

Study on the Impact of Professional Identity of Guilin University Students majoring in Science, Engineering and Aerospace on the Effectiveness of Science Popularization

-- Mediated by self-efficacy

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Abstract: This paper firstly analyses the role and value of popularization of science, and then takes undergraduates of Guilin Polytechnic College of Aeronautics and Astronautics as the research object, and uses the SPSS20 software tool to gain an in-depth understanding and explore the influence of aerospace undergraduates of Polytechnic College of Aeronautics and Astronautics on the effect of aerospace popularisation of science and the media effect of self-efficacy from the three dimensions of professional emotions, professional attitudes, and professional cognition under the sense of professional identity. To this end, a research model was constructed to validate the variables by setting the structural relationship between the variables and the media effect through a theoretical examination of the variables. The only aerospace university in Guilin City, Guangxi Province, was selected, and a 10-day questionnaire survey was conducted from 30 January to 8 February 2024 with 557 undergraduate students from the School of Aerospace and Astronautics in the first, second, third and fourth years as the research subjects. After analysing the data from the recovered questionnaires to determine the relationship between the variables, the following observations were made by verifying the mediated effects: First, professional identity has a significant effect on science effectiveness. Second, professional identity has a significant effect on self-efficacy. Third, self-efficacy has a significant effect on science popularisation effect. Fourth, professional identity had a significant effect on science popularisation effect through self-efficacy, and the mediating effect of self-efficacy was statistically significant.

Keywords: Professional identity, science popularisation effectiveness, self-efficacy.

1. Introduction

1.1. Background to the study

Firstly, popularisation of science is the key to achieving scientific and technological development and innovation. In recent years, the importance of popularisation of science and technology has been widely recognized by the state and society (Ren Fujun, & Zhai Jiequan, 2011). In September 2022, the CPC Central Committee 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 clearly put forward the development goal of "accelerating the formation of a big pattern of popularisation of science and technology in which the whole society participates together". The development goal of "accelerating the formation of a big science popularisation pattern with the joint participation of the whole society" was clearly put forward.

Secondly, with the rapid development of China's space industry, it is imperative for citizens to popularise space science. The popularisation of aerospace science will spread the professional and difficult-to-understand aerospace knowledge to the public in an easy-to-understand way to satisfy the national understanding of aerospace knowledge. At present, we have few talents in aerospace science popularisation, and the internal structure of the team is unbalanced. There is an urgent need to establish an excellent

team of space science popularisation talents.

Thirdly, undergraduates in aerospace science and engineering are expected to take the initiative to assume the social responsibility of popularising aerospace science. Undergraduates of aerospace science and engineering majors are already qualified to popularize science in terms of their knowledge reserves and scientific thinking, and the dissemination of their knowledge and advanced technologies to the public is, on the one hand, a manifestation of the group's ability to apply their knowledge, and on the other hand, the fulfilment of a certain degree of social responsibility to carry out social services.

1.2. Significance of the study

Firstly, popularisation of science is an important way to improve the scientific quality of all people and the level of science education. The improvement of the quality and efficiency of science popularisation will be conducive to the cultivation of national innovation culture and new talents, and will also promote the sustained power of science and technology innovation.

Secondly, aerospace science popularisation is an effective means for the general public to understand the level of China's aerospace science and technology and to enhance the scientific literacy of the audience. Based on the modernisation of science popularisation through the combination of scientific and technological informatisation and

popularisation of the media, it is conducive to strengthening national self-confidence and enhancing the scientific quality of the entire population.

1.3. Purpose of the study

This study focuses on the group of aerospace undergraduates in science and engineering, and constructs a structural model of professional identity and the effect of science popularisation through the empirical analysis of professional identity on the effect of science popularisation and the mediating effect of self-efficacy, in order to encourage and guide the aerospace undergraduates to participate in the popularisation of aerospace science in a targeted manner, to strengthen China's popularisation of science and to make contribution to the achievement of the goal of cultivating "arts and sciences compatible, interdisciplinary and complex" scientific talents and enhancing the national science literacy as proposed in the Outline of the Plan for Popularisation of Science and Technology in China.

