A Study on Science normal students' Popularization Practice Ability and Its Influencing Factors

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Abstract: As future science teachers and potential main force of science popularization practice in the country, Science normal students' science popularization practice ability has gradually become a hot topic in their talent cultivation. Based on the theory of science popularization practice ability construction, this study designed a questionnaire to investigate the level science normal students' science popularization practice ability and its influencing factors. The study found that science normal students' preparation ability, practice ability, evaluation ability, and overall ability in science popularization were moderate. Gender and grade significantly influenced the overall level of science popularization practice, while major did not have a significant impact. Personal attitudes and practical experience had a positive correlation with the improvement of science popularization practice ability.

Keywords: Science Normal Students; Popularization Practice Ability; Questionnaire

1. Introduction

In September 2007, the Chinese government released *Several Opinions on Strengthening the Construction of National Scientific competency*. It mentioned that scientific competency mainly includes the comprehensive capabilities of scientific popularization creation, science and technology communication channels, scientific education systems, social organization networks for science popularization work, scientific popularization talent teams, and macro-management of government science popularization work, which together represent the comprehensive strength of the state in providing scientific popularization products and services to the public.On September 4th, 2022, the General Office of the State Council and other departments in china issued the *Opinions on Further Strengthening the Popularization of Science and Technology in the New Era*. The document points out that scientific popularization should be given equal importance as scientific and technological innovation, and that the social responsibility of scientific popularization should be strengthened throughout society, while promoting the improvement of popular science capabilities and the overall scientific competency of the population.Among them, universities, as important venues for scientific popularization, should strengthen their sense of responsibility for science popularization, leverage the advantages of rich science education resources and well-equipped scientific research facilities in university science popularization bases, enhance science education, and actively organize and support teachers and students to carry out diverse and colorful popular science practice activities.

Against this backdrop, science normal students, as future science teachers, are one of the important factors in the science education system and the main force in national scientific popularization. Strengthening science education, supporting science teachers and students to carry out popular science practice activities, aligns with China's current goal of cultivating core competencies. Xinxin Chen and Zuhao Wang (2023) revealed that scientific practice has become an important pathway for cultivating students' scientific competency in many countries, including China.Haishen, Chen&Shanyan, Song. (2022) in their research has shown that conducting popular science practice activities can effectively enhance the scientific core competencies of pre-service science teachers.Xiaohong Zhan.Peixian,Wen & Jixia.Fu (2021) proposed that popular science dissemination activities generally integrate the disciplines of chemistry, biology, physics, and natural geography, as well as educational resources such as technology, history, and culture. These practical activities are conducted

through experiential science practices and other means.normal science students have expertise in scientific knowledge and practical resources, as well as a certain ability to convey scientific information. By participating in science popularization practice activities, they can improve their scientific practical abilities, and also have a significant impact on science popularization capacity building in China.However, currently, there are few studies on the science popularization practice ability of science normal students. This study investigates the current situation and influencing factors of the science popularization practice ability of science normal students through a questionnaire survey. The results have important reference value for cultivating the practical ability of science normal students and promoting the development of science popularization in China.

2. Research Status

Many countries have long recognized that science teachers are important resources for social science popularization practice, so they attach great importance to cultivating the science popularization practice ability of science teachers. Basically, relevant courses on science popularization practice ability are included in the training curriculum for science teacher candidates.For example, in the United States, science communication practice courses are included in the training of science teachers. Museums and science centers are also involved in this effort. Peixiao,Qi & HongweiWang(2021) found the Museum of Science and Industry in Chicago has designed a wide range of training courses for science teachers, which are provided free of charge. These courses not only enhance science teachers' science communication skills but also train them to utilize venue resources for teaching science.Ivan Shibley (2008) argues that integrating science popularization content into university courses can help improve science normal students' attitudes towards science courses. This approach can help students better understand and appreciate the interdisciplinary nature of science and enhance the science practice ability of science normal students.In the study by Yuqing Geng (2021), it was found that higher education and science popularization are both educational activities that complement each other. China has continuously increased its investment in science popularization and higher education. Science popularization practice is a form of social education for college students, which can enhance their practical and innovative abilities.Xinming Han (2017) explored the important role of science popularization capacity building in university science and technology parks in areas such as technology transfer, social impact enhancement, and popularization of science and culture. Science and technology parks, as important resources for university student science popularization practice, can enhance their abilities in developing, designing, and explaining science.In Liliane's study (2011), the motivational factors of high school students participating in the Canadian Science Fair were investigated. The study found that students' motivation for participating in science communication activities mainly includes interest in science content, self-efficacy, the guarantee of achieving rewards or satisfaction, social aspects of participation, and work strategies for gaining scientific knowledge and methods. By understanding the expected benefits that students seek through participation in science communication activities, it can greatly assist science teachers in conducting science communication practice and teaching.The Chinese scholar, Lu Hao(2017)proposed that the most effective method to enhance citizens' scientific competency is to carry out science popularization, and the characteristics of college students are particularly suitable for the special requirements of science popularization.Wang Yuliang(2018) proposed that university students are not only the audience of science popularization, but also knowledgeable and cultured science communicators. The development of science popularization resources for university students should be based on the mechanism of student organizations in universities, combined with the innovation plans and social practices of university students.Wang Xiaohong suggests that the lack of emphasis on science popularization in universities is one of the reasons for the shortage of scientific spirit among college students. To address this issue, multiple approaches such as creating a scientific atmosphere on campus, organizing students to participate in scientific practice activities, etc., should be taken to reshape college students' scientific spirit. Liao Hongyuan et al(2002) proposed in their research that, in order to enhance scientific competency among college students, it is necessary to carry out popular

