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Development of a Self-Identity Construction Model for Private Vocational College Students Using Data Science Techniques

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Abstract

This study aimed to synthesize theories of self-identity learning to develop a self-identity development model for private vocational college students in Yunnan Province, China, identify key influencing factors, and evaluate the model's effectiveness. Using purposive sampling, the study involved 17 experts and 1,004 first-year students. Data were collected through a semi-structured questionnaire via Delphi Technique, supported by consultations via email, WeChat video, and in-person interviews. The model's validity was assessed based on satisfaction levels from students, teachers, and stakeholders. Statistical analyses included weight calculations, means, standard deviations, coefficients of variation, and path analysis. The results showed strong expert consensus, with an average score of M = 4.5008 and CV = 0.1181, forming a model of 27 first-level and 21 second-level indicators. The "career development expectation evaluation" held the highest weight at 26.86% in the initial assessment, while "dynamic feedback loop development" recorded the highest importance at 0.442 in the practical development phase. Practical testing demonstrated significant effectiveness, with satisfaction means ranging from M = 4.059 to 4.341. Regression analysis confirmed significant mutual influences among the model's five modules. Overall, the model effectively addresses the urgent need for personalized development strategies for private vocational college students in Yunnan Province.

Keywords: Self-Identity Development, Private Vocational Colleges, Student Development Model, Delphi Technique, Career Development Expectations, Sustainable Development Goals (SDG 4 and SDG 10)

1. Introduction

With the rapid advancement of economic globalization and in response to the strategic objectives of China's 2035 modernization plan, there is an increasing demand for the comprehensive quality of skilled talents across the country [1]. Situated in the remote western region of China, Yunnan Province has historically relied on vocational education to cultivate large numbers of skilled workers, significantly contributing to local social and economic development [2]. In recent years, to address the shortage of educational resources in public vocational institutions and to broaden the pathways for vocational learning, numerous private vocational colleges have been established in Yunnan, offering greater diversity and accessibility in vocational education options [3], [4].

According to China's national examination and admission regulations, students who are not admitted into universities or public vocational colleges but still aspire to pursue higher education often continue their studies at private vocational colleges [5]. Therefore, while the private vocational sector emphasizes curriculum reforms and teaching innovations, it must also prioritize the psychological development of students, particularly in fostering a strong sense of self-identity [6]. As an underdeveloped frontier region, Yunnan's unique socio-economic and cultural environment makes the issue of student self-identity development particularly urgent and meaningful [7]. Building a comprehensive understanding of self-identity among private vocational college students is crucial for their academic success, emotional resilience, and future career development [8]. In light of this, it is essential to explore and construct a practical and contextually

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appropriate self-identity development model tailored to the specific conditions of private vocational colleges in Yunnan Province [9].

The purpose of this study is to design a student self-identity development model centered around two key dimensions: individual characteristic self-identity and vocational student self-identity. Through empirical testing, the study aims to validate the model's structure and effectiveness, ultimately providing valuable insights and reference points for similar initiatives in private vocational education across other regions [10], [11].

2. Literature Review

2.1. The concept of self-identity

The word "Self" is oneself in English, and in Chinese, self needs to be split into two characters, namely "自" and "我". In China, the meaning of "self" has never been directly expressed before. Later, with the development of the times, "我" gradually extended to the first person, expressing the individual's own self. The word "identity" is a modern word in Chinese. There was no such word in ancient times, and its origin can only be traced back to foreign words. According to its English spelling "identity", some people believe that it originated from the Latin "idem", which means "same". Some people also found that the German word "identitat" used to express identity is very similar to the spelling of modern English "identity", so there is also a saying that it originated from Germany [2]. There is also a saying that the word "identity" was first proposed by Austrian psychologist Freud as a psychological concept. Generally speaking, "identity" is a product of human spiritual consciousness and a consensus reached [3]. It can be applied to the individual itself or to the external environment.

