

ORIGINAL ARTICLE

Enhancing vocational students' identities through program-occupation-skill alignment and learning experiences: A mediation analysis based on learning experiences

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ABSTRACT

Modern vocational education, as a primary institutional vehicle for building a skill-oriented society, faces widespread identity crises. Against this background, how to enhance vocational education students' professional identities and help them successfully transition between school and professional systems has become a focal point of concern. This study conducted a questionnaire survey across 15 vocational institutions in China. Based on 886 valid questionnaires, the influence and mechanism of vocational program-occupation-skill alignment on vocational education students' professional identities under the dual system curriculum framework were examined. The findings revealed the following. First, under the dual-system curriculum framework, the degree of vocational program-occupation-skill alignment significantly influenced vocational education students' professional identities, with higher alignment correlating to higher levels of professional identity. Second, vocational program-occupation-skill alignment affected professional identity through the mediating role of learning experience, whereby high alignment enhanced professional identity by promoting students' learning experiences. To enhance the endogenous momentum of vocational education development, efforts should focus on skill formation as the core lever and on supply-demand matching as the main objective, thereby achieving the effective integration of various components in the dual-system training model and improving vocational education students' learning experiences through capacity building and teaching enhancement.

Key words: vocational education, professional identity, learning experience, mediating effect

INTRODUCTION

A skills-based society is a crucial pillar for China's social modernization, and modern vocational education serves as the primary institutional vehicle for building such a skills-based society. For a long time, vocational education, as China's main channel for cultivating technical and skilled talent, has achieved remarkable development in expanding the educational scale and

improving the quality of talent cultivation. At the same time, vocational education development faces a widespread identity crisis that seriously constrains the development of a skills-based society and the cultivation of technical and skilled talent pools. Research has shown that this identity crisis in vocational education results from the combined effect of external and internal factors (Mi & Zhou, 2007). Due to its relatively late development, vocational education faces challenges in

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faculty expertise, curriculum alignment, and industry partnerships, all of which contribute to its identity crisis. This makes it difficult for vocational education talent cultivation to align with the needs of society, industries, and enterprises (Zhang, 2024), leading to insufficient attractiveness (Jin & Shi, 2022) and low social recognition of vocational education (China Vocational Education Development Research Group, 2021). Under these external constraints, vocational education students face educational skepticism and labor market discrimination and are becoming the primary bearers of social identity threats. This generates subjective insecurity, further exacerbating the identity crisis (Ma, 2023). Although the predicament of students under the vocational education identity crisis is noteworthy, current academic research mainly focuses on institutional identity (Qi & Li, 2024; Zhang & Qi, 2024), social identity (Chen, 2022; Peng & Zhang, 2023), and cultural identity from a macro perspective (Sun, 2017; Wang & Wang, 2018). While this research provides suggestions for policy construction, institutional development, and system building, it overlooks students' agency in constructing the institutional meaning of vocational education within the school system. Undoubtedly, vocational education identity is gradually achieved through the interaction between macro institutions and micro subjects (Yang & Wang, 2023). The development of vocational education should respect students' subject statuses and roles (Li & Xu, 2018), forming endogenous momentum for vocational education identity by cultivating their professional identities and industry sense of belonging (Wang & Mao, 2010).

The fundamental task of vocational education is to cultivate high-quality technical and skilled talent. As future frontline workers with technical skills, vocational education students are a crucial force driving economic development, industrial upgrading, and technological innovation. For individuals, the significance of choosing vocational education lies in how technical skills learning and training can improve their living standards and social status (Zhang, 2024). Achieving these objectives requires vocational education to emphasize both "educational" and "vocational" aspects, thereby completing the transition between the school system and the vocational system (Sun, 2017) specifically manifested in the indispensable combination of professional learning and internships/practical training under the dual-system curriculum framework. Under this dual system, it is particularly important to help students perceive the connection between vocational education and personal development/social identity and to ensure the effectiveness of the learning process (Peng & Zhang, 2023). This not only aids the development of vocational education students' professional identities in their learning and future careers but also helps provide

endogenous momentum for the social recognition of vocational education.

