Multiple Linear Regression Analysis of the Impact of Ideological and Political Elements Labor Spirit on the Professional Competence of Architectural Students

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Abstract: The cultivation of labor spirit is closely related to the career planning of students majoring in architecture. However, there is no clear empirical research on how the spirit of labor affects the professional competence of architecture students. The study adopted a questionnaire survey method and designed a questionnaire including personal basic information, labor spirit scale, and professional ethics scale. By stratified random sampling, junior students majoring in construction engineering and representatives of enterprises in vocational colleges were selected as research samples. Cronbach's α coefficient was used to evaluate the internal consistency of the questionnaire, and principal component analysis (PCA) was used to verify the structural validity of the questionnaire. Subsequently, multiple linear regression analysis was used to explore the relationship between various dimensions of labor spirit and professional competence. The survey result showed that the regression coefficient between the diligence factor and the professional knowledge acquisition factor was 0.88. Regression analysis revealed a positive correlation between the diligence, sense of responsibility, and innovative spirit factors in the application of labor spirit in vocational architecture teaching and professional knowledge, professional skills, communication ability, cooperation spirit, and professional ethics factors. Furthermore, from the teaching implementation process and teaching effect, it was indicated that the integration of ideological and political elements in the teaching of professional courses can enhance students' professional interest and social responsibility, and the cultivation of labor spirit had a significant effect on the professional quality of architecture students.

1. Introduction

The cultivation of professional ethics in the field of higher education was receiving increasing attention. It not only related to the personal career development of students, but also served as an important indicator for measuring the quality of education. As a discipline with strong practicality and technicality, architecture had more specific and strict requirements for students' professional qualities. As an important carrier of ideological and political education in universities, the function of curriculum ideological and political education in cultivating students' labor spirit cannot be ignored.

This study filled the gap in research on the relationship between labor spirit and professional competence of architecture students. The article first used Cronbach's α coefficient to evaluate the reliability of the questionnaire, ensuring the reliability of the data. Finally, multiple linear regression analysis was used to quantify the impact of labor spirit on professional competence, providing data supported training strategies for architecture education.

The introduction section of the article introduces the overall structure of the research. The relevant work section summarized the theoretical and empirical research on the cultivation of professional ethics. The third part described the questionnaire design, sample selection, data collection, and analysis methods. The fourth part was about the results and discussion, presenting the results of reliability analysis and regression analysis, and discussing them. The last part was the conclusion, which summarized the research findings and proposing suggestions for architectural education.

2. Related Work

The reconstruction of vocational education triggered by new quality productivity, vigorously improving the quality of vocational education and cultivating the professional qualities of college students were the core issues of reform and innovation in higher vocational education. Scholar Zhang Guangqiu supplemented and improved the traditional concept of explicit vocational development with the development of implicit vocational literacy of college students[1]. He measured and analyzed the current status of vocational literacy development in universities, and explored the construction of a vocational literacy index system for college students with the concept of full staff, full process, and all-round. Based on the current vocational literacy education and enterprise management practices in universities, he clarified the explicit and implicit professional competence indicators for college students. Scholar Xu Liang regarded excellent traditional Chinese culture as a carrier of inheritance, which would trigger vocational college students' identification with traditional culture, aesthetic education, and practice, enhance their professional competence[2]. Based on this, he analyzed the impact of traditional culture on improving students' professional competence, providing positive assistance for related research. In response to the phenomena of inadequate grasp of connotation, unreasonable curriculum system, and lack of integration between industry and education, Scholar Gu Miao promoted the successful transformation of the domestic economic structure and strengthened the manufacturing industry[3], especially the high-end manufacturing industry, by addressing the issues of inadequate grasp of connotation, unreasonable curriculum system, and lack of integration between industry and education. Scholar Meng Meng combined the new Vocational Education Law and the new requirements for vocational literacy of vocational college students in the new era, analyzed the current situation of the lack of vocational literacy among vocational college students, and proposed four improvement paths: continuously strengthening career planning, constructing a reasonable education plan, deepening curriculum reform, and enhancing the spirit of craftsmanship and innovation[4]. Scholar Zhu Jing provided an overview of the connotation of vocational literacy among vocational college students, with a focus on discussing and analyzing the significance, necessity, and effective ways of integrating vocational literacy into students' daily education and management work[5]. He incorporated vocational literacy education into the overall framework of vocational college student work and opened up new ideas for using vocational literacy courses to help students carry out career planning. Kochkinova and other scholars viewed that labor education as a primary form of personality development, which playing a leading role in all forms of education[6]. Scholars Malik et al. from the University of Auckland in the United States believed that the implementation of labor education elements can be combined with project driven methods, hands-on practice, and experimental activities to enhance

students' learning motivation[7].