Self-identity is the process in which an individual discovers the difference or identity between himself and the external environment during the process of development and change, and finally achieves internal and external consistency [4]. From a psychological perspective, the internal psychological environment of the human body is a complex system. In the ever-changing external environment, maintaining a clear understanding of oneself and adhering to individuality and uniqueness is self-identity. Individual independent self-identity is the recognition of the "identity" of the individual's initial psychological appearance and characteristics [5]. It links the individual's initial psychological state with unknown future changes and has continuity and variability.

2.2. The concept of Delphi technique

The Delphi technique, also known as the expert forecasting method, is a recognized research tool that can predict the future or future development trajectory. Since the Delphi method requires the conclusion to be authoritative and influential, the selection of the expert group is particularly strict. For example, the academic requirements are at least a bachelor's degree or above, and university researchers with research literacy and professorial titles must join. Other members must be leaders and cutting-edge thinkers in their respective fields. Therefore, some scholars will specialize in the generation, application, development and innovation of the Delphi method, and some scholars will study it as a course. Some researchers believe that the Delphi method is not only a research tool, but also an important tool and method for communicating with relevant stakeholders or enthusiastic groups around a certain topic [6]. Like many current voting decision-making methods for systems or policies, the Delphi method also expresses attitudes in the form of voting, but the Delphi method not only votes for or against, but also votes for or against [7]. During the voting stage, experts in the Delphi group can also express their own suggestions or opinions.

2.3. Enlightenment from Literature Review

Although scholars from all over the world attach great importance to the cultivation and development of students' self-identity, it is found through the reading and sorting of literature that in the field of private vocational education research, the research on the particularity of students' own background is not deep enough, there are few influential feasible experiences in the literature, and there is almost no training or development model for reference. Therefore, this study takes the self-identity development of private higher vocational students in Yunnan Province, a western economically underdeveloped area, as the research object, and strives to provide academic reference materials for the cultivation and development of students in the field of vocational education, fill the lack of modeling of self-identity development of

students in the field of vocational education in China's border provinces, and hopes that this study can provide practical and scientific experience for other similar private higher vocational colleges

3. Methodology

3.1. Sampling Technology Selection

This study adopted the Delphi sampling technique to determine the framework and content of the self-identity development model for students in private vocational colleges [12]. Four rounds of Delphi expert consultations were conducted, engaging 17 professionals from various disciplinary and vocational education backgrounds. Communication with experts was carried out through emails, WeChat video discussions, and in-person meetings [13]. Expert opinions were collected using a 5-point Likert scale, where responses ranged from 1 = strongly disagree to 5 = strongly agree, providing a quantitative basis for consensus evaluation [14].

3.2. Instrumentation

To clarify the research flow, figure 1 presents a visual overview of the five sequential phases involved in the instrumentation process of this study. Each phase builds upon the findings of the previous stage to systematically construct and validate the self-identity development model for private vocational college students.

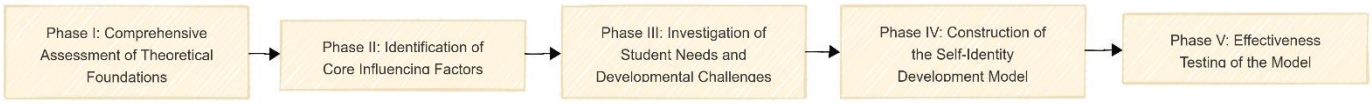

Figure 1. Flowchart of the Instrumentation Phases for Developing the Student Self-Identity Model

3.2.1. Phase I: Comprehensive Assessment of Theoretical Foundations

At this stage, a semi-structured interview method was utilized, where semi-open-ended questions were sent to 17 experts to stimulate brainstorming [15]. This approach enabled experts to think innovatively about key topics such as private vocational education, student self-identity, and development interaction mechanisms. It encouraged the discovery of neglected issues and helped fill knowledge gaps, ultimately supporting the design of the core influencing factor questionnaire in Phase II, the interview outline in Phase III, and the model structure in Phase IV.

3.2.2. Phase II: Identification of Core Influencing Factors

Based on extensive literature review and empirical studies on student self-identity, 32 preliminary influencing factors were identified [16]. Through four iterative rounds of expert feedback using the Delphi method, these factors were refined and logically structured to capture the essential components for model construction [17].