From a practical perspective, vocational education students are at a crucial period for identity formation. However, in an environment in which vocational education faces an identity crisis, this group generally shows low levels of identity. Specifically, under the "streaming of students into general and vocational education tracks" policy, vocational education students demonstrate low achievement motivation (Sun, 2014) and low self-identity and consider their education to be a "failure" (Song, 2015; Zhou & Chen, 2011). Previous domestic research has discussed multiple dimensions affecting vocational education students' professional identities, such as institutional exclusion, social discrimination, and traditional cultural concepts, but has rarely focused on student subjects or conducted in-depth research within a school environment. Some research has pointed out that against the background of dual-system education, vocational education students possess dual identities as students and workers, implying that their identity construction has both continuous and discontinuous characteristics (Brockmann & Laurie, 2016).

International research focusing on the school system has indicated that school curriculum settings and learning experiences significantly influence vocational education students' professional identities. First, the dual-system curriculum framework better promotes professional identity compared to single-school education (Kirpal, 2006). Second, vocational education students' professional identities are constructed through past learning experiences; thus, the content, structure, discourse construction, and interaction of the dual-system curriculum framework that delivers learning experiences also affect vocational education students' professional identities (Brockmann & Laurie, 2016). In the Chinese context, whether and how the dual-system curriculum framework setting affects vocational education students' learning experiences and professional identities still needs further discussion.

Based on the ongoing analysis, professional identity among vocational education students has emerged as a critical nexus bridging micro-level psychological mechanisms and macro-level social issues. This interconnection holds substantial practical significance for comprehensively understanding both students' perceptions of vocational education system development and institutional quality enhancement, as well as their prospective career choices as technical and skilled professionals. This study focuses on the impact of the dual-system teaching curriculum system setting and learning experiences on the vocational identities of vocational education students by grasping the different

reasons for the vocational identities of vocational education students in the school system. It attempts to enrich the subject perspective of the significance construction of vocational education systems and explores a path to improving the vocational education literacy of vocational education students to promote the development of vocational education systems.

LITERATURE REVIEW

Research on vocational education students' professional identities

Professional identity, as a dimension of social identity, is an important topic in sociological research. Its basic concept refers to individuals' degrees of identification with their professions or work, whether they self-define as belonging to certain professional groups, and their assumptions of corresponding professional roles (Fu *et al.*, 2024). Current academic research on professional identity can be divided roughly into two aspects: (1) exploring how macro-level policies, institutions, and cultures shape individual identities from a social structure orientation; and (2) examining individuals' cognitive and action processes in establishing their identities from an individual agency perspective (Chreim *et al.*, 2007). Regarding vocational education identity, research has either analyzed reasons for low vocational education identity from external factors, such as institutions, society, and culture, or has discussed the debate between negative and positive discourse systems derived from vocational education students' resistance culture.

At the institutional level, China's vocational education system is imperfect, with goals and implementation paths at different stages of vocational education being relatively vague, making it difficult to form developmental synergy (Zhang, 2024). Compared with higher education, vocational education has implicitly become "lower-tier education" and "dead-end education" due to insufficient attention and resource investment, problems such as substandard vocational education conditions and a disconnect between program settings and social needs have become prominent (Li, 2010), further aggravating the solidification of negative identity. This institutional predicament has led to the solidification of class status among vocational education students who have limited family capital, restricted social mobility, and disadvantaged labor market positions. Moreover, policy gaps and regional constraints in the articulation between vocational and undergraduate education have further compressed students' vertical mobility opportunities (Tan & Nie, 2024). At the social level, media linking vocational education students with negative expressions, such as "fighting and brawling", "internet addiction",