Scholar Li Yuanyuan believed that using F-test, independent sample t-test, chi square test, correlation analysis, and regression analysis could help summarize the characteristics of college students' sense of achievement in ideological and political courses, test the fit of the hypothesis model, and verify the influencing factors of college students' sense of achievement in courses[8]. Scholar Yang Wenjing believed that the Perceived Classroom Learning Environment Scale had 16 items[9]. Through principal component analysis, it was found that good teaching and clear goals had a significant positive correlation with the overall learning behavior of college science freshmen, while academic burden had no significant correlation with overall learning behavior; Further conclusions were drawn through multiple regression models that professional knowledge, whether or not to serve as a student leader, learning motivation, classroom environment, and course objectives had significant predictive effects on the overall learning behavior of science freshmen. Scholar Cheng Xinying believed through models such as PCA and Cronbach's Alpha reliability analysis that factors such as "learning motivation," "professional beliefs," "learning interest," "course evaluation," and "teacher-student relationship" all had a positive effect on the emotional dimension of university course teaching effectiveness, while the dimensions of college students' learning motivation, interest, attitude, also had a positive impact on their teaching effectiveness [10]. Scholar Xu Yanan believed that the curriculum design advocated by the ADDIE model coincides with the goals of labor education[11]. Integrating labor education into university courses enabled college students to gain social labor experience during the course learning process, inspiring their emotions and actions to safeguard public interests and values. This was also an internal driving force for professional course learning. In addition, scholars believed that more classroom practice and labor spirit should be integrated into higher education[12-13]; Some scholars had also proposed teaching design attempts from multiple dimensions such as entrepreneurship education, teacher-student dialogue, and attention to classroom satisfaction[14-15]. The above research provided valuable insights and methods for cultivating professional ethics, but there was no clear empirical study on how the spirit of labor affected the professional ethics of architecture students. In this case, the purpose of this study was to explore the influence of labor spirit in curriculum ideology and politics on the professional quality of architectural students by combining Cronbach's α coefficient and multiple linear regression analysis. It is expected to provide more accurate professional competence training strategies for architecture education and also provide reference for vocational education in other professional fields.

3. Method

3.1 Questionnaire Design and Data Collection

3.1.1 Questionnaire Design Process

From literature review and expert consultation, the research identified the key dimensions of labor spirit, mainly including diligence, sense of responsibility, and innovative spirit. Meanwhile, according to the requirements of the construction industry and the goals of ideological and political courses, evaluation indicators for professional competence have been determined, including professional knowledge, practical skills, communication and coordination abilities, professional ethics, and teamwork spirit.

Based on the above dimensions and indicators, the initial draft of the questionnaire mainly included the following parts:

1) Personal basic information: Collecting participants' basic information such as grade, gender, major, etc. for hierarchical analysis.

2) Labor spirit scale: Using a 5-point Likert scale, participants were asked to rate a series of statements related to labor spirit (such as "I believe hard work is very important for personal career development") to quantify their attitudes towards labor spirit.

3) Professional literacy scale: The 5-point Likert Scale was also used to evaluate participants' self-evaluation and actual performance in professional knowledge, practical skills, and other aspects.

4) Open ended questions: Providing open-ended questions for participants to describe their experiences and feelings in the course of ideological and political education, as well as other factors they believed could affect their professional competence.

In order to ensure the comprehensibility and logicality of the questionnaire, the research team conducted a pre-test on a small scale, invited architecture students to fill out the questionnaire, and provided feedback. Based on feedback, the questionnaire had been revised, including adjusting the wording of questions, optimizing the layout of the scale, and correcting any statements that may cause misunderstandings (The questionnaire content was attached as Attachment 1).