1.4. Research Questions

In the process of in-depth interviews and questionnaires, the researcher raised several questions as follows:

First, does professional identity affect the effectiveness of science popularisation?

Second, does professional identity have an effect on self-efficacy?

Third, does professional identity mediate science popularisation through self-efficacy?

2. Theoretical Background

2.1. Popularisation of science

Around 1956, the term "popularisation of science" was formally introduced into China as an abbreviation of science popularisation and became a standardised professional term. Liu Huajie analyses the evolution of "popular science" in the context of the era of scientism, through the "traditional science popularization", "public understanding of science". The evolution of "science popularisation" in the context of scientism has gone through the process of "traditional science popularisation", "public understanding of science" and "science communication". The meaning of "traditional popularisation of science and technology" refers to the popularisation of science and technology, with emphasis on top-down "transmission" and "belief", of which "belief" is more important, and the content of transmission is more important. "The "public understanding of science" is defined by the Royal Society, and is sometimes interpreted as a Western approach to science popularisation, which is based on the scientific community. Popularisation of science is based on the position of the scientific community, scientists in order to obtain public support and recognition of science, and to popularise science to the public, to improve the public's scientific literacy. "Science communication" should strictly be a reflective science communication, emphasising the transmission and reception of science and technology among different subjects, so it includes science popularisation and science and technology reporting, and can be described as science popularisation in a broader sense, where the process

of science popularisation includes discussions beyond the level or dimension of scientific knowledge, and is carried out on the basis of the premise of respecting the public's rights and feedback. feedback as a prerequisite for popularising science (Wang Xiang, 2006). Currently, academics are more likely to agree on "science communication", i.e., the dialogue between the subject of science popularisation and the audience. It is more concerned with emphasising the subjective thoughts of the audience group, and the audience individuals have different views on science due to their own different situations. Science communication better reflects the principle of human-centred thinking by defining its value and correctness on the basis of a full understanding of the audience group.

2.2. Status and trend of science popularisation in China

According to statistics, at the beginning of the founding of new China, the illiteracy rate in China was up to more than 80%, and only a few people had scientific quality. The proportion of citizens with scientific quality was 1.6% in 2005, reached 10.56% in 2020, and has reached 12.93% in 2022 (He Wei, Zhang Chao, Ren Lei, & Huang Lele, 2019). Zheng Nian (2018) pointed out that at present, China has entered the stage of high-quality development, scientific and technological innovation continues to expand and improve, and the connotation and extension of science popularisation has also undergone profound changes, science popularisation is facing a new development environment and requirements, and some new trends and phenomena have also emerged.

Firstly, the concept of popular science has changed. The concept of popularisation of science is gradually evolving from focusing on the transmission of knowledge in the past to focusing on the establishment of scientific concepts, nurturing the spirit of science, fostering innovative thinking and creating a social atmosphere.

Secondly, the environment of popularisation of science has changed. Popularisation of science is becoming increasingly important in enhancing global scientific consensus, addressing global challenges, promoting global sustainable development and building a community of human destiny.

Thirdly, there is a change in the system of popularisation of science. The system of popularisation of science needs to change from government-led to government-guided social mobilisation mechanism and market-oriented operation mode with the participation of multiple actors.

Fifthly, the means of popularisation of science has changed. The supply of high-quality popular science is full of humanistic care and enlightened thinking, and it is more humane, civilian and life-like to get close to the public, so that the public can have a greater sense of identity and access.

2.3. Research hypotheses and research model

This study constructed a theoretical research model based on the relationship between variables examined in prior research and background theory. The purpose is to explore the influence of professional identity on the effect of science and technology aerospace college students on the effectiveness of science and technology, self-efficacy and any mediating effect. The research model is shown in [Figure 1].

