

# *An Empirical Analysis of Science and Technology Competition and College Students' Scientific Literacy*

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**Abstract:** This paper divides scientific literacy into three dimensions: Scientific knowledge, scientific ability and scientific spirit, and then uses the questionnaire survey data to analyze the influence of college students' participation degree of competition, participation motivation of competition, participation atmosphere of competition and condition guarantee of competition on scientific literacy. The study found that college students' participation degree of competition has a significant positive impact on scientific knowledge, scientific ability and scientific spirit; Participation motivation of competition has no significant impact on the scientific literacy of each dimension; Participation atmosphere of competition has a significant positive impact on scientific knowledge and scientific spirit; The condition guarantee of competition has a significant positive impact on scientific knowledge and scientific ability. Finally, this paper puts forward targeted policy recommendations.

## **1. Introduction**

The cultivation of college students' scientific literacy is of great significance to the development of college students [1-3]. Domestic scholars have done more research on improving the scientific quality of college students. Among them, improving the scientific literacy of college students through science and technology competitions is more concerned by scholars. However, the specific effect of science and technology competition on improving the scientific literacy of college students remains to be further studied.

In recent years, I have repeatedly guided students to participate in science and technology competitions, such as "Challenge Cup" competition, "Learning Cup" competition. In the process of guidance, it is found that there are obvious differences between the students who have participated in the science and technology competition and the students who have not participated in the science and technology competition, especially in scientific knowledge, scientific ability and scientific spirit. Based on this, this paper takes the students of Shaanxi institute of international trade & commerce as the research object, using the questionnaire survey to collect data, and makes an empirical analysis of science and technology competition and college students' scientific literacy.

## 2. Research Review

For the study of science and technology competition and college students' scientific literacy, most scholars have found that science and technology competition has a significant positive impact on scientific literacy through empirical research [4,5].

Based on large-scale survey data, Hu Yongmei and Xue Haiping (2014), evaluated the impact of science competitions on the scientific literacy of high school students in China. The study found that participating in scientific competitions has a greater impact on improving the scientific literacy of high school students [6]. Jin Zhifeng and Xue Haiping (2014) investigated and analyzed the current situation of high school students' scientific literacy in China, and found that the scientific literacy of students participating in science competitions was significantly higher than that of non-participating students [7]. Xie Jun and Li Zhenyan et al. (2018) believed that scientific literacy is an important part of college students' comprehensive literacy. Only by making rational use of extracurricular scientific and technological activities and creating an environment for cultivating good scientific literacy, can college students' enthusiasm for actively enhancing scientific literacy be improved, and their scientific literacy be comprehensively improved [8].

## 3. Empirical Analysis

### 3.1. Data Sources

This paper mainly obtains data through questionnaire survey. The research objects are mainly students who have participated in science and technology competitions in Shaanxi institute of international trade & commerce. A total of 45 questionnaires were collected, and the missing values and obvious contradictory samples were deleted. Finally, 39 valid samples entered the analysis of this study. The valid questionnaire rate reached 86.67%.

### 3.2. Sample Characteristic

Student sample characteristics are shown in Table 1.

Table 1: Student sample characteristics (N = 39)

		Sample size	Percentage (%)
Gender	Male	21	53.8
	Female	18	46.2
Grade	University Grade 1	5	12.8
	University Grade 2	14	35.9
	University Grade 3	20	51.3

### 3.3. Measurement of Variables

**Scientific Literacy.** This paper measures scientific literacy from three dimensions: Scientific knowledge (KZ), scientific ability (KN) and scientific spirit (KJ) [9]. For scientific knowledge, this paper sets up three questions: "(KZ1) To participate in science and technology competition let me master a lot of extracurricular scientific concept", (KZ2) "To participate in science and technology competition helps me to understand the scientific principle", (KZ3) "Participating in scientific competitions helps to understand the scientific research process". For scientific ability, this paper sets three questions: (KN1) "Participating in the science and technology competition has improved my practical ability", (KN2) "Participating in science and technology competition trains my logical

thinking ability”, (KN3) “Participating in science and technology competition improves my ability to analyze and solve problems”. For the scientific spirit, this paper sets up three questions: (KJ1) “Participating in the science and technology competition exercises my perseverance”, (KJ2) “Participating in the science and technology competition helps to enhance my team spirit”, (KJ3) “Participating in the science and technology competition enhances my sense of innovation”. In this paper, the Likert scale is used to quantify the problem. In this paper, the Likert scale is used to quantify the problem, 1 = very inconsistent, 2 = inconsistent, 3 = general, 4 = relatively consistent, 5 = fully consistent, the larger the value, the higher the scientific literacy.