3.1.2 Sample Selection and Data Collection

Based on a survey questionnaire on labor spirit among students majoring in architecture, this study adopted a commonly used stratified random sampling method and selected junior students majoring in construction engineering and enterprise representatives as research samples. This method ensured the diversity and typicality of the sample, which helped to capture a wide range of characteristics of architecture students, thus enabling the research results to more comprehensively reflect the situation of the entire student population.

During the data collection process, electronic questionnaires were distributed to the target sample group via email, social media, and campus bulletin boards, and printed versions were provided to students who preferred paper questionnaires. In order to make the survey questionnaire data more authentic and accurate, the working group regularly checked the collection status of the questionnaire and provided timely feedback and support to the respondents who have doubted when filling out the paper questionnaire. After the collection was completed, the data was organized, including checking the completeness of the questionnaire, handling missing and outlier values. The data from the paper questionnaire was manually entered into an electronic database, and the data from the electronic questionnaire was cleaned and validated. Subsequently, the working group backed up the collected data to ensure its security, laying the groundwork for the following model analysis. After the survey questionnaire collection was completed, all survey results needed to be sorted and preliminarily analyzed so as to verify the consistency and reliability of the data.

3.2 Application of Cronbach's α Coefficient

The Cronbach's α coefficient ranges from 0 to 1, with higher values indicating better reliability of the questionnaire. In practical applications [16-17].

(1) α<0.6: low reliability, may require redesign of the questionnaire.

(2)0.6 ≤ α<0.7: the reliability was acceptable, but further evaluation and improvement were recommended.

(3) 0.7 ≤ α<0.8: good reliability.

(4) α ≥ 0.8: excellent reliability.

When conducting reliability analysis of data, the first step was to calculate the variance and covariance of all questions in the questionnaire; The second step was to use the Cronbach's alpha coefficient formula to calculate the reliability coefficient [18-19]. The third step was to evaluate the internal consistency of the survey questionnaire results based on the values from the second step.

After obtaining the Cronbach's α coefficient, it needed to evaluate it. If the coefficient was below an acceptable threshold, it meant that some questions in the questionnaire were not completely consistent or there was redundancy between questions. In this case, it was necessary to re-examine the questionnaire design and consider deleting or modifying some questions.

In addition, to further validate the structural validity of the questionnaire, the Statistical Package for the Social Sciences (SPSS) technique was used for principal component analysis (PCA), and Kaiser Meyer Olkin (KMO) test and Bartlett sphericity test were selected to evaluate whether the data was suitable for factor analysis. In general, when the KMO value was greater than 0.6, it indicated that the research data was suitable for factor analysis, while the significance value of Bartlett's test was less than 0.05, it indicated that the questionnaire options supported the factor structure of the data.Extract principal components through PCA method, and then solved the eigenvalues and eigenvectors. Next, determined the maximum correlation direction based on the criterion that the eigenvalues were greater than 1. Selected the main components of labor spirit in architectural teaching, and then rotated the extracted factors to simplify the factor structure and improved interpretability. The results were shown in Table 1. Finally, explained the rotated factors, determined the concepts they represented, and identified the trend of variable changes to provide functional variables for the next step of multiple linear regression analysis.

Table 1: Dimension verification results

Dimension	KMO Value	Bartlett's Test of Sphericity	Eigenvalue	% of Variance Explained
Diligence	0.88	<0.001	3.5	70%
Sense of Responsibility	0.87	<0.001	3.4	68%
Innovative Spirit	0.86	<0.001	3.2	64%
Professional Knowledge	0.90	<0.001	3.8	76%
Practical Skills	0.85	<0.001	3.3	66%
Communication and Coordination Skills	0.84	<0.001	3.1	62%
Professional Ethics	0.89	<0.001	3.6	72%
Team Spirit	0.83	<0.001	3.0	60%

3.3 Multiple Linear Regression Analysis

3.3.1 Model Construction and Data Analysis Methods

Regression analysis aimed to reveal a linear relationship between multiple independent variables and a dependent variable. The starting point of building this model was to clarify the independent variables, namely, the different dimensions of labor spirit, which mainly included factors of diligence, sense of responsibility, and innovative spirit. The factors obtained quantitative data through carefully designed questionnaires. The dependent variable was the professional competence of students, which involved multiple aspects such as professional knowledge, practical skills, communication and coordination abilities, professional ethics, and teamwork spirit.