3.2.3. Phase III: Investigation of Student Needs and Developmental Challenges

Recognizing that the formation of self-identity is a gradual and dynamic process, Phase III aimed to deeply understand the evolving needs and issues faced by private vocational college students [18]. To achieve this, three structured questionnaires and two interview outlines were developed to gather diverse perspectives from students and related educational personnel, ensuring a comprehensive and multi-angle analysis.

3.2.4. Phase IV: Construction of the Self-Identity Development Model

The data synthesized from previous phases were used to construct the initial framework of the self-identity development model [19]. The expert panel conducted repeated evaluations of the model's validity and structural logic, ensuring that each indicator met the consensus threshold before finalizing the model.

3.2.5. Phase V: Effectiveness Testing of the Model

To verify the model's practicality and scientific robustness, two private vocational colleges in Yunnan Province were selected for an effectiveness test lasting one academic semester (approximately 4.5 months) [20]. A total of 20 classes were randomly selected, involving 1,004 students (502 students in the experimental group and 502 in the control group) from the Faculty of Construction Engineering to assess the model's impact.

3.3. Data processing and analysis

The collection and analysis of questionnaire data in this study were systematically organized to ensure data validity and reliability. Initially, the "Questionnaire Star" platform was employed for the design, distribution, and collection of the questionnaire across all research phases [12]. This platform was selected due to its flexibility, user-friendly interface, and integration with advanced data management tools. After completing data collection, the responses were exported and further analyzed using the SPSSAU statistical software. SPSSAU provided comprehensive analytical capabilities, including descriptive statistics, inferential analysis, and validation testing, thereby enabling a thorough and accurate interpretation of the quantitative data gathered throughout the study [14]. The statistical processes involved calculating means, standard deviations, coefficients of variation, and conducting path analysis to verify the relationships among variables within the proposed self-identity development model.

In addition to questionnaire data, qualitative data were collected through interviews to complement and deepen the understanding of students' self-identity development experiences. All interviews were conducted after obtaining the informed consent of participants, ensuring adherence to ethical research standards. Each interview session was recorded in its entirety to preserve the richness of the participants' narratives. Subsequently, the recorded audio files were transcribed using the WeChat "Video Audio to Text" application, followed by meticulous manual verification to correct any transcription errors and enhance data accuracy [15].

Once the transcription process was completed, the textual data were imported into Nvivo15 software for qualitative analysis. Nvivo15 enabled a structured and systematic approach to handling large volumes of text data. Several analytical techniques were employed, including word frequency analysis to identify key themes and concepts, thematic coding to organize the data into coherent categories, and feature extraction to uncover latent patterns and relationships within the participants' responses [18]. This qualitative analysis provided valuable insights into the emotional, cognitive, and social aspects of students' self-identity development, which quantitatively-driven methods alone could not capture.

By combining both quantitative and qualitative data processing techniques, this study ensured a comprehensive and triangulated analysis framework. Such a mixed-methods approach not only strengthened the validity of the findings but also enriched the understanding of the complex phenomenon of self-identity construction among private vocational college students.

4. Results and Discussion

4.1. Analysis of Delphi Expert Consultation Results

After four rounds of indicator optimization by the Delphi expert group, the self-identity development model of private higher vocational students in Yunnan Province was finally formed, which consists of 27 first-level indicators and 21 second-level indicators. The expert scores of the above 39 indicators ranged from 3 to 5, M=4.5008, and the CV mean was 0.1181, indicating that the experts had a high degree of recognition of the measured indicators, the CV mean was low, and the coordination of the measured indicators was high. Therefore, combined with the data results and the fact that the experts did not propose further revisions, it was determined that the content of the 48-item student self-identity development model was relatively complete.

4.2. Description of the Framework of the Student Self-Identity Model

The Yunnan private higher vocational students' self-identity development model was completed after four rounds of iterative consultation and evaluation by the Delphi expert group from the initial construction. The model focuses on the two core dimensions of "individual self-characteristic identity" and "self-identity as a vocational college student". With the complex social culture of Yunnan as the background, the model develops and improves the self-identity of private higher vocational students through a systematic, scientific, multi-dimensional interactive, iteratively optimized education model, so that private higher vocational students can face their studies, life and unknown future more actively and healthily.

