudarstvennogo universiteta. Seriya: Pedagogika, psikhologiya*, 2023, no. 3, pp. 37–49. DOI: 10.18323/2221-5662-2023-3-37-49.

INTRODUCTION

Reasons for the study

Scientific literacy is an important part of national literacy, and the overall improvement of national literacy has become a prerequisite for economic and social development. On June 3, 2021, the State Council issued the Outline of the National Scientific Literacy Action Plan (2021–2035), and on September 6, 2022, the General Office of the Central Committee of the CPC, and the General Office of the State Council issued. The Opinions on Further Strengthening the Popularisation of Science and Technology in the New Era, which reflects the importance China attaches to the value of science education. The important significance of science education for rural revitalisation lies in creating a high-quality farmer team, that meets the requirements of the development of rural agricultural modernisation, improving the scientific literacy of farmers, and accelerating the comprehensive revitalisation of rural areas¹. Science education in rural

primary schools is an important foundation stage for the formation of rural students' scientific literacy. Therefore, it is necessary and important to pay attention to science education and its effect in rural primary schools. Social support can enable schools to acquire new resources and professional knowledge; strengthen communication and contact between schools and communities; increase external funds, provide training, materials and resources for schools to strengthen the effect of science education². Therefore, in order to better improve national scientific literacy, universities, scientific research institutes, enterprises, grass-roots organizations, scientific communities, social groups and other multiple subjects need to actively participate in grass-roots science popularisation services³, and provide

[DB/OL]. [2022-08-06] // The State Council The People's Republic of China. URL: http://www.gov.cn/zhengce/content/2021-06/25/content_5620813.htm.

² Hutto N. Using Partnerships To Strengthen Elementary Science Education [microform] : A Guide for Rural Administrators [DB/OL]. [2022-09-06]. URL: <https://eric.ed.gov/?id=ED326361>.

³ The General Office of the State Council, the General Office of the Central Committee of the CPC issued the Opinions

¹ Circular of The State Council on the issuance of the Outline of the National Scientific Literacy Action Plan (2021–2035)

corresponding social support for science education in rural schools, which is not only the national policy requirements, but also the inevitable choice for improving the quality of science education in rural schools.

Social support for science education in rural primary schools may range from moderate to substantial, or from one-time activities to long-term work. No matter what form of social support, effective support will improve and promote the effect of science education in rural primary schools. Therefore, in order to better improve the quality of science education in rural primary schools, it is necessary to explore which of the many social supports have a greater impact on the effect of science education, in rural primary schools; under the conditions of different school characteristics and different teaching capital, support of which has great influence on the effect of science education in rural primary schools. This study attempts to reveal the influence of various social supports on the effect of science education in rural primary schools, and aims to provide valuable suggestions, for improving the quality of science education in rural primary schools.

Theoretical analysis and research hypothesis

1. Social support and the effect of science education in rural primary schools

Social support, refers to the various kinds of help and required resources that individuals or organisations get from social relationship networks, or from others [1], according to its functions. Social support includes instrumental support and emotional support; according to the nature of its support sources. Social support includes formal support and informal support [2]. These supports include policy support, financial support, technical support, environmental support, personnel support, obtained by individuals or organizations from outside. Social support for science education in rural primary schools, mainly includes financial support, environmental support, professional support, and personnel support obtained from government departments, universities, enterprises, grass-root organisations, social groups and other subjects. The quality and realisation degree of social support is determined by the quantity, quality, type, efficiency, and other aspects of social resources transmitted by the social relationship network, as well as the degree of coincidence between the "actual provision" and "acquisition perception" of these resources [3].

Poor and backward natural, and economic conditions are likely to lead to educational backwardness. Comparing rural schools with urban schools, the reason why there is a gap, stems from nothing more than the difference between natural conditions and economic conditions. From the perspective of the actual conditions of rural schools, their ability, platform and opportunity to proactively improve themselves are limited. If they only rely on their own resources rather than any external forces, the gap will be difficult to improve [4]. To eliminate the difference between urban and rural education, it is necessary not only to invest corresponding material and human resources, but also to intro-

duce social support. Social support plays an irreplaceable role in promoting the development of education and teaching in rural schools. Social support can supplement the problem of insufficient government allocation of various resources, by giving full attention to the advantages of specialty, technology, and resources according to the educational needs of rural areas [5]. In 1916, Hanifan pointed out in the "Community Centre of Rural Schools" that the investment of social capital is conducive to the success of rural schools [6]. Rural schools with different locations, types, scales and school running conditions, have different social support needs in the implementation of science education. Therefore, for rural schools with different characteristics, the role of the same social support may play a very different role, and for remote rural schools where science teachers are generally part-time, the effect of improved training of science teacher quality in social support, may be more pronounced. Rural schools can obtain different resources in the real environment, and potential social structure through different social support. These kinds of external support resources can make up for the shortage of rural schools' own science education resources. Realise the effective integration of multiple resources inside and outside rural schools, and thus inject continuous impetus into the improvement of the quality of science education in rural schools [7].