Science and Technology Competition. This paper measures science and technology competition from participation degree of competition, participation motivation of competition, participation atmosphere of competition and condition guarantee of competition. For the participation degree of competition, this paper sets two questions: (CD1) “The number of times you participate in science and technology competition”; (CD2) “The number of times you won the science and technology competition”. For the participation motivation of competition, this paper sets up four questions: (DJ1) “I participated in the science and technology competition to exercise my oral expression ability”; (DJ2) I participated in the science and technology competition to obtain credits; (DJ3) “I participated in the science competition to get a certificate”; (DJ4) “I participated in the science and technology competition to get material rewards”. For the participation atmosphere of competition, this paper sets up two questions: (FW1) “Around me students to participate in science and technology competition enthusiasm is very high”; (FW2) “Good campus science and technology culture is very helpful for me to participate in science and technology competition”. For the condition guarantee of competition, This paper sets up four questions: (TB1) “I think our school has given enough attention to the development of science and technology competition”; (TB2) “In the process of participating in the science and technology competition, I received sufficient financial support”; (TB3) “Schools provide us with enough space for science and technology competitions”; (TB4) “The school has provided us with adequate hardware to ensure the launch of the technology competition”. For the question of participation motivation of competition, participation atmosphere of competition and condition guarantee of competition, the Likert scale is used, 1 = very inconsistent, 2 = inconsistent, 3 = general, 4 = relatively consistent, 5 = fully consistent.

### 3.4. Reliability and Validity Test

The reliability and validity of scientific literacy test results are shown in Table 2.

Table 2: Reliability and validity test results of scientific literacy

	Question	Component	Cronbach's $\alpha$	KMO	Bartlett's test	Cumulative (%)
Scientific knowledge	KZ1	0.792	0.600	0.620	12.153	56.163
	KZ2	0.769				
	KZ3	0.676				
Scientific ability	KN1	0.876	0.765	0.665	29.431	68.172
	KN2	0.811				
	KN3	0.788				
Scientific spirit	KJ1	0.914	0.749	0.572	33.950	67.743
	KJ2	0.772				
	KJ3	0.775				

Table 3: Reliability and validity test results of Science and technology competition

	Question	Component	Cronbach's $\alpha$	KMO	Bartlett's test	Cumulative (%)
Participation degree of competition	CD1	0.924	0.804	0.500	25.472	85.438
	CD2	0.924				
Participation motivation of competition	DJ1	0.870	0.761	0.520	101.736	60.505
	DJ2	0.782				
	DJ3	0.689				
	DJ4	0.759				
Participation atmosphere of competition	FW1	0.884	0.638	0.500	13.833	78.124
	FW2	0.884				
Condition guarantee of competition	TB1	0.912	0.866	0.793	91.868	75.915
	TB2	0.899				
	TB3	0.882				
	TB4	0.787				