As shown in figure 2, the operation of the model starts from the students' admission to the college. Through the identification and evaluation of five indicators such as individual characteristics and career development expectations,

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the actual situation and needs of the students are understood. With a three-year improvement cycle, a student self-identity improvement project with clear purpose of theoretical guidance + practical operation is carried out. The operation mode of this model is "module collaboration + dynamic feedback", which is in line with the current talent training model of vocational education and is also convenient for the specific implementation of the model in the later stage.

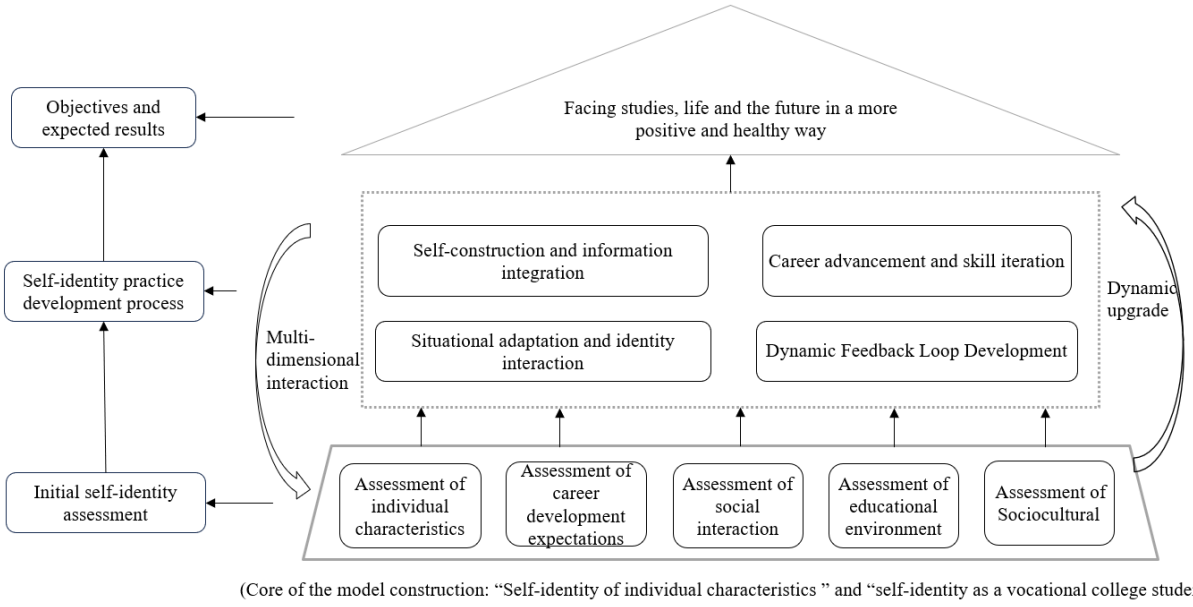

Figure 2. The model framework for the development of self-identity among students in private vocational colleges

4.3. Introduction to Model Elements

The elements of the self-identity model of students in private vocational colleges are based on the 14 core influencing factors in the early stage, combined with the actual needs of students, the social culture of Yunnan Province, and the actual situation of various private vocational colleges.

4.3.1. Elements and weightings of the “initial self-identification assessment” phase

The evaluation elements of this stage are designed to provide reference data for the next stage of self-identity improvement work for students, so as to provide better intervention and services for them according to local conditions. A total of 5 evaluation dimensions are designed, and the dimensions and contents included are as follows: Personal characteristics assessment includes three contents: self-concept assessment, self-efficacy assessment, and self-value assessment; career development expectation assessment includes two contents: career identity assessment and career planning ability assessment; social interaction assessment includes interpersonal relationship self-evaluation; educational environment assessment includes three contents: college culture identity assessment, mental health education assessment, and social support system assessment; social culture assessment includes social multicultural assessment.