2. Teaching capital and the effect of science education in rural primary schools

Teaching capital is the synthesis of various objective conditions, necessary for schools to carry out teaching activities, and ensure the normal operation of teaching, including text resources, environmental resources and human resources. These teaching capital are the preconditions for curriculum implementation. If there are no necessary resources, the demand for teaching and learning in teaching activities will be unsatisfied, and the realisation of curriculum objectives will be greatly discounted.

Text is the carrier to realise complete meaning and function through language and culture [8], and its own system structure determines the functions of reserve, inheritance and innovation in the process of school curriculum implementation [9]. The text resources are the basis and guarantee for the efficient implementation of the curriculum [10]. The text resources of science education in rural primary schools cover textbooks, student activity manuals, teaching aids, teachers' teaching books, school-based curriculum and so on. Whether the text resources are scientific and complete is directly related to the education of the curriculum, and the gestation and release of curriculum efficiency [11]. Environmental resources, at the school level, are the basic conditions, and needs to ensure the implementation of the curriculum. The environmental resources of science education in rural primary schools mainly include laboratories, experimental equipment, network teaching resources and so on required for the opening and implementation of the curriculum. There is a phenomenon in a certain field, which must be caused by the coordination of all substances in the field [12]. The environment in which individuals live can directly affect an individual's internal experience [13]. Students in a good educational environment are more likely to be stimulated, aware of their potential, and interested in learning. Making curriculum content with a certain depth

on *Further Strengthening the Popularization of Science and Technology in the New Era* [DB/OL]. [2022-09-06] // *The State Council The People's Republic of China*. URL: http://www.gov.cn/zhengce/2022-09/04/content_5708260.htm.

and breadth more understandable. The human resources in schools are the sum of various abilities and qualities attached to teachers. As far as science education in rural primary schools is concerned, its human resources include the number of teachers and professional quality available for the opening and implementation of the curriculum. According to the theory of allocation efficiency, the optimal allocation of production factors can be realized, and the efficiency can reach the optimal state [14]. Reasonable allocation of teacher resources is a necessary prerequisite for curriculum implementation. As far as the effect of curriculum implementation is concerned, it does not depend entirely on the number of teachers, but also on the quality of the teachers [15]. Different rural primary schools have differences in science education text resources, environmental resources and human resources. Social support can solve the problem of insufficient teaching capital in rural schools to a certain extent, but rural schools with different teaching capital have different needs for the type and intensity of social support, and rural schools lacking human resources need more specialist science education teachers. In the case of reasonable institutional arrangements, the quantity and quality of human resources determine the effective acquisition and use of text resources, environmental resources and social resources. With the help of external social support, the science teaching capital of rural schools can be improved, thus promoting the effective implementation of science education in rural primary schools. To summarise, we present three hypotheses.

Hypothesis 1: different social support has different independent influences on the effect of science education in rural primary schools.

Hypothesis 2: under the background of different school characteristics, different social support has different influences on the effect of science education in rural primary schools.

Hypothesis 3: under different teaching capital conditions, different social support has different influences on the effect of science education in rural primary schools.

Literature review

The issue of science education in rural primary schools has attracted much attention in recent years. Existing studies have discussed and reflected on the issue of science education in rural primary schools from different perspectives. Scholars generally believe that insufficient teaching capital is an important factor, affecting the effect of science education in rural primary schools. From the perspective of text resources, rural school students mainly acquire scientific knowledge through science textbooks, and the way is relatively single [16]. Resources such as science books and science network resources are beyond the reach of rural students, and there are few decent scientific teaching aids and learning tools in rural schools. Textbooks are important curriculum resources for the implementation of science education, but they are not the only ones. Science teachers, independently develop a school-based curriculum based on local materials in a rural natural environment, which can make up for the shortage of teaching resources to some extent [17]. From the perspective of environmental resources, science education is centered on inquiry and experiment, and experimental teaching is the main link of science education. The shortage of science education laboratories in

rural primary schools, directly restricts the effect of science education. There are mainly some common experimental instruments in the science education laboratory of rural primary schools, such as alcohol lamps, beakers and test tubes. Due to the lack of advanced scientific experimental equipment and instruments, many hands-on curriculum can only be demonstrated, and even some schools can only be demonstrated by teachers on the blackboard [18]. There are few full-time laboratory administrators in rural primary schools, which makes the experimental equipment not effectively maintained and utilised [19]. From the perspective of human resources, teachers' scientific professionalism directly affects the effect of science education in rural primary schools. The teachers of science education, in rural primary schools, are relatively weak [20], with few full-time teachers, most of whom are part-time teachers and lack a scientific professional background. The non-specialisation of science teachers means it is difficult to guide students to cultivate strict scientific thinking, scientific literacy and scientific cognitive ability, thus affecting the effect of science education [21].