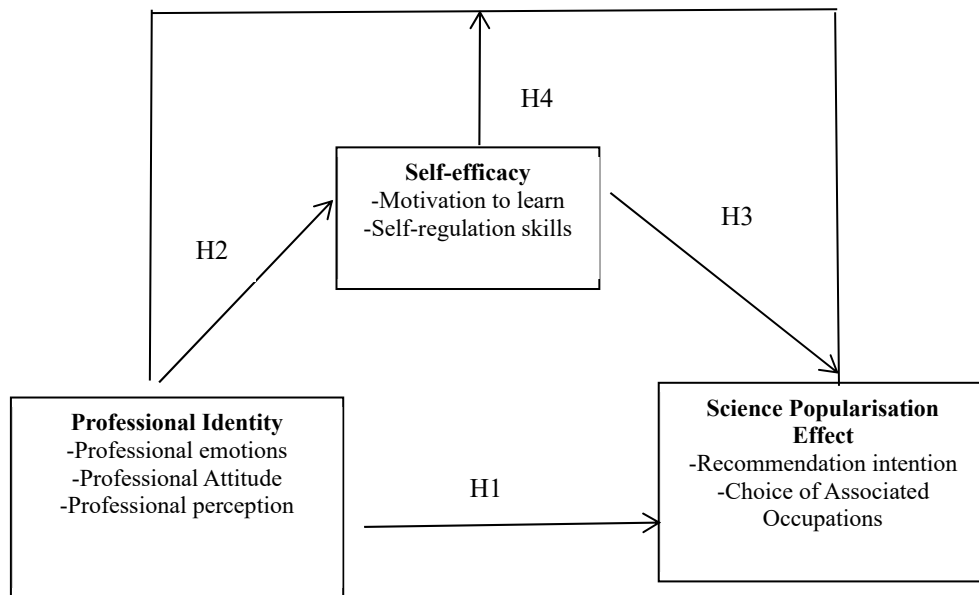


Figure 1. Study model

Based on the research model, this study examined the influence of professional identity on the effectiveness of science popularisation based on the theoretical background and cutting-edge research explored, and further hypothesised whether self-efficacy has a mediated effect influence as follows.

H1: Professional identity significantly affects science popularisation effects

H1-1: Professional identity will have a significant effect on recommendation intention

H1-2: Professional identity has a significant effect on the choice of associated occupations.

H2: Professional identity has a significant effect on self-efficacy.

H2-1: Professional identity has a significant effect on motivation to learn

H2-2: Professional identity has a significant effect on self-regulation ability

H3: Self-efficacy has a significant effect on the effectiveness of science popularisation

H3-1: Self-efficacy has a significant effect on recommendation intention

H3-2: Self-efficacy has a significant effect on the choice of associated occupations

H4: Self-efficacy mediates professional identity and science popularisation effects

This study was conducted with first-, second-, third- and fourth-year students enrolled in a four-year undergraduate degree programme in science and engineering aerospace at the only aerospace institution located in Guangxi Province, China. From 30 January 2024 to 8 February 2024, an online questionnaire was conducted by online messaging for 10 days and distributed to 640 people, deleting 83 data with incorrect answers to the screening questions and less than 240 seconds of response time, and collecting 557 valid questionnaires, with a data validity of 87.03%. Empirical analyses were conducted as objects.

Descriptive statistical analysis of the basic information of the research sample is shown in Table 1.