science activities and promote the scientific spirit, and to encourage college students to directly participate in scientific practice, so as to continuously improve their scientific and technological competence Qihui Xie's (2023)research results found that, regarding the willingness of college teachers to engage in popular science, popular science resources can have a positive and significant impact, while personal costs can have a negative and significant impact. Work environment and satisfaction incentives do not have a significant impact. Therefore, suggestions were made to increase investment in popular science, establish incentive mechanisms for popular science, and develop popular science resources in colleges and universities. Kangning Xu(2005)believes that higher normal universities are the main places for training teachers, and that through curriculum reform in normal universities, the scientific cmpetency and popular science ability of normal students should be improved, in order to provide more qualified teachers who are capable of scientific popularization education for primary and secondary schools.WeigenWang et al(2009)believe that biology major normal students are the future biology teachers and important participants in popularizing biological knowledge. Cultivating their popular science abilities is beneficial to improving their overall quality, teaching ability, and better serving society. Therefore, it is proposed that normal universities should cultivate students' popular science abilities in various aspects such as classroom teaching, scientific research, and extracurricular activities according to the needs of the times .QianZhang (2023)indicates that medical students have a high level of participation in popular science activities, but the forms of participation and sources of knowledge are relatively limited, and the scope of popular science content, venues, and audiences is relatively narrow. It is suggested that measures be taken to enhance medical students' interest in popular science, expand participation channels, and provide courses in popular science theory and practice to promote their participation in popular science and enhance their practical abilities in this field.In summary, college students generally lack practical abilities in popular science, and the quality of the college student popular science team varies greatly, with overall low levels of practical ability in popular science. As the main force of social science communication, science education students' practical abilities in popular science have been rarely studied. Therefore, studying the practical abilities of science education students in popular science and their influencing factors can provide a reference basis for the construction of an evaluation system and training model for their practical abilities in popular science.

3. Research Design

Foster-Fishman, P. G(2001)mentioned that the capability theory posits that an individual's capability refers to the total sum of their physical and mental abilities, including their actual abilities and energy that are demonstrated in real-life activities, such as physical strength, intelligence, moral strength, aesthetic ability, practical operation ability, as well as general abilities and special professional talents for engaging in certain specialized activities.According to Lei Ming(2005)argues that the general ability construction of a subject mainly includes: learning ability construction, cognitive ability construction, judgment ability construction, choice ability construction, decision-making ability construction, and practical ability construction. Among them, practical ability construction refers to the ability of the subject to actively objectify their own essential power in the activity of understanding and transforming the world. It includes the ability to design, plan and develop a scheme, plan, and steps for how to transform the object; the ability to practice, using tools and resources to transform the objective world; and the ability to evaluate and improve the practice activities carried out.This study, based on the theory of practical ability construction, examines the science education students' science popularization practical ability from three dimensions: preparatory ability, practical ability, and evaluative ability. Preparatory ability refers to the ability to accurately identify target audiences, design appropriate forms, content, and methods of science popularization activities, develop detailed plans, and clarify the purpose and significance of the activities. Practical ability refers to the ability to select appropriate science popularization methods and tools based on the actual situation and the needs of the target audience, to carefully organize, arrange, and implement science popularization activities, and to achieve vivid presentation of science and

dissemination of scientific culture. Evaluative ability refers to the ability to objectively and comprehensively evaluate the effectiveness and impact of science popularization activities, summarize experiences, identify problems, improve methods, and enhance the quality and effectiveness of science popularization practice.