The numerical size of the weight reflects the importance of the indicator. From table 1, it can be seen that there are 5 secondary indicators, namely Assessment of individual characteristics, Assessment of career development expectations, Assessment of social interaction, Assessment of educational environment, and Sociocultural Assessment, and their weight values are 0.068, 0.269, 0.218, 0.182, and 0.263 respectively. The weights of each item are relatively uniform, all around 0.200. However, compared with other indicators, the weight of "Assessment of career development expectations" is the highest, with a weight of 26.86%, which means that experts believe that "Assessment of career development expectations" occupies the most important position in the initial assessment module.

"Assessment of individual characteristics" includes 3 third-level indicators, and the weight of "Self-concept assessment" is 0.218, which means it is the most important among the 3 third-level indicators. “Assessment of career development expectations” includes two third-level indicators, among which the weight value of “Assessment of

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professional identity" is 0.006 lower than that of "Career planning ability assessment". The weight value of "Assessment of professional identity" is higher and is more important. "Assessment of educational environment" also includes three third-level indicators, among which the weight of "College cultural identity assessment" is 0.204, the highest weight, and is in the most important position. The weight of "Social support system assessment" is 0.029, the lowest weight, and is the least important compared to the other two indicators.

Table 1. Calculation results of weights by entropy method (I)

Items	Information entropy value e	Information utility value d	Weight coefficient w
B5: Assessment of individual characteristics	0.9987	0.0013	0.068
B6: Assessment of career development expectations	0.9948	0.0052	0.269
B7: Assessment of social interaction	0.9958	0.0042	0.218
B8: Assessment of educational environment	0.9965	0.0035	0.182
B9: Sociocultural Assessment	0.995	0.005	0.263
C1: Self-concept assessment	0.9948	0.0052	0.218
C2: Self-efficacy assessment	0.9952	0.0048	0.204
C3: Self-worth assessment	0.9993	0.0007	0.029
C4: Assessment of professional identity	0.9993	0.0007	0.029
C5: Career planning ability assessment	0.9994	0.0006	0.023
C6: Interpersonal relationship self-assessment	0.9994	0.0006	0.023
C7: College cultural identity assessment	0.9952	0.0048	0.204
C8: Mental health education assessment	0.9994	0.0006	0.023
C9: Social support system assessment	0.9993	0.0007	0.029
C10: Social Multicultural Assessment	0.9948	0.0052	0.217

4.3.2. Elements and weights of the stages of the "self-identity practice development process"

After collecting relevant data about the actual status and needs of students' self-identity, the stage of self-identity practice development begins. In this development process, a continuous closed loop of positive development of students' self-identity is formed through dynamic cyclic iteration feedback and optimization mechanisms. The dimensions that work together but operate independently are the self-construction and information integration dimensions of identifying and interpreting one's own core characteristics, reflecting on the connection between external local culture and the individual's own status, emphasizing the adaptive situational adaptation and identity interaction dimensions of individuals adapting to multiple social identity transformations, and encouraging students to actively participate in skill training courses and practical activities. The key to whether the practice modules of the above three dimensions can achieve sustainable development is to improve the existing student training and development tracking mechanism and establish a dynamic feedback loop mechanism system that can not only track the development of students' self-identity throughout the process, but also provide feedback, solutions or optimization countermeasures. See figure 3 for details.

Among the four secondary indicators in the practical stage of the model, the weight of "Dynamic Feedback Loop Development" is 0.442, the highest value, indicating that experts believe it is the most important of the four secondary indicators. The second is "Self-construction and information integration", whose weight index is 0.018 lower than the previous one, and its importance is second. The weights of the other two secondary indicators are both 0.067, indicating that they are equally important.

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The above four secondary indicators each include at least two third-level indicators. Among the three third-level indicators included in "Self-construction and information integration", the weight value of "Local cultural identity" is 0.127, indicating that experts believe that this indicator is the most important, and the weight values of the other two are both 0.019, indicating that they are of the same importance. Among the three third-level indicators included in "Situational adaptation and identity interaction", the weight value of "Strengthening the identity of vocational college students" is 0.176, indicating that it is the most important for students to adapt and transform their social identities. Among the two indicators included in “Career planning and forward-looking skills layout”, the weight value of “Learning local specialty industry skills” is 0.176. Compared with “Participating in the ‘dual system’ training model project”, experts believe that according to the actual situation of private vocational colleges, not all majors carry out “dual system” professional construction, so only a small number of students have the opportunity to participate in the “dual system” project. In this way, students can quickly master the technology and learn professional skills that meet the economic and social needs of Yunnan, which can play a greater role in students’ future career planning. “Dynamic Feedback Loop Development” includes three third-level indicators. The weight value of the third indicator “Integration of feedback from graduates and social needs” is 0.179. Compared with the other two indicators of mechanism construction and intelligent platform construction, experts believe that integrating the feedback needs of graduates and social needs is more important. See table 2 for details.