and "delinquent youth", has diminished vocational education students' discursive power. Meanwhile, against the background of a credential society, the phenomenon of valuing academic degrees over ability and knowledge over skills is widespread. Negative identity labels and social atmosphere have come to underlie vocational education students' social identity construction, with academic, employment, and social circle difficulties jointly weakening vocational education students' identity recognition. From a cultural perspective, widely circulated traditional cultural concepts and vocational education students' unique group cultures have further deepened the identity crisis in vocational education. On the one hand, traditional concepts, such as "scholars should become officials" and "those who work with their minds govern others, while those who work with their hands are governed by others", have led to the nonrecognition of technical and skills education related to production and labor. Although advocacy for equality, democracy, and diverse development has somewhat changed society's definition of talent, the stereotypes of vocational education as "inferior" and a "second-best choice" remain stubborn (Peng & Zhang, 2023). On the other hand, the shaping of "anti-school culture" (Willis, 2013) has greatly influenced scholars' research positions. For instance, Chinese scholars have pointed out that vocational education students share the role of "poor students" in schools, which manifests as a "muddling through" culture (Wang *et al.*, 2019), and its interpretation has evolved into two paths: "self-abandonment" (Ding & Wang, 2017) and "passive resistance" (Woronov, 2016). In recent years, scholars have noticed vocational education students' positive culture of pursuing self-reliance, mutual help, and other moral values outside the classroom, which reconstructs those students' complex subjectivity, agency, and creativity (Song, 2023). Evidently, resistance and opposition do not occupy the whole of vocational education students' lives; rather, they are essentially products of group identity consciousness under institutional and social exclusion. Research on this group should delve into the school system, exploring the sources of vocational education students' identity recognition in interactive relationships. In addition, studies have explored the influence of demographic factors, such as gender, grade, and place of origin, on professional identity (Meng, 2024).

From a literature review, it can be found that research on factors influencing vocational education identity has begun to receive widespread attention from academia, but comparatively, research from an individual agency perspective is insufficient. Undeniably, the identity transformation experienced by vocational education students in the dual system of school and vocation as a vivid practice has profound implications for their profes-

sional identities and career choices that are sufficient to enrich the practical scenarios of professional identity research. At present, group-level professional identity research involves rich groups, such as migrant workers (Chen, 2005), domestic workers (Liang, 2023), teachers (Jiang, 2024), medical staff (Yu *et al.*, 2024), and students (Xuan, 2024), while in the field of vocational education, it mainly focuses on teachers' and students' professional identity issues. Additionally, research on professional identity measurement has different angles and emphases. For example, internationally, Holland's vocational identity scale measures the clarity and stability of personal characteristics related to occupations from a single dimension (Holland *et al.*, 1980), while Melgosa (1987) divided professional identity into four dimensions: achievement, moratorium, foreclosure, and diffusion. Domestic research on professional identity in vocational education also has rich measurement dimensions. Some researchers have measured vocational education teachers' professional identities from three dimensions: identification with the school, identification with teaching work, and identification with future career development (Li, 2017). Others have studied vocational education students' professional identities from six dimensions: professional cognition, professional emotion, professional expectation, professional values, and professional behavioral tendencies (Sun, 2017). Based on previous work, Zheng *et al.* (2018) measured free medical students' professional identities from five dimensions—value identification, behavioral identification, professional identification, environmental identification, and attitude identification—using a scale with good reliability and validity. Therefore, the current study measures vocational education students' professional identity from these five dimensions, having adapted the scale questions accordingly.

Relationship between the dual-system curriculum framework and professional identity

The dual vocational training system originated in Germany. The term "dual" refers to two elements: the school, which imparts knowledge and skills to students, and enterprises, which provide off-campus practical training venues. The dual system is characterized by six main features. First, it involves the two training entities of schools and enterprises. Second, it encompasses two types of educational content, with schools delivering professional theoretical knowledge and general education and enterprise training focusing on vocational practice. Third, it employs two categories of teacher: theoretical instructors in schools and practical trainers in enterprises. Fourth, students maintain dual status as both school students and enterprise apprentices. Fifth, students must pass two distinct types of examinations: theoretical tests in schools and skills assessments in