4. Questionnaire Design

The questionnaire consists of three parts: basic information, influencing factors, and science communication practice abilities. The basic information includes gender, grade, and major. The influencing factors part contains two sections: personal attitudes and practical experiences, with a total of 10 questions. The evaluation of Science Popularization Practice abilities is divided into three dimensions: planning, practice, and evaluation, with 10 questions in each dimension and a total of 30 questions. Both the influencing factors and science communication practice abilities are assessed using a Likert-type scale with five options: strongly disagree, disagree, uncertain, agree, and strongly agree, assigned scores of 1, 2, 3, 4, and 5, respectively. Higher scores indicate a greater impact and higher level of the observed variable on the science communication practice abilities of science normal students. The research team discussed and determined the levels of the scores for each individual dimension and the overall dimensions.

Table 1. Levels of Science Popularization Practice Ability

		unqualified	qualified	medium	good	outstanding
scoring formula	Individual dimensions	27below	27-31	32-36	36-41	42 above
	Total dimensions	81below	81-95	96-108	108-122	123above

5. Research Participants

The subjects of this study were science education students from a teacher training college in GD province, China, from five different majors including physics, biology, chemistry, geography, and integrated science. The personal information of the subjects included gender, grade level, and major, as shown in Table 2.

Table 2. Research Participants Table

Items	Options	numbers	(%)
Gender	male	85	32.197
	female	179	67.803
Year level	freshman	39	14.773
	sophomore	67	25.379
	junior	86	32.576
	senior	72	27.273
Major	science	107	40.530
	physics	60	22.727
	chemistry	29	10.985
	biology	32	12.121
	geography	36	13.636
Total		264	100

6. Data Source and Analysis of Data Reliability and Validity

From early March to mid-April 2023, an electronic questionnaire was distributed on the Questionstar platform to science, physics, biology, chemistry, and geography majors from a n*ormal university* in GD province. The first round of 42 questionnaires was sent out on March 10, and 40 questionnaires were returned, yielding a response rate of 95%. After checking and removing invalid responses, the survey was further improved and the second round of 270 questionnaires was sent out on April 10, with 264 questionnaires returned, resulting in a response rate of 98%.

In order to ensure the reliability and validity of the questionnaire's Likert-scale questions and to measure the science education students' level of science popularization practice and influencing factors, SPSS 25.0 software was used to conduct a reliability and validity analysis on the questionnaire's Likert-scale questions. The Cronbach's alpha coefficient was used to test the scale reliability, and the Cronbach's alpha coefficient for all Likert-scale questions in the

questionnaire was 0.978, which is greater than 0.80, indicating that the scale has good reliability. The structural validity of the questionnaire was tested using factor analysis. The overall KMO value was 0.949, greater than 0.9, and all p-values were less than 0.05, indicating that the Bartlett sphericity test results were significant. Therefore, the scale is suitable for factor analysis.

7. Data Analysis

Analysis of Science Education Students' Scientific Popularization Practice Abilities.

According to Figure 1, Figure 2, Figure 3, and Table 3, it can be seen that the level of science education practice ability of science normal students is not high and is at a moderate level (average score of 104.86), indicating a basic level of science education practice ability. By analyzing the distribution of science education practice ability among science normal students based on gender, grade, and major, it was found that: (1) Female science education students had slightly better science education practice ability than male students, with an average score of 106.13 for females and 102.19 for males; (2) The science education level of seniors reached an excellent level, with an average score of 108.9 for seniors, while freshmen had the lowest level, with an average score of 98.72, suggesting that as the grade level increases, the various skills and practical experiences of teacher education students may have an impact on their science education practice ability; and (3) Students majoring in science education had the highest level of science education practice ability, with an average score of 106.43, while geography majors had a higher average score (105.61) and a smaller standard deviation (12.42), indicating that geography majors' performance in science education practice ability was relatively stable.