Table 1. Demographic characteristics

	variant	quorum	percentage (%)
sex	Male	446	80.1
	female	111	19.9
grade	First Grade	187	33.6
	Second Grade	166	29.8
	Third Grade	115	20.6
	Fourth Grade	89	16.0
major	Aircraft Manufacturing Engineering (AME)	193	34.6
	Aircraft Power Engineering	169	30.3
	Aircraft quality and reliability	195	35.0
place of residence	Municipalities and above	169	30.3
	county town	203	36.4
	countryside	185	33.2
Parental education	Junior high school and below	181	32.5
	High school and secondary school	206	37
	College and Bachelor's Degree	102	18.3
	Postgraduate and above	68	12.2

From the distribution of basic information of the research sample, there is a large proportion of males among the undergraduates in the College of Astronautics of G aerospace

colleges, which is also in line with the current situation of imbalance between men and women in most of the engineering colleges; in terms of the degree of enthusiasm for

filling out the questionnaires, we found that freshmen students fill out the most effective questionnaires, followed by juniors, and finally seniors, which allows us to understand that the degree of interest in the popularisation of aerospace science varies from grade to grade. At the same time, it also allows us to analyse from the side that students in different grades, due to changes in professional level, individual cognitive level and family influence, will affect their cognition of science popularization; in the distribution of filling out the effective questionnaires, the number of filling out the questionnaires of the three majors has a balanced distribution.

2.4. Research tools

2.4.1. The Professional Identity Scale

The Professional Identity Scale developed by Teng Manman, which includes 20 entries, was used to measure the three dimensions of professional emotions, professional attitudes, and professional perceptions of college students. The scale was retested for two months in the subsequent study, and the retest reliability of the scale was $r = 0.92$. The internal consistency coefficient ranged from 0.65 to 0.90, and the scale had good reliability and validity (Tengmanman, 2014).

In this study, the Cronbach's alpha coefficient of the Professional Identity Scale is 0.92, the Cronbach's alpha coefficient of the Professional Affective Scale is 0.89, the Cronbach's alpha coefficient of the Professional Attitude Scale is 0.88, and the Cronbach's alpha coefficient of the Professional Cognitive Scale is 0.89. The measurement of this scale can accurately reflect the level of social support of individuals. The Professional Identity Scale uses a five-point Likert scale, with numbers 1 to 5 indicating "not at all consistent", "not at all consistent", and "not at all consistent", "The larger the number, the higher the individual's sense of professional identity.

2.4.2. The Science Popularisation Effectiveness Scale

The Science Popularisation Effectiveness Scale compiled by Jinqiu Xie is a questionnaire completed by simplifying and revising the structure of cognition and current status based on the Report on the Construction of the Scientific Quality of Chinese Citizens (2018) and on the basis of previous related studies. The questionnaire has 10 entries, with questions 1 to 5 measuring the intention to recommend and questions 6 to

10 measuring the choice of the associated occupation. In this study, the Cronbach's alpha coefficient was 0.88 for the intention to recommend subscale and 0.90 for the choice of associated occupation subscale, using a 5-point Likert scale, with numbers 1 to 5 indicating "not at all", "not at all", "not at all", "not at all", "not at all", "not at all", "not at all", "not at all", "not at all", and "not at all"., "average", "fairly consistent", "fully consistent", the higher the number, the better the individual's science popularisation.

2.4.3. The General Science Effectiveness Scale (GSES)

The original version of the General Self - Efficacy Scale (GSES) was developed by Schwarzer et al. and the one used in this study was the Yufang Bian (2003) Self-Efficacy Scale. Schwarzer (1997) first started to develop a measure of self-efficacy, and in the process of revision it was reduced from 20 items to 10 items. Research has consistently provided evidence that the GSES has demonstrated good convergent and discriminant validity, and is now widely used in cross-cultural research as a common tool in self-efficacy research. The GSES is designed to measure the general self-efficacy of individuals to cope effectively with different situations.

In this study, the Cronbach's alpha coefficient for the self-efficacy scale was 0.89. The scale has 10 items and is rated on a 5-point Likert scale, with numbers 1 to 5 indicating "not at all", "not at all", "generally", "fairly", "not at all", "generally", "fairly", and "fully", with larger numbers indicating higher general self-efficacy, "average", "fairly consistent", "fully consistent", the larger the number, the higher the general self-efficacy.

