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].
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

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

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 juniors, 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", "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", "not at all", and "not at all". The larger the number, the better the individual's sense of professional identity.

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, reduced 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>
<thead>
<tr>
<th>variable</th>
<th>sample size</th>
<th>minimum value</th>
<th>maximum value</th>
<th>average value</th>
<th>standard deviation</th>
<th>median</th>
</tr>
</thead>
<tbody>
<tr>
<td>professional identity</td>
<td>557</td>
<td>1.350</td>
<td>4.700</td>
<td>3.334</td>
<td>0.664</td>
<td>3.400</td>
</tr>
<tr>
<td>Degree of effectiveness of science popularisation</td>
<td>557</td>
<td>1.000</td>
<td>5.000</td>
<td>3.272</td>
<td>0.850</td>
<td>3.200</td>
</tr>
<tr>
<td>self-efficacy</td>
<td>557</td>
<td>1.200</td>
<td>5.000</td>
<td>3.289</td>
<td>0.857</td>
<td>3.200</td>
</tr>
</tbody>
</table>

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 coefficient method, to test the reliability level of the questionnaire, it is usually considered that when the Cronbach coefficient is greater than 0.7, the questionnaire reliability is at an acceptable level; when the Cronbach 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

<table>
<thead>
<tr>
<th>item count</th>
<th>sample size</th>
<th>Cronbach’s alpha coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>59</td>
<td>557</td>
<td>0.968</td>
</tr>
</tbody>
</table>

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, communality, 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 |

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.

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. Therefore, the degree of science popularisation effect is taken as the dependent variable, thus improving the explanatory power of the model. The results of the analyses are shown in Tables 5.

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

<table>
<thead>
<tr>
<th>Unstandardised coefficient</th>
<th>Standardised coefficient</th>
<th>Covariance Diagnostics</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>standard error</td>
<td>Beta</td>
</tr>
<tr>
<td>a constant</td>
<td>0.672</td>
<td>0.094</td>
</tr>
<tr>
<td>professional identity</td>
<td>0.450</td>
<td>0.042</td>
</tr>
<tr>
<td>self-efficacy</td>
<td>0.168</td>
<td>0.027</td>
</tr>
</tbody>
</table>

R² 0.606 0.604
F (3,553)=283.708, p=0.000
D-W value 1.739

Dependent variable: degree of effectiveness of science popularisation

* p<0.05 ** p<0.01

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 popularisation, which finally confirms the factors that improve the effect of science.
organising students to participate in science popularisation activities, such as practical education activities, are important for universities. In addition, increasing students' self-efficacy can enhance their professional ability and comprehensive practical confidence of their majors during learning. Therefore, our education of professional courses should enrich the content of professional courses and provide support for the cultivation of professional ability and comprehensive practical confidence of college students. Thus, the professional ability and comprehensive practical confidence of college students should improve through the application of theory to practice. In this thesis, the professional ability and comprehensive practical confidence of college students are enhanced through the application of theory to practice. In this thesis, the professional ability and comprehensive practical confidence of college students are enhanced through the application of theory to practice. In this thesis, the professional ability and comprehensive practical confidence of college students are enhanced through the application of theory to practice. In this thesis, the professional ability and comprehensive practical confidence of college students are enhanced through the application of theory to practice.
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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