Overall, the level of science popularization practice ability among science education students is not high and is at a moderate level with basic science communication abilities. Female students have a certain advantage and the science popularization practice ability of science education students improves with grade level. Science majors have slightly better science communication practice abilities than students in other majors, but they are also at a moderate level and have not reached a good level. This may be related to the teaching skills practice experience of science education students, different curriculum settings for teacher training students, and their science communication practice experience.

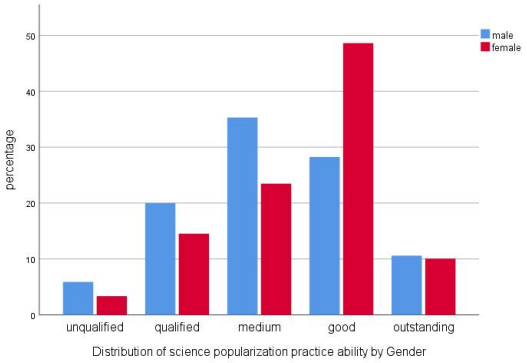

Figure 1. Distribution of Science Popularization Practice Ability by Gender

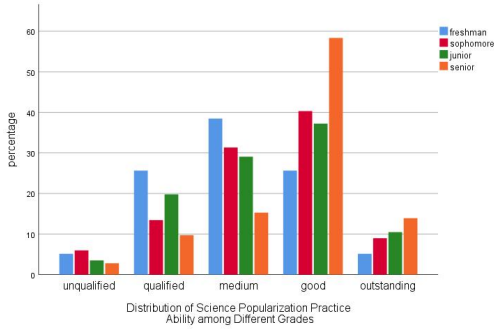

Figure 2. Distribution of Science Popularization Practice Ability among Different Grades

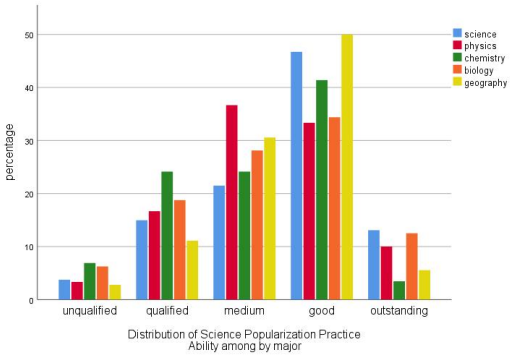

Figure 3. Distribution of Science Popularization Practice Ability Among By Major

Table 3. Overall level of Science Popularization Practice Ability among Normal Science Students

		Min	Max	Mean	SD
Total		27	135	104.86	14.527
Gender	Male	65	135	102.19	14.443

	Female	27	135	106.13	14.434
Grade	freshman	65	135	98.72	13.728
	sophomore	75	135	104.54	13.521
	junior	27	135	104.51	16.135
	senior	75	135	108.9	12.716
Major	science	71	135	106.43	13.783
	physics	27	135	103.52	16.646
	chemistry	79	122	101.48	13.032
	biology	79	135	104.34	16.196
	geography	65	125	105.61	12.42

8. Differences in Science Communication Practice of Science Normal Students Based on Gender, Major, and Grade

(1)According to Table 4, there are significant differences in the overall level of science and technology popularization practice ability between genders ($p<0.05$), with female students having higher mean scores than male students in the dimensions of preparation, practice, and evaluation ability. There were significant differences in preparation and evaluation ability ($p<0.05$), but no significant differences in practice ability ($p>0.05$). This indicates that gender may have some influence on the preparation and evaluation ability of science and technology education students in terms of popularization practice ability, but its influence on practical ability is not significant. This may be because female students are more meticulous and thoughtful in the preparation and evaluation process, while male students have advantages in hands-on ability and social skills, and therefore do not show much difference from female students in terms of popularization practice ability.

Table 4: Gender Differences in Science Popularization Practice Abilities

Variable	Items	Mean	SD	t	P
Planning	Female	34.944	5.109	2.095	0.037**
	Male	33.482	5.675		
Practice	Female	35.76	4.913	1.589	0.113
	Male	34.706	5.282		
Evaluation	Female	35.425	5.062	2.158	0.032**
	Male	34	4.899		
Overall	Female	106.128	14.434	2.072	0.039**
	Male	102.188	14.443		

Note: *** , ** , and * represent significance levels of 1%, 5%, and 10%, respectively. The same applies below.