That a social support can improve the effect of science education in rural primary schools has become the consensus of many scholars. The generally accepted way of social support is to hire, off-campus, science education professionals or volunteers who are enthusiastic about scientific activities, or experts with special skills in rural communities, to serve as experts or counsellors to guide science education. The construction of high-quality counsellors ensures the quantity and quality of science education teachers, in rural schools, thus, ensuring the smooth development of science education activities on campus [22]. Training plays an important role in improving the quality of rural science teachers. The design of the content and methods of science education teacher training in rural primary schools will be targeted and effective only, if it is placed in the background of rural schools. Training sets different priorities according to the needs of rural teachers' in science education, providing science teachers with the needs of rural schools, so that teachers can gain something each time and promote their quality improvement [23]. The training of science education teachers in rural primary schools, should be based on renewing the teachers' scientific education concept and scientific knowledge structure, and cultivating the teachers' teaching and experimental hands-on ability in science education. Only science teachers who receive high-quality training can have the ability and energy to carry out science education and teaching activities in depth, and cultivate rural students' scientific literacy and innovation consciousness [24].

Based on the research and analysis of relevant literature, it is found that the discussion of science education in rural primary schools mainly reveals the problems, difficulties and strategies from the perspectives of text resources, environmental resources, human resources and social support. However, it is rare to analyse the relationship among social support, teaching capital, and the effect of science education in rural primary schools through empirical data. Through quantitative research and comprehensive consideration of the internal relationship among them, it can provide an improved realistic starting point and operating procedures for improving the effect of science education in rural primary schools. In view of this, this study conducts

research and analyses relevant data in rural primary schools, in order to provide valuable reference suggestions, for the implementation of science education in rural primary schools.

RESEARCH DESIGN

Questionnaire design and variable selection

The questionnaire used in this paper is a self-made questionnaire, by the research group of the National Social Science Foundation Project "Study on the retention mechanism of rural teachers". On the basis of theoretical analysis and literature review, the questionnaire was designed in combination with Primary School Science Curriculum Standards for Compulsory Education (2017 Edition and 2022 Edition), and the Outline of the National Scientific Literacy Action Plan (2021–2035). The whole questionnaire is divided into four dimensions. The first dimension is the basic information of the subjects, including gender, age, length of teaching, school type, number of school classes, school location and school running conditions. The second dimension is the independent variable, the teaching capital of rural primary school science education, including text resources, environmental resources and human resources. The text resources mainly include textbooks, student activity manuals, teaching aids, teachers' teaching books, and school-based curriculum. Environmental resources mainly include laboratories, experimental materials and equipment, and network teaching resources. Human resources mainly include the number of full-time and part-time teachers and whether teachers with an academic background. The third dimension is the intermediary variable social support, that is, social support provided by government departments, universities, scientific research institutes, enterprises, grass-root organisations, scientific communities, social groups and other subjects. Including economic support, the support of scientific education venues, the guidance of science education and teaching on-site, also improvement training of science teacher quality, and serving as a science education counsellor. The fourth dimension is the dependent variable science education effect, including the opening situation and the classroom teaching effect of science curriculum. Among them, the opening situation of science curriculum includes the opening situation of science curriculum in grades 1 to 2 shall be offered for no less than 1 class hour per week. The opening situation of science curriculum in grades 3 to 6 is not less than 2 class hours per week. The implementation of various exchange and display activities related to science education, and the opening of science and technology corners or science and technology parks on campus; the classroom teaching effect of the science curriculum. The questionnaire is in the form of a Likert five-level scale, which is represented by numbers 1–5. The higher the score from 1 to 5, the lower the degree of conformity. See Table 1 for the variable setting and its descriptive statistics.

Data sources

The investigation time of this study is from May to July, 2022. Five regions, namely Mudanjiang, Suihua, Jiamusi, Shuangyashan and Jixi, Heilongjiang Province, China, were selected, and 500 county, town and rural primary school

teachers were selected by stratified sampling in each region. This study conducted a telephone interview before the questionnaire was distributed, and learned that there were relatively few science teachers in rural primary schools, and most of them were part-time. If only full-time science teachers are investigated, the survey data will be obviously insufficient. Therefore, after communicating with the leaders of the survey schools, the samples are screened, and teachers who know about science education in all grades are selected by layers to distribute questionnaires to ensure the number and representativeness of the samples. The survey was conducted through the network platform WenJuanXing. A total of 2500 questionnaires were distributed, 2500 questionnaires were recovered, and invalid questionnaires were eliminated, leaving 2458 valid questionnaires, with an effective rate of 98 %. See Table 2 for sample basic information. In this study, SPSS 20.0 and AMOS 20.0 were used to make statistics and analysis on the survey data. The overall reliability of the questionnaire was 0.917. The measurement model fitting index of the questionnaire was CMIN/DF=3.985, NFI=0.918, RFI=0.900, IFI=0.924, TLI=0.906, CFI=0.924, RMSEA=0.073, SRMR=0.0650. In the structural model fitting index, CMIN/DF=13.727, NFI=0.920, RFI=0.902, IFI=0.926, TLI=0.908, CFI=0.926, RMSEA=0.073, SRMR=0.0624. All the index values meet the basic requirements, indicating that the structural validity of the model is good.

Methods

In order to verify the independent influence of different social support on the effect of science education in rural primary schools, this study adopted linear regression analysis. Without considering other factors, different social support was put into the model to analyse the independent influence of different forms of social support on the effect of science education in rural primary schools.