Data analysis was also essential before model construction. Firstly, prepared the data of the questionnaire results before analysis, which included cleaning the data to remove missing values and outliers to ensure data reliability. Next, the least squares method was used to estimate the parameters in the regression equation by finding the extreme values of the functions in the model, and the optimal coefficients were determined by minimizing the sum of squares of the error terms. Thirdly, statistical testing of relevant data was conducted, mainly using t-test to analyze the

significance of each variable coefficient, as well as F-test for the significance of the entire model. Meanwhile, in order to better measure the goodness of fit of the regression model to the observed data, the determination coefficient R-squared was calculated, which measured the proportion of the variance explained by the model to the total variance, thus providing an indicator of the goodness of fit of the model.

3.3.2 Selection of Independent and Dependent Variables

The independent variable, also known as the explanatory variable, covered key dimension of labor spirit, including factors of diligence, sense of responsibility, and innovative spirit. The dimension was quantified using the Likert scale in the questionnaire survey, which ensuring consistency and comparability of the data.

The dependent variable, also known as the dependent variable, focused on the dimension of vocational skills and literacy of architecture students, including factors of professional knowledge, practical skills, communication and coordination abilities, professional ethics, and teamwork spirit. These assessments of professional ethics combined student self-evaluation, teacher evaluation, and peer evaluation to obtain comprehensive and objective data.

3.3.3 Implementation of Regression Analysis

In order to provide a more comprehensive perspective, considering the relationship between multiple variables and the more accurate prediction of the implementation effect of labor spirit ideological and political elements in architecture courses, multiple linear regression analysis was adopted to quantify and explain how different dimensions of labor spirit affect students' professional competence through statistical methods. Firstly, ensuring that all data undergoes thorough preprocessing, including cleaning, standardization, and handling of missing and outlier values, to meet the requirements of multiple linear regression analysis. Next, based on the research hypothesis and theoretical framework, the independent and dependent variables of the model were clearly defined. The independent variables included multiple dimensions of labor spirit, such as diligence, sense of responsibility, and innovation spirit, while the dependent variables involved students' professional knowledge, practical skills, communication and coordination abilities, professional ethics, and teamwork spirit.

In the process of data analysis, statistical software was introduced, multiple linear regression analysis method was selected, input data and specify the model, estimated the model parameters, that is, the coefficients of each variable. In order to evaluate the results of the survey questionnaire data and better measure the goodness of fit of the regression model, R^2 in the regression model was calculated. The concern of whether there is a linear relationship in the regression equation was evaluated using the F-test. Whether the expected values of quantitative variables in several predefined groups were different from each other, which was helpful for judging the overall significance of the evaluation model. Under the focus of labor spirit in the ideological and political elements of the curriculum, multiple factors were selected for t-test to determine whether their impact on the dependent variable was significant, and the sign and size of the coefficients were checked to better explain the functional relationship.

After the model was calculated, the residuals of each model were obtained, and then model diagnosis was carried out to determine the distribution of residuals. Observed the difference between actual observations and model predictions to ensure that the normality, homoscedasticity, and independence of residuals complied with the assumptions of multiple linear regression. Identified and handled any outliers or impact points, preliminary check for multicollinearity from the correlation coefficient matrix between independent variables, and ensured that there was no

excessive correlation between them that affected the stability and interpretability of the model.

4. Results and Discussion

4.1 Results of Questionnaire Reliability Analysis

By conducting a detailed analysis of the collected questionnaire data, the Cronbach's α coefficient was calculated, as shown in Table 2.