2.4.4. Statistical methods:

The statistical methods used in this study mainly include: using SPSS20 software to process the raw data, and unfolding descriptive analysis, frequency analysis, reliability and validity analysis, correlation analysis, and regression analysis on the corresponding results.

3. Analysis of Information

3.1. Descriptive statistical results and analyses

Using SPSS20 statistical analysis software, descriptive analyses of the study variables can be reached for the overall values of each study variable, as shown in Table 2.

Table 2. Results of the overall narrative analysis of each study variable

designatin	sample size	minimum value	maximum values	average value	standard deviation	median
professional identity	557	1.350	4.700	3.334	0.664	3.400
Degree of effectiveness of science popularisation	557	1.000	5.000	3.272	0.850	3.200
self-efficacy	557	1.200	5.000	3.289	0.857	3.200

As can be seen from Table 2, the mean score of professional identity is 3.334, which is higher than the other two dimensions; the mean score of the degree of effectiveness of science popularisation is 3.272, which is in the third place, and is lower than professional identity and self-efficacy. The mean score of self-efficacy is 3.289, which is in the second place. The results of the above descriptive analyses show that the average scores of the respondents' sense of professional identity, the degree of effectiveness of science popularisation and self-efficacy are above 3.2, indicating that the respondents' sense of professional identity, the degree of science popularisation and effectiveness, and self-efficacy are

at a good level.

3.2. Feasibility analysis

3.2.1. Reliability analysis

This study uses SPSS20 statistical analysis software, using the Cronbach's coefficient method, to test the reliability level of the questionnaire, it is usually considered that when the Cronbach's coefficient is greater than 0.7, the questionnaire reliability is at an acceptable level; when the Cronbach's coefficient is greater than 0.8, the questionnaire reliability is at a better level. The results of the reliability analysis in this paper show that the Cronbach's alpha coefficient of the

questionnaire is 0.968, which is higher than the judgement level of 0.8, indicating that the questionnaire in this paper has a good level of reliability, and the quality of the reliability of the survey data is high.

Table 3. Results of confidence analyses

item count	sample size	Cronbach's alpha coefficient
59	557	0.968

3.2.2. KMO and Bartlett test

The purpose of KMO and Bartlett test is to analyse whether the research items in the questionnaire are reasonable and meaningful. Factor analysis is a common method for validity analysis, and the validity level of the questionnaire is comprehensively analysed through the indicators of KMO value, commonality, and variance explained rate and factor loading coefficient. Among them, the KMO value can judge the suitability level of the questionnaire information extraction correspondence; the common metropolis is used to analyse the unreasonable research items in the questionnaire; the variance fructification rate can illustrate the level of questionnaire information extraction, and the factor loading coefficients can measure whether the correspondence

between the dimensions and the question items meets the expectation. The results of the KMO and Bartlett's test are shown in Tables 4. The KMO value of the questionnaire is 0.958, which is greater than the judgement standard of 0.8, indicating that the questionnaire can effectively extract the research data.

Table 4. KMO and Bartlett's test

KMO value	0.958
Bartlett Sphericity Check	approximate chi-square 19307.535
	df 1485
	p-value 0.000

3.2.3. Regression analysis

Stepwise regression analysis improves the performance of the model by adding or removing variables step by step, which can reduce the risk of overfitting and determine which variables have the strongest explanatory power for the dependent variable, thus improving the explanatory power and predictive ability of the model. The results of the analyses are shown in Tables 5.