When analysing the influence of different social supports on the effect of science education in rural primary schools, the different characteristics of schools are taken as control variables, and all social supports are added to the model at the same time, and the influence of all social supports is analysed by stepwise linear regression.

Teaching capital is the first factor that affects the quality of education and teaching. In order to explore whether different social supports have different mediating effects in the influence of different teaching capital on rural science education, this study divides science teaching capital into two situations: sufficient teaching capital and insufficient teaching capital, which are used as independent variables respectively; the effect of rural primary school science education used as a dependent variable. Taking five kinds of social support as intermediary variables, including economic support, the support of science education venues, the guidance of science education and teaching on-site, improvement training of science teacher quality, and serve as a science education counsellor, constructed a model, adopted model 4 in the macro program of PROCESS 3.0, and selected Bootstrapping (repeated sampling technology) method to analysed respectively, to test the influence of different social support on the science education effect of rural primary schools under different science teaching capital.

Table 1. Variable setting and its descriptive statistics
Таблица 1. Настройка переменной и ее описательная статистика

Variable	Variable dimensions and topics		Max	Min	Mean	Standard deviation
Independent variable: the teaching capital of rural primary school science education	Text resources	Sufficient textbooks	5	1	2.20	0.934
		Sufficient student activity manuals	5	1	2.62	1.127
		Sufficient teaching aids	5	1	2.58	0.987
		Sufficient teachers' teaching books	5	1	2.19	0.942
		Sufficient school-based curriculum	5	1	2.62	1.077
	Environmental resources	Sufficient Laboratories	5	1	2.78	0.950
		Sufficient experimental materials and equipment	5	1	2.73	0.996
		Sufficient network teaching resources	5	1	2.86	1.005
	Human resources	Sufficient full-time and part-time teachers	5	1	2.71	1.104
Sufficient teachers with academic background		5	1	4.12	1.282	
Mediating variable: social support	More economic support		5	1	4.15	1.036
	More the support of science education venues		5	1	4.22	1.008
	More the guidance of science education and teaching on-site		5	1	3.72	1.058
	More improvement training of science teacher quality		5	1	3.38	0.970
	More serve as a science education counselor		5	1	4.37	0.980
Dependent variable: the effect of rural primary school science education	Opening situation	Science curriculum in grades 1 to 2 shall be offered for no less than 1 class hour per week	5	1	2.26	1.268
		Science curriculum in grades 3 to 6 shall be offered for no less than 2 hours per week	5	1	1.82	1.066
		Set up rich exchange activities related to science education.	5	1	3.59	0.992
		Create various types of science and technology corners, science and technology parks, etc.	5	1	3.75	1.089
	Teaching effectiveness	The classroom teaching effect of science curriculum is good	5	1	2.36	0.911

RESULTS

Independent influence of different social support on the effect of science education in rural primary schools

The summary table of regression analysis on the independent influence of different social support on the effect of science education in rural primary schools is shown in Table 3.

The results of data analysis show that different social supports have significant independent influence on the effect of science education in rural primary schools, but the influence of different social supports on the effect of science education is different. Among them, the most influential social support is the improvement training of science teacher quality, which explains the effect of science educa-

tion by 35.2 %, that is, the effect of science education increases by 0.352 units for every additional unit of the improvement training of science teacher quality; secondly, the influential social support is the guidance of science education and teaching on-site, which explains the effect of science education by 29 %; the explanatory power of three forms of social support, namely, economic support, the support of science education venues and serving as a science education counselor, is between 15 % and 16 %. This result verifies the establishment of hypothesis 1. This shows that different social support has a positive influence on the effect of science education in rural primary schools, and the greater the support, the better the effect of science education.

Table 2. Sample basic information
Таблица 2. Основная информация по выборке

Project	Option	Frequency (person)	Percentage (%)	Project	Option	Frequency (person)	Percentage (%)
Gender	Female	1659	67.5	School type	Nine-year education school	505	20.5
	Male	799	32.5		Primary school	1953	79.5
Age	21~30	184	7.4	Number of school classes	1~10	1419	57.7
	31~40	705	28.6		11~20	674	27.3
	41~50	963	39.8		21~30	264	10.8
	51~60	605	24.7		31~	101	4.1
	61~70	1	0.0	School location	County and town	367	14.9
Length of teaching	0~10	365	14.8		Rural	2091	85.1
	11~20	551	22.4	School running conditions	Very good	275	11.2
	21~30	986	40.3		Better	924	37.6
	31~40	548	22.3		General	966	39.3
	41~50	8	0.4		Relatively poor	225	9.2
					Very poor	68	2.8

Table 3. Summary table of regression analysis on the independent influence of different social support on the effect of science education in rural primary schools
Таблица 3. Сводная таблица регрессивного анализа независимого влияния различных видов социальной поддержки на результат естественно-научного образования в сельских начальных школах

Independent variable	Coefficient of determination (R^2)	Regression model integrity test (F)	Standardized regression coefficient (β)
Economic support	0.159	463.406***	0.398
The support of science education venues	0.156	453.651***	0.395
The guidance of science education and teaching on-site	0.290	1002.273***	0.538
Improvement training of science teacher quality	0.352	1331.551***	0.593
Serve as a science education counselor	0.155	452.193***	0.394

Note. *** – $p < 0.001$;
dependent variable – the effect of rural primary school science education.
Примечание. *** – $p < 0,001$;
зависимая переменная – образовательный результат сельской начальной школы.