Table 2: Reliability analysis results

Questionnaire Section	Item-Item Correlation Coefficient Range	Total Item-Total Correlation Coefficient	Cronbach's α Coefficient
Labor Spirit	0.72 - 0.85	0.91	0.89
Professional Knowledge	0.68 - 0.78	0.85	0.88
Practical Skills	0.70 - 0.80	0.87	0.87
Communication and Coordination Skills	0.65 - 0.75	0.84	0.86
Professional Ethics	0.74 - 0.82	0.89	0.89
Teamwork Spirit	0.69 - 0.79	0.86	0.87

From the results of calculation and verification, the Cronbach's alpha coefficient was much higher than the generally accepted standard of 0.7, indicating that the two keywords of labor spirit and professional ethics set in the survey questionnaire had high internal consistency. This meant that the various questions in the questionnaire can mutually confirm each other when evaluating students' professional competence and work spirit, in other words, the question types in the scale had a strong reliability.

The high reliability questionnaire results indicated that it can be used for subsequent multiple linear regression analysis, which helped to understand how different dimensions of labor spirit affected the professional competence of architecture students, including professional knowledge, practical skills, communication and coordination abilities, professional ethics, and teamwork spirit.

4.2 Results of Multiple Linear Regression Analysis

The results of multiple linear regression analysis revealed a significant relationship between the dimensions of labor spirit such as diligence, sense of responsibility, and innovative spirit, and professional qualities such as professional knowledge, practical skills, communication and coordination abilities, professional ethics, and teamwork spirit. The followings were the main findings of regression analysis:

Regression coefficient: various dimensions of labor spirit showed significant positive or negative correlations with different aspects of professional competence (Figure 1).

Figure 1 revealed the regression coefficients between the dimensions of labor spirit such as diligence, sense of responsibility, and innovative spirit, and professional qualities such as professional knowledge, practical skills, communication and coordination abilities, professional ethics, and teamwork spirit. Among them, the regression coefficient between the diligence factor in the spirit of labor and the professional knowledge acquisition factor was 0.88, indicating a strong positive correlation between diligence level and professional knowledge level. The high value of this coefficient indicated that as students' diligence increases, their level of professional knowledge also significantly improved. Figure 2 revealed the correlation coefficients between various dimensions.
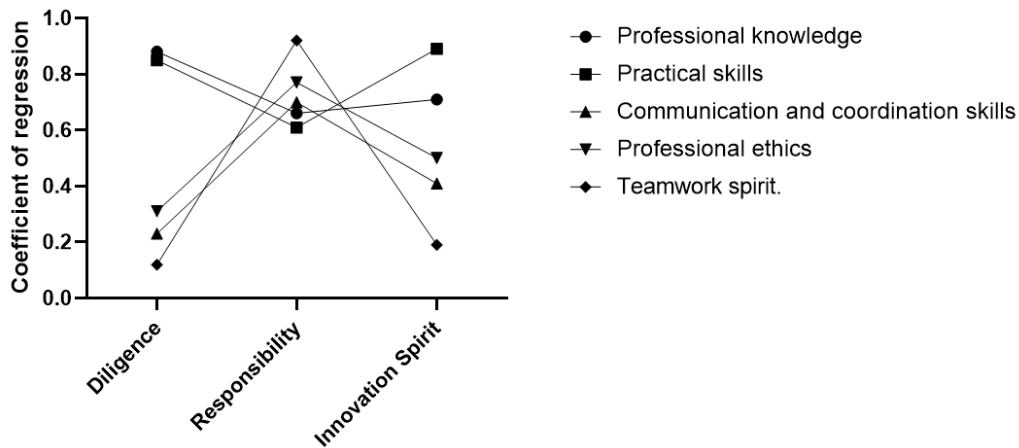
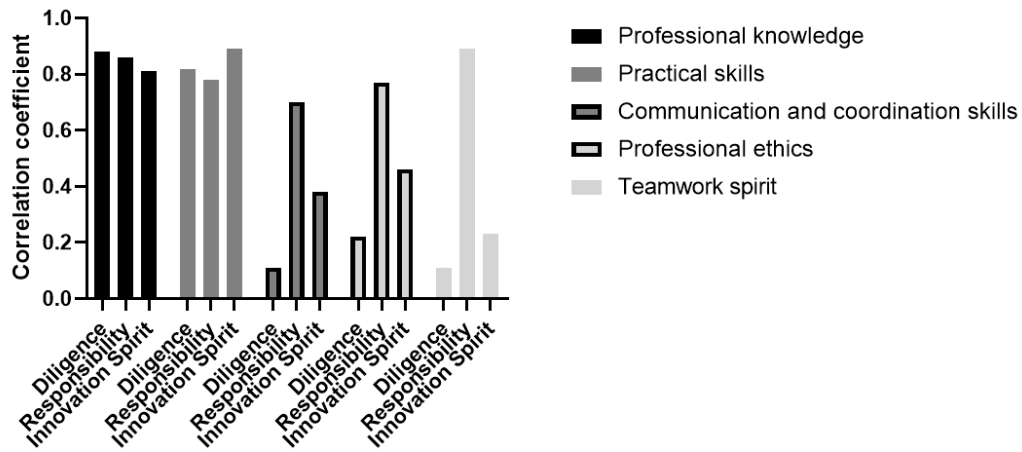Figure 1: Regression coefficient of labor spirit