Table 5. Major Differences in Science Popularization Practice Abilities

Variable	Items	Mean	SD	F	P
Planning	Chemistry	32.966	4.799	1.162	0.328
	Science	35.15	5.508		
	Physics	33.967	5.816		
	Biology	34.344	5.313		
	Geography	34.639	4.176		
Practice	Chemistry	34.207	4.221	0.56	0.692
	Science	35.393	4.766		
	Physics	34.567	5.893		
	Biology	34.531	5.88		
	Geography	35.361	4.176		
Evaluation	Chemistry	34.31	4.863	0.703	0.591
	Science	35.888	4.571		
	Physics	34.983	5.709		
	Biology	35.469	5.798		
	Geography	35.611	4.753		

Overall	Chemistry	101.483	13.032	0.865	0.486
	Science	106.43	13.783		
	Physics	103.517	16.646		
	Biology	104.344	16.196		
	Geography	105.611	12.42		

(2)As shown in Table 5, the results indicate that there is no significant difference in science popularization practice abilities among science , chemistry, biology, physics, and geography majors, in terms of their preparation, practice, evaluation, and overall levels, with p-values all greater than 0.05. This may be because science education and training for prospective science teachers are relatively similar, regardless of their specific major, as they receive similar education and training in subject knowledge, teaching methods, and science popularization practice abilities . However, science normal students scored higher on average in all dimensions, both individually and overall (average scores of 35.15 for preparation, 35.393 for practice, 35.888 for evaluation, and 106.43 for overall). Analysis of the course offerings in the talent development plans for these five majors shows that science normal students have courses in science popularization practice abilities design theory and science communication practice training, which may have a positive impact on the practical abilities of prospective science teachers.

(3)As shown in Table 6, the results indicate that there is a significant difference in science popularization practice abilities among different grade levels in terms of their preparation, practice, evaluation, and overall levels, with p-values all less than 0.05. Fourth-year students scored the highest on average in all dimensions, while first-year students scored the lowest. This may be due to fourth-year students having received more extensive and systematic scientific knowledge and practice, as well as having a stronger awareness of science communication education, which benefits their science communication practice abilities. Additionally, fourth-year students have more educational and social practical experience, which makes them more mature and confident, and better able to utilize their science communication practice abilities.

Table 6. Grade Differences in Science Popularization Practice Abilities

Variable	Items	Mean	SD	F	P
Planning	freshman	32.333	5.348	4.988	0.002***
	sophomore	34.239	4.878		
	junior	34.174	5.821		
	senior	36.208	4.642		
Practice	freshman	33.077	4.403	3.427	0.018**
	sophomore	34.866	4.748		
	junior	34.849	5.734		
	senior	36.222	4.473		
Evaluation	freshman	33.308	5.105	3.415	0.018**
	sophomore	35.433	4.704		
	junior	35.488	5.675		
	senior	36.472	4.216		
Overall	freshman	98.718	13.728	4.372	0.005***
	sophomore	104.537	13.521		
	junior	104.512	16.135		
	senior	108.903	12.716		

9. Regression Analysis of the Impact of Personal Attitudes and Practical Experiences on the Science Popularization Practice Abilities of Science Nomal Students.

The regression analysis of the impact of personal attitudes and practical experiences on science popularization practice abilities is shown in Table 7. The results indicate that personal attitudes and practical experiences have a positive correlation with the level of science popularization practice abilities among sscience nomal students (p-values are all less than 0.001). The impact of personal attitudes and practical

experiences on science popularization practice abilities of sscience nomal students is consistent with our expectations. Firstly, a positive and responsible personal attitude promotes the attention and level of commitment of science normal students towards science popularization practice abilities , thereby enhancing their science popularization practice abilities . Secondly, the experience of science popularization practice is an important way to improve the science popularization practice abilities of science nomal students. Through participation in science communication exhibitions, lectures, training sessions, competitions, and other activities, science nomal students can improve their science communication awareness, practice methods and skills, gain practical experience, and thus enhance their science popularization practice abilities.

Table 7. Regression Analysis of Individual Attitudes and Practical Experiences on Science Nomal Students Science Popularization Practice Ability.