The influence of different social support on the effect of science education in rural primary schools under the background of different school characteristics

Different social support will show different influences because of different school characteristics, such as school type, number of classes, school location and school running conditions. Regression analysis coefficient of determination (R^2) table of the effect of different social support on science education in rural primary schools under the background of different school characteristics is shown in Table 4.

From the perspective of school types, whether it is a nine-year school or primary school, the social support with absolute dominant explanatory power is the improvement training of science teacher quality, with explanatory power of 40.5 % and 33.9 % respectively; this shows that five kinds of social support can jointly predict the effect of

science education, and 40.5 % of the variation of 45.2 % in a nine-year school is completed by the improvement training of science teacher quality; of the 38.8 % variance in primary schools, 33.9 % is completed by the improvement training of science teacher quality (see model 1). From the perspective of the number of school classes, among schools with different class numbers, the social support with absolute dominant explanatory power is still the improvement training of science teacher quality; in schools with less than 10 classes, its explanatory power is 33.6 %; among the schools with 11~20 classes, its explanatory power is 33.3 %; among the schools with 21~30 classes, its explanatory power is 40.3 %; in schools with more than 30 classes, its explanatory power is 37.2 % (see model 2). From the perspective of school location, the dominant social support in county and town, rural schools is still

Table 4. Regression analysis coefficient of determination (R^2) table of the effect of different social support on science education in rural primary schools under the background of different school characteristics

Таблица 4. Таблица коэффициента детерминации (R^2) регрессивного анализа влияния разных видов социальной поддержки на естественно-научное образование в сельских начальных школах на основе разных школьных характеристик

Different school characteristics		Economic support	The support of science education venues	The guidance of science education and teaching on-site	Improvement training of science teacher quality	Serve as a science education counselor	Total
Model 1: School type	Nine-year education school	0.010	–	0.036	0.405	–	0.452
	Primary school	0.013	0.003	0.034	0.339	–	0.388
Model 2: Number of school classes	1~10	0.002	0.012	0.031	0.336	0.004	0.385
	11~20	–	0.004	0.045	0.333	–	0.382
	21~30	0.047	–	0.015	0.403	–	0.466
	31~	0.029	–	–	0.372	–	0.400
Model 3: School location	County and town	–	–	0.036	0.340	–	0.375
	Rural	0.013	0.003	0.034	0.354	–	0.404
Model 4: School running conditions	Very good	–	–	–	0.353	0.021	0.373
	Better	0.004	0.029	0.008	0.304	–	0.344
	General	0.007	–	0.052	0.273	–	0.332
	Relatively poor	–	–	0.030	0.398	–	0.428
	Very poor	–	0.062	–	0.240	–	0.302

Note. Dependent variable – the effect of rural primary school science education; independent variable – economic support, the support of science education venues, the guidance of science education and teaching on-site, improvement training of science teacher quality, serve as a science education counselor.

Примечание. Зависимая переменная – образовательный результат сельской начальной школы; независимая переменная – экономическая поддержка, поддержка мест осуществления естественно-научного образования, методическая помощь естественно-научному образованию и преподаванию на местах, повышение качества подготовки учителей естественно-научных дисциплин, помощь консультанта по естественно-научному образованию.

the improvement training of science teacher quality; in county and town schools, its explanatory power is 34 %; in rural schools, its explanatory power is 35.4 % (see model 3). From the perspective of school running conditions, the social support with absolute superiority and explanatory power under various conditions, is still the improvement training of science teacher quality; in schools with very good school conditions, its explanatory power is 35.3 %; among the schools with better school conditions, its explanatory power is 30.4 %; in schools with general school conditions, its explanatory power is 27.3 %; in schools with relatively poor school conditions, its explanatory power is 39.8 %; in schools with very poor school conditions, its explanatory power is 24 % (see model 4). Some social support in Table 3 was excluded from the model because of its weak explanatory power. The above data show that different social support has different influences on the effect of science education in rural primary schools under different school characteristics, and the improvement training of science teacher quality is the most explanatory social support in all cases. From this, it is inferred that hypothesis 2 is true.

The mediating effect of different social support between the sufficient teaching capital and the effect of rural primary schools science education

The data in Table 5 shows that the total effect, direct effect and total mediating effect in the model are significant, and the mediating effects of the guidance of science education and teaching on-site, and the improvement training of science teacher quality is significant; the mediating effect of economic support, the support of science education venues, and serving as a science education counsellor is not significant. In the model, the total effect value is 0.8077, and the mediating effect value of economic support is 0.0185, accounting for 2.29 % of the total effect; the mediating effect of the support of science education venues is 0.0091, accounting for 1.13 % of the total effect; the mediating effect of the guidance of science education and teaching on-site is 0.0596, accounting for 7.38 % of the total effect; the mediating effect value of improvement training of science teacher quality is 0.1631, accounting for 20.19 % of the total effect; the mediating effect of serving as a science education counsellor is 0.0057, accounting for 0.71 % of the total effect; the total mediating effect is 0.2560, accounting for 31.69 % of the total effect. The direct effect value of science teaching capital is 0.5517, accounting for 68.31 % of the total effect. Therefore, it is inferred that hypothesis 3 holds under the condition of sufficient capital for science teaching.