Table 4: Descriptive statistics of variables

Variable	Question	N Valid	Minimum	Maximum	Mean	Std. Deviation
Scientific knowledge	KZ1	39	2	4	3.31	0.521
	KZ2	39	2	3	2.67	0.478
	KZ3	39	2	4	2.97	0.537
Scientific ability	KN1	39	2	4	2.72	0.510
	KN2	39	2	4	2.38	0.544
	KN3	39	2	5	2.92	0.480
Scientific spirit	KJ1	39	1	5	2.77	0.706
	KJ2	39	1	4	2.41	0.595
	KJ3	39	2	4	2.95	0.826
Participation degree of competition	CD1	39	1	3	1.72	0.560
	CD2	39	0	2	0.97	0.778
Participation motivation of competition	DJ1	39	2	4	2.90	0.447
	DJ2	39	1	4	2.74	0.785
	DJ3	39	2	5	2.90	1.095
	DJ4	39	1	4	2.69	0.800
Participation atmosphere of competition	FW1	39	2	5	3.21	0.695
	FW2	39	3	4	3.33	0.478
Condition guarantee of competition	TB1	39	2	4	2.90	0.754
	TB2	39	1	5	2.72	1.605
	TB3	39	1	5	2.28	1.337
	TB4	39	1	4	2.46	1.144

The test results of reliability and validity of science and technology competition are shown in Table 3.

The analysis of the above table shows that the scales of participation degree of competition, participation motivation of competition, participation atmosphere of competition and condition guarantee of competition have good reliability and validity.

Descriptive analysis of the variables is shown in Table 4.

For descriptive analysis, this paper mainly analyzes the minimum, maximum, mean and standard deviation of the relevant measurement items of each variable.

The correlation coefficients between the variables are shown in Table 5.

Table 5: Person correlation coefficients between variables

	1	2	3	4	5	6	7
Participation degree of competition	1						
Participation motivation of competition	0.145	1					
Participation atmosphere of competition	0.171	0.298*	1				
Condition guarantee of competition	0.278*	-0.252	-0.598***	1			
Scientific knowledge	0.266**	0.075	0.675***	0.807***	1		
Scientific ability	0.511**	0.139*	-0.05	0.315*	0.302**	1	
Scientific spirit	0.6495***	-0.018	0.396**	0.049	-0.097	0.366*	1

Notes: \* \*\*, \*\* ,and\*represent that the estimated coefficients are significant at the 1% ,5% ,and 10% confidence levels, respectively.

Through the above table, the participation degree of college students' science and technology competition is significantly positively correlated with scientific knowledge, scientific ability and scientific spirit;

The Participation motivation of college students' science and technology competition is weakly correlated with scientific knowledge and scientific spirit, and positively correlated with scientific ability.

The participation atmosphere of college students' science and technology competition is significantly positively correlated with scientific knowledge and scientific spirit, and has no significant correlation with scientific ability.

The condition guarantee of college students' science and technology competition is significantly positively correlated with scientific knowledge and scientific ability, and has no significant correlation with scientific spirit.

Firstly, taking college students' scientific knowledge, scientific ability and scientific spirit as the dependent variables, and the participation degree of competition, participation motivation of competition, participation atmosphere of competition, condition guarantee of competition as the independent variables, WLS is used for regression estimation.

Then, a principal component of scientific knowledge, scientific ability and scientific spirit is extracted as scientific literacy. Taking scientific literacy as the dependent variable, and the participation degree of competition, participation motivation of competition, participation atmosphere of competition, condition guarantee of competition as the independent variables, WLS is used for regression estimation. Using SPSS19.0, get Table 6.

Table 6: Regression results of theoretical model

Variable	Scientific knowledge	Scientific ability	Scientific spirit	Scientific literacy
Participation degree of competition	0.199* (1.926)	0.429** (2.542)	0.612 *** (4.603)	0.609*** (4.831)
Participation motivation of competition	-0.041 (-0.432)	0.059 (0.384)	0.009 (0.072)	0.027 (0.238)
Participation atmosphere of competition	0.394** (3.219)	0.046 (0.228)	0.339** (2.146)	0.240* (2.134)
Condition guarantee of competition	0.506*** (3.995)	0.238*** (1.148)	0.083 (0.509)	0.354** (2.285)
R Square	0.738	0.298	0.565	0.780
Adjusted R Square	0.707	0.216	0.513	0.609
F	23.921***	3.616**	11.020***	13.219***

Notes: The standard error robust to heteroscedasticity is shown in parentheses; \* \*\*, \*\* ,and\*represent that the estimated coefficients are significant at the 1% ,5% ,and 10%confidence levels, respectively.