Linear regression analysis n=264									
	Unstandardized coefficients		standardized coefficients	t	P	VIF	R^2	Adjust R^2	F
	B	standard error	Beta						
constant	1.376	0.137	-	10.07	0.000***	-	0.579	0.575	F=179.275, P=0.000***
Personal attitude	0.255	0.034	0.342	7.433	0.000***	1.315			
learning experience	0.386	0.033	0.532	11.552	0.000***	1.315			
Dependent variable: the average value of the overall									

10. Conclusion and Suggestions

10.1 Conclusion

(1)This study found that the overall level of science popularization practice ability among science nomal students was moderate, and gender had a significant effect on the preparation and evaluation abilities, with female students slightly outperforming male students in preparation, evaluation, and overall ability. Major did not have a significant effect on the science popularization practice ability ofscience nomal students, but regardless of whether it was a single dimension or overall level, the average score of science majors was higher than that of other majors (average score of preparation ability was 35.15, practical ability was 35.393, evaluation ability was 35.888, and overall level was 106.43). This may be related to the fact that science nomal students have theoretical courses on science popularization activity design and practical courses on science popularization practice ability training. Grade level had a significant effect on the science popularization practice ability ability of science normal students, with seniors having the highest average scores in all three dimensions and overall level, while freshmen had the lowest average scores in all three dimensions and overall level. This may be because seniors have more rich and systematic knowledge and practice in science, stronger understanding of science popularization education, and more opportunities for educational and social practice, which makes them more mature, confident, and better able to demonstrate their science popularization practice ability .

(2) Personal attitudes and practical experience have a positive correlation with the overall level of science popularization practice ability (P values are all less than 0.001). A positive and responsible attitude will promote the importance and involvement of science popularization practice ability for science nomal students , thereby enhancing their science popularization practice ability. At the same time, having personal experience in science communication activities such as exhibitions, lectures, training, and competitions can improve the awareness of science communication, the methods and skills of science popularization practice , increase practical experience, and thus enhance science popularization practice ability.

10.2 Suggestions

(1) Integrate the training of science nomal students with the development of science popularization talents, and increase the emphasis on the cultivation of science popularization abilities for science nomal students.

In China's *Opinions on Further Strengthening Science and Technology Popularization Work in the New Era*, schools are required to strengthen science education and continuously improve the scientific competency of teachers and students, actively organize and support them to carry out a variety of science popularization activities. Teachers' colleges and universities should incorporate these requirements into the talent

development plan for science nomal students, integrate science popularization practices into curriculum design, scientific practice, social practice, and labor education. Some science popularization theory courses, science popularization practice training courses, and interdisciplinary courses should be provided, and science popularization lectures and activities should be integrated into university social practice programs to increase the emphasis on the cultivation of science popularization abilities for science nomal students, integrating the training of science nomal students and the development of science popularization talents.

(2) Organizing students to participate in diverse science popularization competitions to enhance science nomal student's awareness of science popularization practices.

As the main force of future science popularization professionals and an important human resource for implementing core competency education, science nomal students' participation in open and experiential practices such as science popularization competitions(JianhuiChen, Tao Huang ， 1999) can help improve their scientific practice abilities . Studies(YongheZheng ， 2023) have shown that the construction of primary school science teacher teams in China is a weak link in the *Strong Teacher Plan*, and practical wisdom needs to be improved. Science nomal students' science popularization practices can promote scientific practice . Organizing students to participate in diverse science popularization practice activities, such as science popularization lecture competitions, science popularization drama performance competitions, science popularization innovation work competitions, and science popularization activity design competitions, can deepen their understanding of science popularization practices and improve their awareness and ability in science popularization practices.

(3) Fully utilizing the science education resources of normal universities and science popularization bases outside of campus to enhance the science popularization practice abilities of Science nomal students.

Fully utilizing the science popularization resources such as specialized laboratories with scientific characteristics, such as biological specimen museums, geographic exhibition halls, chemical mini laboratories, and physics maker spaces in normal universities, and collaborating with science popularization bases outside of campus to set up open days, such as Science Popularization Month, Science Popularization Week, or Science Popularization Day, to vigorously promote science popularization activities. Research(Chunmei Wu, 2014) has shown that university science popularization clubs can cultivate a good science popularization atmosphere and exercise students' science popularization practice abilities. Establishing a science education major student science popularization club can provide a good science popularization atmosphere, cultivate science normal students to act as science popularization volunteers, plan science popularization activities, create science popularization works, and train science popularization explanations, thereby enhancing their science popularization practice abilities.