The mediating effect of different social support between insufficient teaching capital and the effect of science education in rural primary schools

The data in Table 6 shows that the total effect, direct effect and total mediating effect in the model are significant, and the mediating effects of the guidance of science education, and teaching on-site, and the improvement training of science teacher quality are significant. The mediating effect of economic support, the support of science education venues and serving as a science education counsellor is not significant. In the model, the total effect value is 0.6447, and the mediating effect value of economic support is

–0.0013, accounting for –0.2 % of the total effect; the mediating effect value of the support of science education venues is –0.0012, accounting for –0.19 % of the total effect; the mediating effect of the guidance of science education and teaching on-site is 0.0627, accounting for 9.73 % of the total effect; the mediating effect value of improvement training of science teacher quality is 0.1423, accounting for 22.07 % of the total effect; the mediating effect of serving as a science education counsellor is 0.0118, accounting for 1.83 % of the total effect; the total mediating effect is 0.2144, accounting for 33.26 % of the total effect; the direct effect value of science teaching capital is 0.4303, accounting for 66.74 % of the total effect. It is concluded that hypothesis 3 is still true under the condition of insufficient science teaching capital.

DISCUSSION

The improvement training of science teacher quality and the guidance of science education and teaching on-site have great independent influence on the effect of science education in rural primary schools

From the results of independent impact analysis, we can see that economic support, the support of science education venues, the guidance of science education and teaching on-site, the improvement training of science teacher quality and serving as a science education counsellor, all significantly affect the effect of science education in rural primary schools. Among the five social supports, the improvement training of science teacher quality and the guidance of science education and teaching on-site have greater influence. These social supports all play a positive role in promoting science education. The greater the support, the better the effect of science education, that is, the more economic support, the more science education venues, the more guidance of science education and teaching on-site, the more improvement training of science teacher quality, and the more they serve as science education counsellors, the better the effect of science education in rural primary schools. From this, it can be inferred that in terms of single-dimensional social support, in the process of improving the quality of science education in rural primary schools, the internal development of science teachers should be paid more attention to.

Under different school characteristics, the improvement training of science teacher quality and the guidance of science education and teaching on-site have great influence on the effect of science education in rural primary schools

The results of stepwise regression analysis show that the influence of different social support on the effect of science education in rural primary schools is significantly different when considering the school characteristics of rural schools, such as the school type, the number of school classes, the school location and the school running conditions. Under the characteristics of all schools, the improvement training of science teacher quality, has become the most influential social support for the effect of science education in rural schools, with an explanatory power of 24–40.5 %. Secondly, the guidance of science education, and teaching on-site plays a great role, and its explanatory

Table 5. Analysis of the mediating effect of different social support under the condition of sufficient teaching capital
Таблица 5. Анализ промежуточного влияния разных видов социальной поддержки при условии достаточного учебного капитала

Path	Effect value	Bootstrap Standard error	95 % confidence interval	
			Lower limit	Upper limit
X→M1→Y	0.0185	0.0118	-0.0043	0.0419
X→M2→Y	0.0091	0.0137	-0.0172	0.0368
X→M3→Y	0.0596	0.0172	0.0276	0.0940
X→M4→Y	0.1631	0.0213	0.1245	0.2073
X→M5→Y	0.0057	0.0119	-0.0175	0.0295
M1+M2+M3+M4+M5	0.2560	0.0230	0.2126	0.3023
X→Y	0.5517	0.0365 (S.E)	0.4800	0.6233
Total effect	0.8077	0.0374 (S.E)	0.7343	0.8811

Note. *** – $p < 0.001$;

X – capital of science teaching, Y – the effect of rural primary school science education;

M1 – economic support, M2 – the support of science education venues, M3 – the guidance of science education and teaching on-site, M4 – improvement training of science teacher quality, M5 – serve as a science education counselor.

Примечание. *** – $p < 0,001$;

X – учебный естественно-научный капитал, Y – результат естественно-научного образования сельской начальной школы;

M1 – экономическая поддержка, M2 – поддержка мест осуществления естественно-научного образования, M3 – методическая помощь естественно-научному образованию и преподаванию на местах, M4 – повышение качества подготовки учителей естественно-научных дисциплин, M5 – помощь консультанта по естественно-научному образованию.