The sample data show that the regression coefficient of participation degree of competition to scientific knowledge is 0.199 ( $P < 0.1$ ), indicating that the stronger the students' participation in the scientific and technological competition, the higher the improvement of their scientific knowledge. The regression coefficient of participation motivation of competition to scientific knowledge is -0.041, not significant. The regression coefficient of participation atmosphere of competition to scientific knowledge was 0.394 ( $P < 0.05$ ), indicating that the stronger the atmosphere of students' science and technology competition, the higher the improvement of their scientific knowledge. The regression coefficient of condition guarantee of competition to scientific knowledge is 0.506 ( $P < 0.01$ ), indicating that the higher the condition guarantee of students' science and technology competition, the higher the improvement of their scientific knowledge.

The regression coefficient of participation degree of competition to scientific ability is 0.429 ( $P < 0.05$ ), indicating that the stronger the students' participation in competitions, the higher their scientific ability. The regression coefficient of participation motivation of competition to scientific ability is 0.059, not significant. The regression coefficient of participation atmosphere of competition to scientific ability is 0.046, not significant. The regression coefficient of the condition guarantee of competition to scientific ability is 0.238 ( $P < 0.01$ ), indicating that the higher the condition guarantee

of students' science and technology competition, the higher the improvement of their scientific ability.

The regression coefficient of participation degree of competition to the scientific spirit is 0.612 ( $P < 0.01$ ), indicating that the stronger the students' participation in science and technology competitions, the higher the improvement of their scientific spirit. The regression coefficient of participation motivation of competition to scientific spirit is 0.009, not significant. The regression coefficient of participation atmosphere of competition to scientific spirit is 0.339 ( $p < 0.05$ ), indicating that the stronger the atmosphere of students' science and technology competition, the higher the improvement of their scientific spirit. The regression coefficient of condition guarantee of competition to scientific spirit is 0.083, not significant.

The regression coefficient of participation degree of competition to scientific literacy is 0.609 ( $P < 0.01$ ), indicating that the stronger the students' participation, the higher the improvement of their scientific literacy; The regression coefficient of participation motivation of competition to scientific literacy is 0.027, not significant. The regression coefficient of participation atmosphere of competition to scientific literacy is 0.240 ( $P < 0.1$ ), indicating that the stronger the atmosphere of students' science and technology competition, the higher the improvement of their scientific literacy; The regression coefficient of condition guarantee of competition to scientific literacy is 0.354 ( $P < 0.05$ ), indicating that the higher the condition guarantee of students' science and technology competition, the higher the improvement of their scientific literacy [10].

#### 4. Conclusions and Policy Implication

Improve the conditions of all aspects of security, consolidate the foundation of science and technology competition. Perfect external condition support is the foundation and guarantee of science and technology competition platform, which plays a decisive role in the smooth development and quality of science and technology competition. Schools should first establish a coordination organization, formulate practical management methods and supporting policies to ensure that all work in the process of extracurricular scientific and technological activities is based on evidence, and minimize the negative impact of extracurricular scientific and technological activities. Secondly, according to the actual needs of students, we should increase the investment and support of hardware. One is the investment of hardware, mainly the construction of experimental platform and reference room, the purchase of instruments and equipment, and the other is the construction of software, including how to manage and use these facilities and platforms scientifically and effectively to create the greatest use value. Finally, the school should be allocated a relatively reasonable cost to ensure that students have sufficient funds to ensure the normal conduct of the competition.

Create a better atmosphere for participation in science and technology competitions. In order to fully stimulate students' positive enthusiasm, schools should pay attention to the establishment of appropriate incentive mechanism, give full play to students' initiative, and enhance students' self-confidence and sense of achievement in participating in science and technology competitions. At the same time, we should also pay attention to the introduction of excellent teacher resources to the guidance of extracurricular scientific and technological activities. Ensuring the enthusiasm of teachers and students for extracurricular scientific and technological activities is not an accidental behavior, but a benign and healthy long-term mechanism, so as to fully mobilize the enthusiasm of all levels and stimulate their potential.

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