Table 5. Results of stepwise regression analysis (n=557)

	Unstandardised coefficient		Standardised coefficient	t	p	Covariance Diagnostics	
	B	standard error	Beta			VIF	tolerance level
a constant	0.672	0.094	-	7.120	0.000**	-	-
professional identity	0.450	0.042	0.440	10.701	0.000**	2.372	0.422
self-efficacy	0.168	0.027	0.212	6.159	0.000**	1.663	0.601
R ²				0.606			
Adjustment R ²				0.604			
F				F (3,553)=283.708,p=0.000			
D-Wvalue				1.739			

Dependent variable: degree of effectiveness of science popularisation

* p<0.05 ** p<0.01

As can be seen from Tables 5, professional identity, self-efficacy, and stress coping styles are taken as independent variables, gender, grade, major, home location, and parents' education are taken as control variables, and the degree of science popularisation effect is taken as the dependent variable for the stepwise regression analysis (specific regression method: stepwise stepwise method), and after the model is automatically identified, professional identity, self-efficacy, and stress coping styles are finally left out, The R-square value is 0.606, which means that professional identity, self-efficacy, and stress coping can explain 60.6% of the changes in the degree of science popularisation effect. The model passed the F-test (F=283.708, p=0.000<0.05), indicating that the model is valid, and the model formula is: the degree of science popularisation effect = 0.672 + 0.450* professional identity + 0.168* self-efficacy + 0.920* stress coping styles. The test for multiple covariance of the model found that all the VIF values in the model are less than 5, meaning that there is no covariance problem; and the D-W value is around the number 2, thus indicating that there is no autocorrelation in the model, and there is no correlation between the sample data, and the model is better. The final specific analysis can be seen:

The value of regression coefficient of professional identity is 0.450 (t=10.701, p=0.000<0.01), which means that professional identity will have a significant positive influence on the degree of science popularisation effect.

The regression coefficient value of self-efficacy is 0.168 (t=6.159, p=0.000<0.01), which means that self-efficacy will have a significant positive influence on the degree of science popularisation effect.

The regression coefficient value of stress coping styles is 0.920 (t=6.266, p=0.000<0.01), which means that stress coping styles will have a significant positive influence on the degree of science popularisation effect.

In conclusion, the analysis shows that professional identity, self-efficacy, and stress coping styles will have a significant positive influence on the degree of science popularisation effectiveness.

4. Conclusions

4.1. This paper reviews the findings of this study and draws the following conclusions.

First, professional identity has a very positive impact on the effectiveness of science popularisation among aerospace college students in Guilin Science and Technology. Many prior studies on professional identity and science popularisation have also shown results consistent with this study. That is, there are positive and significant effects on professional emotions, professional attitudes, professional perceptions, and professional behaviours in professional identity on the effect of science popularization, which finally confirms the factors that improve the effect of science

popularization. By improving college students' professional identity to improve the breadth and depth of college students' science popularisation effect, we can stimulate students' attention to science popularisation activities and promote their willingness to actively participate in science popularisation activities. In fact, the ultimate goal of college students studying professional theory courses is to apply them to practical operation, and science popularisation activities provide students with practical opportunities, so the two should be combined in the development of professional courses. The education of professional theory courses can improve students' sense of professional identity, and the sense of professional identity can promote the effect of science popularisation, and the three form a benign interactive cycle. On the other hand, aerospace science popularisation activities can improve students' ability to apply theory to practice. In the process of aerospace science popularisation activities, college students will deepen their knowledge of their majors and improve their comprehensive ability. On the one hand, university students spread their professional knowledge and latest research to the public through science popularisation activities to deepen and consolidate their professional knowledge or stimulate the thinking of new research directions; on the other hand, in the process of science popularisation, their communication with the public is two-way, so they will inevitably have collision of ideas and think about the appropriateness of their own science popularisation means and methods according to the difference of the target audience. The publicity of science is a two-way communication between them and the public. At the same time, the participation of university students in the process of popularisation of science is not only a test of professional theoretical knowledge, but also a test of how to communicate with different types of audiences, how to plan and organise activities, as well as teamwork and other aspects. These are exactly what is lacking in the existing talent training programmes for university students. While a solid grasp of theoretical knowledge and scientific methodological skills in the field should be the basic requirement for undergraduates in science and engineering, as the world evolves in a diversified manner, so should the objectives of talent training. Therefore, Chinese universities should supplement their training programmes with the participation of undergraduates in science popularization activities.