Figure 2: Correlation coefficient dimension of labor spirit

The correlation coefficient in Figure 2 clearly indicated that the correlation between diligence factor and communication and coordination skills factor was low, while the correlation between sense of responsibility factor and teamwork spirit factor was high, with a correlation coefficient of 0.89. This significant positive correlation suggested that a strong sense of responsibility greatly promoted the development of students' teamwork spirit. This was because in a team environment, students with a strong sense of responsibility were more inclined to take on obligations, abide by rules, and support their teammates. These findings emphasized that in architecture education, in addition to emphasizing personal qualities such as diligence and innovation factors, educators also needed to attach importance to cultivating a sense of responsibility, as well as providing opportunities and training for communication, coordination, and teamwork.

4.3 Discussion and Practical Application

To further investigate the correlation between diligence and professional knowledge, the research conducted a detailed analysis of students with different diligence indices to understand their average professional knowledge scores under the corresponding diligence indices (Figure 3).
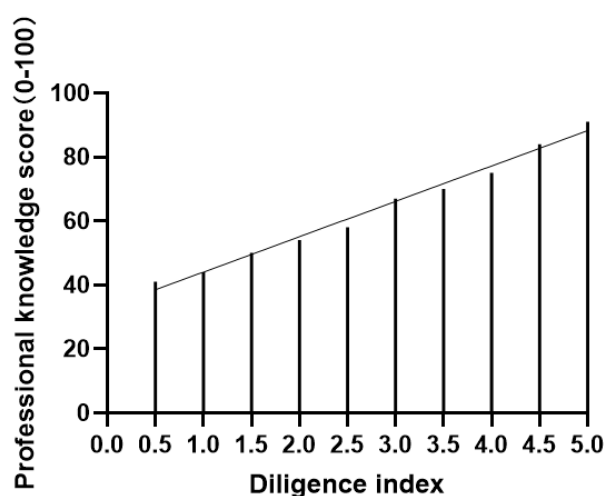
Figure 3: Changes in professional knowledge rating

As shown in Figure 3, with the increase of the diligence factor index in the labor spirit of ideological and political elements, the professional knowledge score gradually increased, showing a positive growth trend. When the index of diligence factor was 5, the professional knowledge score reached 91, indicating a significant positive correlation between diligence factor and professional knowledge level factor. This relationship emphasized the importance of cultivating students' diligence spirit in architecture education. Diligence can not only improve students' learning efficiency, but also promote the accumulation and deepening of their professional knowledge. Further analysis displayed that cultivating a diligent spirit had a positive effect on improving students' mastery of professional knowledge. Integrating labor spirit education into ideological and political courses, whether in theoretical classrooms or practical training, can subtly incorporate good professional qualities. For example, through practical activities, project-based learning, and teaching methods closely integrated with the industry, students' diligent spirit can be stimulated, thereby improving their ability to learn and apply professional knowledge.