Table 2. Entropy method weight calculation results (II)

Items	Information entropy value e	Information utility value d	Weight coefficient w
B10: Self-construction and information integration	0.9965	0.0035	0.424
B11: Situational adaptation and identity interaction	0.9994	0.0006	0.067
B12: Career planning and forward-looking skills layout	0.9994	0.0006	0.067
B13: Dynamic Feedback Loop Development	0.9964	0.0036	0.442
C11: Identification and interpretation of one’s own core traits	0.9994	0.0006	0.019
C12: Self-reflection and summary	0.9994	0.0006	0.019
C13: Local cultural identity	0.9964	0.0036	0.127
C14: Adaptation to multi-ethnic cultural interaction	0.9964	0.0036	0.124
C15: Strengthening the identity of vocational college students	0.995	0.005	0.176
C16 Strengthening professional identity	0.9994	0.0006	0.019
C17: Learning local specialty industry skills	0.995	0.005	0.176
C18: Participating in the” dual system” training model project	0.9994	0.0006	0.019
C19: Construction of student self-evaluation feedback mechanism	0.9994	0.0006	0.019
C20: Application of intelligent feedback platform	0.9965	0.0035	0.122
C21: Integration of feedback from graduates and social needs	0.9948	0.0052	0.179

4.3.3. Operation Mode Description of the Student Self-Identity Model

The operation mode of the self-identity development model for students in private vocational colleges is a systematic, sustainable and dynamic operation mode based on the operation idea of "module collaboration + dynamic feedback". Specifically, the elements and contents of each stage of this model are mostly practical functional modules that can operate independently. By establishing a collaboration mechanism between the independent element modules, the specific implementation content will influence and support each other from multiple angles, and then through dynamic monitoring of the implementation process, the content and rhythm will be adjusted and optimized according to real-time feedback information, thus forming an efficient closed loop of operation.

4.3.4. Description of the Model's Objectives and Expected Results

The overall goal of this model is to achieve the healthy development of self-identity of private higher vocational students in Yunnan Province. After a systematic growth process, the author expects these students to achieve eight goals, namely, more confident, Clearer self-concept cognition, more accurate social role positioning, Stronger social adaptability, Stronger emotional regulation, Stronger sense of professional identity, Stronger sense of belonging to the college, Stronger recognition and integration into Yunnan's diverse culture. Through the realization of the above goals, students can have a deeper understanding of their own characteristics and accept their current social identity as higher vocational students.

4.3.5. Description of the Model's "Support Guarantee"

In order to ensure that the student self-identity development model can be stable and efficient in the actual operation process, strong support measures must be taken. First, scientific mechanisms and system construction are important guarantees for the smooth operation of the model implementation process. A dynamic information tracking and guarantee mechanism for information tracking, collection, analysis, improvement, and feedback of the whole process of student self-identity development should be established and improved; secondly, according to the implementation of the process of each element of the model, it is inseparable from the support of advantageous resources. Inviting local social groups in the college to participate in the complementary sharing of advantageous resources such as curriculum construction, psychological and multicultural base construction, etc., will help students achieve professional identity and quickly integrate into local life. Third, using big data to achieve efficient work operation is a development trend. Therefore, the model also needs to keep pace with the times. Data analysis and feedback modules for the student self-identity development process can be added to the existing education data platform of the college, or mature big data analysis systems that have been used in the market can be directly purchased or rented to provide scientific data support for the smooth operation of the model. The last guarantee is the guarantee of special funds, ensuring that the special investment and management of funds are avoided from being diverted to other uses, and ensuring the continuous operation of each module project.