Table 6. Analysis of the mediating effect of different social support under the condition of insufficient teaching capital
Таблица 6. Анализ промежуточного влияния разных видов социальной поддержки при условии недостаточного учебного капитала

Path	Effect value	Bootstrap Standard error	95 % confidence interval	
			Lower limit	Upper limit
X→M1→Y	-0.0013	0.0123	-0.0264	0.0227
X→M2→Y	-0.0012	0.0133	-0.0276	0.0245
X→M3→Y	0.0627	0.0165	0.0313	0.0963
X→M4→Y	0.1423	0.0193	0.1065	0.1809
X→M5→Y	0.0118	0.0092	-0.0059	0.0304
M1+M2+M3+M4+M5	0.2144	0.0195	0.1761	0.2527
X→Y	0.4303	0.0386 (S.E)	0.3547	0.5060
Total effect	0.6447	0.0380 (S.E)	0.5702	0.7192

Note. *** – $p < 0.001$;

X – capital of science teaching, Y – the effect of rural primary school science education;

M1 – economic support, M2 – the support of science education venues, M3 – the guidance of science education and teaching on-site, M4 – improvement training of science teacher quality, M5 – serve as a science education counselor.

Примечание. *** – $p < 0,001$;

X – учебный естественно-научный капитал, Y – результат естественно-научного образования сельской начальной школы;

M1 – экономическая поддержка, M2 – поддержка мест осуществления естественно-научного образования, M3 – методическая помощь естественно-научному образованию и преподаванию на местах, M4 – повышение качества подготовки учителей естественно-научных дисциплин, M5 – помощь консультанта по естественно-научному образованию.

power is between 0.8 % and 5.2 %. However, when the number of classes in rural schools exceeds 30, and the quality of running schools is very good or very poor, the influence of the guidance of science education and teaching on-site is too small, so it is excluded. Under the characteristics of many schools, economic support, providing science education venues and undertaking science education tasks have not played a normal role because of their small influence. It can be inferred that not all social support can promote the quality of science education in primary schools in any rural schools.

Under different science teaching capitals, the mediating effect of improvement training of science teacher quality, and the guidance of science education and teaching on-site is significant and influential

The test results of mediating effect show that, under the condition of sufficient teaching capital and insufficient teaching capital, the mediating effects of improvement and training of science teacher quality and the guidance of science education and teaching on-site are significant, and play a great role. The mediating effect of other social support is not significant. In the model of sufficient teaching capital, 20.19 % of all the effects of teaching capital on the effect of science education in rural primary schools is the role of improvement and training of science teachers quality, and 7.38 % are the role of the guidance of science education and teaching on-site; the mediating role of the other three variables is not significant, but they still play a positive role. In the model of insufficient teaching capital, 22.07 % of all the effects of teaching capital on the effect of science education in rural primary schools are the role of improvement and training of science teacher quality, and 9.73 % is the role of the guidance of science education and teaching on-site; the mediating role of the other three variables is not significant. Serving as a science education counsellor plays a positive role, while economic support and the support of science education venues play a negative role. Compared with the two models, in the model of insufficient teaching capital, the improvement and training of science teacher quality, and the guidance of science education, and teaching on-site play more mediating effects. It can be inferred that social support is more significant to improve the quality of science education in primary schools with insufficient rural science teaching capital.

PRACTICAL SUGGESTIONS

Establish a multi-subject science education alliance led by the county educational administrative departments, improve the coordination and matching degree of social support resources

Local education administrative departments participate in the implementation of the national scientific quality action to create a good environment, and conditions for rural schools to carry out science education, which is not only advocated by national policies, but also the needs of educational development. The multi-subject science education alliance is an effective way to strengthen the responsibility of science popularisation in the whole society. County educational administrative departments should take organisational leadership, policy support and other ways to guide

universities, research institutes, scientific communities, enterprises, grass-roots organisations, social groups and other multi-subjects to actively participate in the science education alliance [25], stimulate the sense of responsibility and participation motivation of all social subjects, increase the quantity of social support supply, while continuously improving the quality of social support.

Social forces provide social support for science education in rural schools by giving full play to the function of comprehensive support for resource supply. Therefore, the participants in the science education alliance should have all kinds of social resources, which can build a realistic platform for the realisation of social support and meet the various needs of science education in rural primary schools. The science education alliance needs to set up a special committee to take the leading responsibility in improving the quality of science education in rural primary schools, plan social support, coordinate all parties and implement administrative supervision. At the same time, make full use of evaluation technology to monitor, report, publish and guide the relevant information of social support [26]. To promote the standardisation, specialisation and normalisation of social support for science education in rural primary schools. In addition, in order to promote social support to achieve better practical results, county education administrative departments should give correct guidance and norms from the organisational level and the rule of law level, to ensure that all social forces supporting society provide appropriate and suitable social support for science education in rural primary schools according to their own advantages, and enhance the coordination and matching degree of social support resources [27].

Establish a science education demand evaluation system in rural primary schools to enhance the accuracy of social support services

It is an effective way to enhance the accuracy of social support services to establish a science education demand evaluation system for rural schools by county education administrative departments. Before providing social support for science education in rural schools, we must first understand what the needs for improving science education in rural schools are, what resources are available, and what the human, material and economic resources in schools are [28]. The demand evaluation system can present the real situation of science education in rural schools for social support, especially paying attention to those problems and needs that are easily overlooked, and can avoid the inefficiency of social support caused by blind actions.