In the study of the impact of labor spirit in curriculum ideological and political education on the professional competence of architecture students, this article provided new perspectives and methodological innovations at both theoretical and practical levels. By combining Cronbach's α coefficient and multiple linear regression analysis, the study quantified the impact of labor spirit on professional competence, providing data support and practical guidance for education reform. However, research has limitations such as subjectivity in data, neglect of external environmental factors, and failure to capture dynamic changes in professional ethics. To overcome these issues, various statistical methods can be used for research, combined with qualitative methods and quantitative data analysis to obtain a more comprehensive perspective. In addition, by controlling for external variables and adopting a longitudinal research design, the impact of work ethic on professional competence can be more accurately estimated.

5. Conclusion

By combining Cronbach's α coefficient and multiple linear regression analysis, this study explores the impact of labor spirit in curriculum ideological and political education on the professional competence of architecture students. The research results indicated that multiple factors of labor spirit, especially diligence and sense of responsibility were significantly positively correlated with students' professional knowledge, practical skills, communication and coordination abilities, professional ethics, and teamwork spirit. This discovery solved the problem of quantifying

the spirit of labor and its impact on professional ethics, providing an empirical research basis for integrating the ideological and political elements of labor spirit into the teaching of architecture majors.

Although this study provided valuable insights in methodology and analysis, the research sample was limited to students majoring in vocational architecture and cannot fully represent all groups of architectural students. From this perspective, the sample size of the survey was still insufficient, which limited the universal applicability of the results of integrating ideological and moral education in higher vocational construction engineering majors. Secondly, the study adopted a cross-sectional design and failed to capture the long-term dynamic changes in the impact of labor spirit on professional competence. Future research can further validate and expand the findings of this study by expanding the sample size and adopting a longitudinal study design. In addition, this study mainly focused on the impact of labor spirit on professional competence, without exploring factors such as personal interests and social environment that may affect professional competence. The later teaching implementation will consider incorporating more ideological and political elements from the combination of craftsmanship and labor spirit in architecture education, which providing reference value for the study of ideological and political paths in vocational architecture courses.

Acknowledgement

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Attachment 1:

Survey Questionnaire on Professional Literacy and Labor Spirit of Architectural Students

Dear participants:

Hello! This questionnaire aims to evaluate the professional ethics and work ethic of architecture students, in order to understand the impact of ideological and political education on them. Each of your answers will have a significant impact on our research. Please answer the following questions based on your actual situation and genuine feelings. We guarantee that all information will be used only for academic research and strictly confidential.

Part 1: Personal Basic Information

1. What is your grade level?
-Freshman year   -Sophomore year   -Third year student   -Senior year   -Graduate students

2. What is your gender?
-Male   -Female

3. What is your professional direction?
-Architectural Design   -Structural Engineering   -Urban Planning   -Other (please specify: _____)

Part 2: Labor Spirit Scale

Please rate the following statements based on your actual feelings, with 1 point indicating 'strongly disagree' and 5 points indicating 'strongly agree'.

4. I believe that diligent work is very important for personal career development. [1 2 3 4 5]

5. I am willing to work overtime to complete the construction project. [1 2 3 4 5]

6. I often take the initiative to learn new construction techniques and methods. [1 2 3 4 5]

7. I believe that taking responsibility within a team is crucial for the success of a project. [1 2 3 4 5]

8. I often help team members solve problems in their work. [1 2 3 4 5]

9. I am willing to accept new challenges, even if it may exceed my comfort zone. [1 2 3 4 5]

10. I believe that innovative thinking is crucial for architectural design. [1 2 3 4 5]

Part Three: Professional Literacy Scale

Please rate the following statements based on your self-evaluation, with 1 point indicating 'strongly disagree' and 5 points indicating 'strongly agree'.

11. I feel confident in my professional knowledge level. [1 2 3 4 5]

12. I am proficient in using various construction software and tools. [1 2 3 4 5]

13. I am able to effectively communicate and coordinate work with team members. [1 2 3 4 5]

14. I adhere to professional ethics and standards in team projects. [1 2 3 4 5]

15. I am willing to sacrifice personal interests for the benefit of the team. [1 2 3 4 5]

Part Four: Open ended Questions

16. Please describe your experiences and feelings in the course of ideological and political education, as well as other factors that you believe affect professional ethics. _____

Conclusion: Thank you for your participation and valuable time. Your answer is crucial to our research. If you are willing to participate in further research or learn more information, please leave your contact information.

Contact information: [optional]