4.4. Results of Effectiveness Verification

The following results were obtained by using SPSSAU to analyze 615 pieces of overall satisfaction data of the model collected from teachers, administrators, experimental group students, cooperating enterprises and community workers who participated in the practical test of the student self-identity model.

4.4.1. The Practical Test Has Significant Effect and High Practical Adaptability

The evaluation of the practical test satisfaction of the model is mainly carried out around 6 aspects. As shown in table 3, the evaluation of the 6 indicators M= [4.059,4.341], indicating that the overall effect of the practical test of the model is good. The evaluators have a high evaluation of the entire test, CV= [0.088,0.112]. The data fluctuations of each indicator are small, and the scoring stability is good. Among them, the evaluation indicator score of "enhancing students' sense of belonging to the college" is M=4.341, SD=0.474, indicating that the model can play a greater role in enhancing students' sense of belonging to vocational colleges in practice, and the students under test have a strong sense of model experience. The score of the indicator "enhancing students' sense of self-identity" is M=4.059, SD=0.447. The average score is the lowest compared to the other five indicators, but it is still>4, indicating that the model still has the goal of enhancing students' sense of self-identity in practical tests, but some evaluators still have doubts about the actual implementation effect of the model.

Table 3. Model test satisfaction analysis

Items	M±SD	Var	CV
1. The model has enhanced students' self-confidence and belief in their abilities.	4.161±0.368	0.135	0.088
2. The model has helped students define their social roles more clearly.	4.061±0.456	0.208	0.112
3. The model has improved students' adaptability in social and professional settings.	4.338±0.473	0.224	0.109
4. The model has strengthened students' professional identity and career orientation.	4.085±0.454	0.206	0.111

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5. This model enhances students' sense of belonging to the college.	4.341±0.474	0.225	0.109
6. This model enhances students' sense of self-identity.	4.059±0.447	0.2	0.110

Note: M= Mean (1.00-1.49=Strongly disagree,1.50-2.49=Disagree; 2.50-3.49=Neutral; 3.50-4.49=Moderately agree, 4.50-5.00=Strongly agree); SD=Standard Deviation (0<SD<1: Reasonable); CV=Coefficient of Variation (CV＜0.25 =Congruent)

4.4.2. Significant Mutual Influence Within the Model

The author set "evaluation data of model operation" and "evaluation data of support and guarantee" as independent variables X, "evaluation data of module function", "evaluation data of actual model test" and "evaluation data of model operation mode" as dependent variables Y, to analyze the significance and adaptability of mutual influence within the student self-identity development model. The specific variable relationship verification analysis path is shown in figure 3.

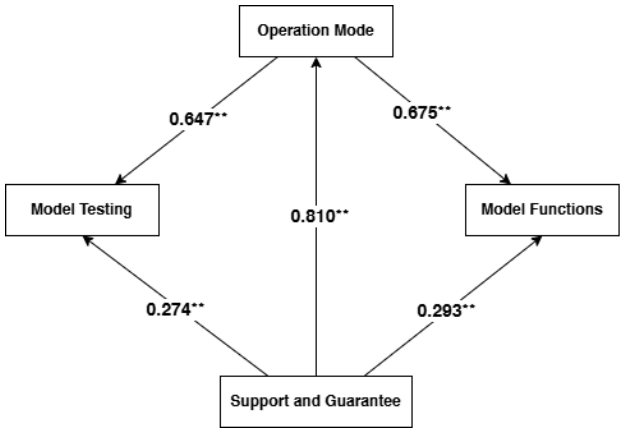

Figure 3. Variable relationship verification path diagram

When the "operation mode" of the model affects the "module function", the standardized path coefficient value is 0.675>0, and this path shows a significance of 0.01 level (z=26.227, p=0.000<0.01), which shows that the "operation mode" of the model will have a significant positive impact on the "module function". When the "support and guarantee" of the model affects the functions of each module, the standardized path coefficient value is 0.293>0, and this path shows a significance of 0.01 level (z=11.374, p=0.000<0.01), indicating that the "guarantee and support" of the model will have a significant positive impact on the "module function". When the "operation mode" of the model affects the "model test", the standardized path coefficient value is 0.647>0, and this path shows a significance of 0.01 level (z=19.990, p=0.000<0.01), which indicates that the "operation mode" of the model will have a significant positive impact on the "model test effect".