References

[1] By Ivan Shibley, Maureen E. Dunbar.Using Science Popularizations to Promote Learner-Centered Teaching[j] .Journal of College Science Teaching.2008.11.55-58

[2] Foster-Fishman, P. G., Berkowitz, S. L., Lounsbury, D. W., Jacobson, S. & Allen, N. A. (2001). Building Collaborative Capacity in Community Coalitions: A Review and Integrative Framework. American Journal of Community Psychology, 29 (2), 241-261

[3] Haishen, Chen&Shanyan, Song. (2022). A Study on the Enhancement Path of Comprehensive Inquiry Ability of Pre-Service Science Teachers: A Comparative Analysis of Theoretical Learning and Practical Experience. Academic Monthly of Education, 04, 65.

[4] HaoLu, XinZhao, Tang Shicheng, Yishu Deng (2017) conducted a study analyzing the characteristics of college students participating in science popularization, using Kunming college students as an example. The study was published in Yunnan Science and Technology Management journal.

[5] HongyuanLiao, XinhuaHu , HuangmingQiu.(2002)Reflection and Practice on Popular Science in Universities [J]. Journal of Hunan Industrial Vocational College,48-49.

[6] Lei Ming. (2005).Theory of Capacity Building: A New Development Framework [D]. Philosophy Teaching and Research

Department, Central Party School of the Communist Party of China,83.

[7] JianhuiChen, Tao Huang . (1999). Developing the abilities of normal students from the perspective of extracurricular activities in high school biology [J]. Journal of Guangzhou Normal College (Natural Science Edition), 20(09): 87-89.

[8] JunliangZhai, Chunmei Wu .(2014)Analysis of influencing factors on improving college students' ability to provide popular science voluntary services [J]. Science Popularization Research, 04: 23-32.

[9] KangningXu , Yueying Li . (2005)Pre-service Education Should Emphasize the Cultivation of Popular Science Ability [J]. Inner Mongolia Education, (04): 44-45.

[10] Liliane Dionne. student’sources of motivation for Partipating in science fairs :an exploratory study within the canada-wide science fair.[j]International Journal of Science and Mathematics Education .2011.06

[11] Peixiao, Qi & Hongwei. Wang Science popularization practices and experiences in typical countries or organizations [EB/OL]. https://www.crsp.org.cn/plus/view.php?aid=3186.

[12] QihuiXie, SuruiLi. (2023) How to Enhance the Willingness of College Teachers to Engage in Popular Science: Environment, Resources, Cost, and Satisfaction. [J] Science Popularization Research, 09: 60-108.

[13] QianZhang, ZefengLu . (2023) Analysis of the current situation and influencing factors of medical students' participation in medical popularization in Medical Education Research and Practice [J].04.231-236.

[14] The Chinese government issued Several Opinions on Strengthening National Scientific competency Development released . September 2007. https://www.most.gov.cn/kjbgz/200702/t20070201_40547.html

[15] The Chinese State Council issued the Opinions on Further Strengthening the Popularization of Science and Technology in the New Era in September 2022. http://www.gov.cn/zhengce/2022-09/04/content_5708260.htm

[16] WeigenWang , ZhaofengDu , Jie Chen (2009). Cultivation of Popular Science Ability among Biology Majors in Normal Universities. Journal of Nanchang Institute of Education,43-45

[17] Xinxin Chen, & Zuhao Wang, (2023). International experiences in scientific practice: theory and practice. China Education Science, 01, 84-95.

[18] Xiaohong,Zhan . Peixian,Wen & Jixia.Fu (2021). An empirical analysis of the impact of "open science practice activities" on the scientific abilities of middle school students. Global Education Outlook, 50(05), 92-113.

[19] Xinming Han. Shukun Tang. A Study on the Functions, Target, Influential Factors and Evaluation System of Science Popularization Capability Construction of University Science and Technology Parks.[j]Open Journal of Social Sciences,2017 ,5,21-37

[20] XiaohongWang. (2001)Scarcity and Reshaping of the Scientific Spirit among College Students [J]. Journal of Hunan Agricultural University: Social Sciences Edition(3): 57-60.

[21] Yu qing Geng, Yan Yan. Higher education and science popularization: Can they achieve coordinated growth? https://doi.org/10.1371/journal.pone.0256612 September 7,2021 2 / 25

[22] YuliangWang, YaoqinShen, MinQi (2018) Several inspirations on the research of college students' science popularization [J]. Science Popularization Research, 6: 29-34.

[23] Zheng Yonghe. (2023). Current situation, influences, and suggestions on the primary school science teacher workforce in China: Based on a large-scale survey of 31 provinces [J]. Journal of East China Normal University (Educational Sciences Edition), 04.1-20