The previous study found that not all social support is effective in any school when implementing social support for science education in rural schools. Under the background of different school characteristics and different science teaching capital conditions, the influence and direction of different social support are significantly different. Therefore, the establishment of science education demand evaluation in rural schools needs to include two indicators. On the one hand, it needs to evaluate the current situation of science education improvement demand, before providing social support. It mainly evaluates and classifies the characteristics of each school, science text resources, environmental resources, human resources and other teaching capital of each school, and takes it as a reference for participants to

choose social support forms to enhance its effectiveness. On the other hand, it is the follow-up evaluation of the effect after the implementation of social support. The evaluation team composed of social support subjects, rural primary school leaders, primary school science teachers, students and their parents evaluates the effect according to the feedback information of the teaching effect of science education in rural primary schools, and the development of students' scientific literacy, and makes appropriate adjustments to social support on the basis of the evaluation.

The quality improvement of science teachers taken as the core of social support to clarify the direction of social support

From the reality of the survey, there is a big problem of human resources in science teaching capital in rural primary schools, and the number of science teachers is insufficient, and most of them are part-time or interdisciplinary. Therefore, the quality of science teachers is fundamental to improving the quality of science education in rural primary schools. The data analysis of this study also fully proves this point, and providing science teachers with improved training of science teacher quality, and the guidance of science education and teaching on-site can significantly improve the effect of science education in rural primary schools. Therefore, the key to social support is the development and quality improvement of human resources.

County education administrative departments should formulate a comprehensive and systematic development plan for science teachers based on the social support platform; the development of teachers is regarded as a continuous process, from on-the-job training, on-site consultation and guidance to auxiliary follow-up support. The improving training of science teacher quality and the guidance of science education and teaching on-site should focus on solving the problems that science teachers in rural primary schools are concerned about and their professional development is limited, providing more targeted and practical social support and promoting the connotation development of science teachers in rural primary schools. We should focus on training and guiding teachers to carry out effective science teaching, guide science teachers to promote practical and process-oriented science teaching in various ways, learn to use hands-on methods to teach students science content and cultivate students' scientific thinking ability, and create conditions to encourage science teachers to constantly update and enrich their scientific knowledge and ability, which is especially helpful to help teachers from non-science majors overcome their fear of teaching science curriculum and continuously improve the quality of science education.

CONCLUSIONS

1. The improvement training of science teacher quality and the guidance of science education and teaching on-site have great independent influence on the effect of science education in rural primary schools.

2. Under different school characteristics, the improvement training of science teacher quality and the guidance of science education and teaching on-site have great influence on the effect of science education in rural primary schools.

3. Under different science teaching capitals, the mediating effect of improvement training of science teacher quality and the guidance of science education and teaching on-site is significant and influential.

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Изучение влияния социальной поддержки на результаты естественно-научного образования в сельских начальных школах

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Поступила в редакцию 17.07.2023

Принята к публикации 07.08.2023

Аннотация: В статье проанализировано влияние различных видов социальной поддержки на результаты естественно-научного образования в сельских начальных школах на основе данных учителей сельских начальных школ в пяти областях провинции Хэйлуцзян в Китае. Выявлено независимое влияние пяти видов социальной поддержки: экономической поддержки, поддержки мест осуществления естественно-научного образования, методической помощи естественно-научному образованию и преподаванию на местах, повышения качества подготовки учителей естественно-научных дисциплин, помощи научного консультанта по вопросам результатов естественно-научного образования в сельских начальных школах. Установлено, что повышение качества подготовки учителей естественно-научных дисциплин и методическая помощь естественно-научному образованию и преподаванию на местах значительно влияют на результаты естественно-научного образования в сельских начальных школах в условиях различных школьных параметров и разного уровня достаточности учебного естественно-научного капитала. В то же время влияние экономической поддержки, поддержки мест осуществления естественно-научного образования и помощи научного консультанта по вопросам результатов естественно-научного образования незначительно. Поэтому для улучшения координирования и подбора уровня социальной поддержки естественно-научного образования в сельских начальных школах необходимо создать многопредметные естественно-научные объединения, возглавляемые окружными отделами управления образованием. В сельских начальных школах должна быть сформирована система оценки потребности в естественно-научном образовании для повышения точности оказания услуг социальной поддержки. Для уточнения направления социальной поддержки за основу следует взять повышение качества подготовки учителей естественно-научных дисциплин.

Ключевые слова: социальная поддержка; сельская начальная школа; естественно-научное образование; образовательный результат.

Благодарности: Проект финансируется Национальным общеобразовательным проектом Национального фонда общественных наук в 2021 году «Изучение механизма удержания сельских учителей» (грант № ВНА210137).

Для цитирования: Юй Хайин, Цуй Юйшань, Фу Хайфань. Изучение влияния социальной поддержки на результаты естественно-научного образования в сельских начальных школах // Вектор науки Тольяттинского государственного университета. Серия: Педагогика, психология. 2023. № 3. С. 37–49. DOI: 10.18323/2221-5662-2023-3-37-49.