When the "support and guarantee" of the model affects the "model test", the standardized path coefficient value is 0.274>0, and this path shows a significance of 0.01 level (z=8.467, p=0.000<0.01), which shows that the "support and guarantee" of the model will have a significant positive impact on the "model test effect". When the "support and guarantee" of the model affects the "operation mode", the standardized path coefficient value is 0.810>0, and this path shows a significance of 0.01 level (z=34.165, p=0.000<0.01), which shows that the "support and guarantee" of the model will have a significant positive impact on the "operation mode".

Through regression (path) analysis, the five hypothesized relationships in the model were verified, reflecting the three-level logic of "guarantee-operation-module function". Overall, the "operation mode" of the model is the key factor affecting the performance of each functional module and the overall system, while the guarantee mechanism plays an indirect role by affecting the operation evaluation.

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5. Conclusion

This study successfully constructed a student self-identity development model specifically designed for application in private vocational colleges in Yunnan Province, China. The model is centered on two critical dimensions: individual trait self-identity and the identity of being a vocational college student.

The resulting model demonstrates a stable and systematic structure. It was developed through the integration of multidisciplinary theories from psychology, education, and sociology, and was supported by extensive empirical survey data. Emphasizing the principles of feasibility, operability, sustainability, and applicability, the model aligns closely with the psychological needs of students in private vocational institutions in Yunnan Province as well as the evolving requirements of vocational education talent development. It fully incorporates essential factors such as students' individual characteristics, school educational environments, social influences, and the overarching goals of vocational training.

Observations from the model's practical testing phase, combined with evaluation data collected throughout the study, reveal that students in the experimental group experienced notable improvements. Their self-confidence significantly increased, and they exhibited a heightened awareness of their career potential. Additionally, their ability to manage learning and life coordination improved markedly, their sense of belonging to both their colleges and classes was strengthened, and their cultural adaptability was enhanced. Overall, the students developed greater courage and optimism when facing an uncertain future. These findings affirm that the model effectively addresses the urgent need for a personalized student development framework within private vocational education in western China.

Moving forward, several recommendations are proposed to enhance and further develop the model. Firstly, it is essential to implement a "One College, One Intervention Plan." Although most private vocational colleges in Yunnan Province are geographically concentrated around Kunming City, each institution possesses unique characteristics. For instance, medical vocational colleges tend to have a higher proportion of female students, while engineering colleges typically enroll more male students. Therefore, intervention strategies must account for gender differences and adapt the content of the interventions accordingly, ensuring that student self-identity development is addressed in the most efficient and context-specific manner.

Secondly, the cooperation and interaction between students' homes and colleges should be strengthened. While students spend the majority of their time in college during their educational journey, the influence of their families on the development of self-identity remains significant. It is recommended that a home-college communication module be added to the model, building a three-dimensional resource-sharing mechanism among home, college, and community. This approach would provide comprehensive support for the development of students' self-identity.

Lastly, it is advisable to establish a multi-evaluation mechanism. To more accurately assess the objectivity and effectiveness of the model's implementation and to broaden its impact, the addition of a third-party evaluation agency or the establishment of a peer evaluation system is recommended. Furthermore, the model should incorporate increased evaluation efforts focused on long-term career development tracking and social recognition of graduates, thereby addressing the limitations of the current single evaluation method.

6. Declarations

6.1. Author Contributions

Conceptualization: M.C., T.S.; Methodology: T.S.; Software: M.C.; Validation: M.C., T.S.; Formal Analysis: M.C., T.S.; Investigation: M.C.; Resources: T.S.; Data Curation: T.S.; Writing Original Draft Preparation: M.C., T.S.,; Writing Review and Editing: T.S., M.C.; Visualization: M.C. All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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The authors received no financial support for the research, authorship, and/or publication of this article.

6.4. Institutional Review Board Statement

Not applicable.

6.5. Informed Consent Statement

Not applicable.

6.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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