Second, professional identity has a positive effect on self-efficacy. This is consistent with the results in prior studies (Schwarzer, 1997; Changbin Chen & Li Zhan, 2017; Vinco, 2007). That is, by professional identity, the factors of self-efficacy improvement were finally identified. In addition, the three sub-dimensions of professional identity-professional emotion, professional attitude, and professional cognition-have a positive effect on self-efficacy, which suggests that it is possible to stimulate the sense of professional identity of completion college students. That is, the professional knowledge and skills acquired can be applied to the practical activities of science popularisation, thus enhancing the confidence of professional competence. Therefore, our universities should enrich the content of professional courses, cultivate the professional ability and comprehensive practical ability of college students, and provide support for the enhancement of students' self-efficacy. In addition, universities should carry out various forms of science popularisation practical education activities, such as organising students to participate in science popularisation

forums; visiting local science and technology museums, exhibition halls and science popularisation corridors; developing laboratories for students on a regular basis; and encouraging students to create science popularisation works in order to enhance students' self-efficacy.

Thirdly, self-efficacy has a positive influence on the effect of science popularisation. Enhancing college students' learning motivation and students' self-regulation ability, college students can make their positive, optimistic and self-confident psychological state towards their professions when they carry out science popularisation activities, thus promoting the effect of science popularisation. Empirical studies have shown that with the continuous popularisation of smart phones and tablet computers, digital science popularisation mobile reading has begun to enter a phase of rapid growth, especially as contemporary college students have a high level of network literacy ability, while the advantages of synchronicity, immediacy and convenience of obtaining scientific and technological information in digital science popularisation mobile reading are becoming more and more prominent, which allows people to pay attention to and obtain a large number of cutting-edge scientific and technological achievements at any time and any place through mobile reading. Enhance students' self-science literacy. College students should make full use of digital media in the process of learning theoretical knowledge in colleges and universities, which not only enriches the amount of professional knowledge of college students, but also satisfies their desire for knowledge, cultivates their thinking ability and insight, and improves their motivation to learn. At the same time, after entering the university, college students will encounter various problems, adapt to the new learning and living environment through self-regulation, and continuously improve their comprehensive efforts. In this thesis, self-efficacy has a positive effect on promoting the effectiveness of science popularisation among college students. College students with a high sense of self-efficacy are more dedicated to the pursuit of professional knowledge, more determined, more positive and optimistic in the process of participating in science popularisation, and will continue to work hard to solve problems and difficulties and persevere. Therefore, colleges and universities should actively cultivate students' sense of self-efficacy, make full use of the advantages of online digital media, make use of diversified science popularisation media platforms, master professional knowledge and learn professional skills, form innovative consciousness and thinking, cultivate positive optimism and confidence in overcoming setbacks, and set up goals and beliefs of contributing to society.

4.2. Recommendations

At present, our universities know very little about the national science policy, relevant science organisations and their activities, which shows that there is a relative lack of publicity and education on science in universities.

First of all, science popularisation should be strengthened among undergraduate students. They should be made aware of the importance of aerospace science popularisation and provided with more channels for aerospace science popularisation, and in the process of aerospace science popularisation, undergraduate students should be able to combine their own professional knowledge with pedagogical knowledge, and disseminate their professional aerospace knowledge to the public in an easy-to-understand form.

Secondly, governments need to increase their efforts to guide and support undergraduate aerospace students to carry out popular science activities. Governments at all levels support aerospace science popularisation in terms of relevant policies and systems. They should stimulate the active participation of aerospace students and assign professional staff to provide guidance.

Once again, local quality enterprises will be attracted to take advantage of the innovative strengths of aerospace disciplines in universities, so that the economic support of enterprises and the innovative science and technology of universities can be combined for mutual benefit. This not only helps to enhance the scientific literacy of local residents, but also strengthens the shaping and promotion of the local city image, and gives undergraduates involved in aerospace science a greater sense of self-worth and honour.

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