enterprises. Sixth, it issues two types of certificates: graduation certificates from schools and skills certificates from industry associations (Sun *et al.*, 2018). From a theoretical perspective, human capital theory suggests that investment in human capital needs to be transformed into individual capabilities and qualities. However, the heterogeneity of human capital results from differences in knowledge, skills, and experience. Moreover, the long-term nature and instability of skill formation make returns on skill investment unpredictable. In practical terms, vocational education students must not only receive systematic theoretical instruction but also enhance their training efficiency and quality by alternating workplace learning and school education (Liu, 2023), which adds to the complexity of effective skill formation. In this context, it is crucial for vocational education to transform educational human capital into skills-based human capital and achieve the effective cultivation and precise placement of technical talent. The role of the vocational program-occupation-skill alignment pathway cannot be overlooked in this process.

International research has clearly demonstrated that the dual-system curriculum structure is more effective than single-school learning in promoting professional identities, which can be further enhanced through continuous workplace learning experiences (Kirpal, 2006). A study of Norwegian vocational education students revealed that the learning process within social structures shapes students' dual identities as both learners and workers. Negative educational experiences in the school setting, such as poor teacher-student relationships and feelings of alienation, failure, and disconnection from school and student subjectivity, shaped a "failed student" learner identity and reduced their sense of identification. Conversely, workplace narratives centered on belonging, peer equity, and adult independence broke down the previously failed learner identity and enhanced vocational education students' identification (Hegna, 2019). Other scholars have incorporated the concept of "place integration" into research on vocational students' professional identities within the dual-system curriculum structure using theoretical models of learner identity and workplace identity development in vocational education. They found that incorporating workplace practice into the learning process is crucial for professional identity formation, validating the effectiveness of the dual-training model (Klotz *et al.*, 2014).

While these studies have confirmed the significant impact of the dual-system curriculum structure on vocational education students' professional identities, current research has largely dichotomized the dual-training model into school learning venues and off-campus practical venues, thereby overlooking the

influence on professional identity of vocational program-occupation-skill alignment as an inseparable pathway during venue transitions. Resolving labor-occupation alignment is key to achieving high-quality employment. For vocational education students, the degree of alignment between their vocational programs and internship positions, as well as the skill alignment between the two, may influence their professional identities and subsequently affect their career choices and performance. Therefore, building upon previous research, this paper proposes the following hypothesis.

Hypothesis 1: Professional-position-skill alignment in the dual-system curriculum structure influences the learning experiences of vocational education students.

Mediating role of learning experiences

In the dual-system curriculum structure, attention must be paid not only to the knowledge and skills acquired by students but also to the learning process of competency formation to facilitate the smooth transition of vocational education students' dual identities. Examining learning experiences as a lens to observe vocational students' learning processes helps in evaluating the coherence and connectivity of various interactive elements in the dual-training model from a bottom-up perspective. Conceptually, learning experiences refers to students' encounters with curricula, teaching activities, educational interactions, and learning environments during the learning process (Nellie Mae Education Foundation, 2013). As students' subjective perceptions of their education, learning experiences play a crucial role in evaluating their autonomous engagement and in examining their perceived learning environments and other education-related factors (*e.g.*, teaching quality, educational management, student affairs, school environment, teaching conditions and utilization, and institutional reputation; Xie *et al.*, 2021). Current research has uncovered rich measurement dimensions of learning experiences. International studies have focused primarily on learning processes, environments, and outcomes, while domestic scholars have mainly emphasized classroom teaching, autonomous learning, teaching effectiveness, and educational contexts (Zhuang *et al.*, 2016). Regarding measurement scales, the Course Experience Questionnaire (CEQ), developed by Australian university quality assurance agencies, has gained wide recognition (Ramsden, 1991). This questionnaire comprises 12 dimensional structures: good teaching, clear goals and standards, appropriate assessment, appropriate workload, generic skills, overall course satisfaction, student learning support, learning resources, learning community, graduate qualities, intellectual stimulation, and overall university experience satisfaction. Domestic research has further explored these dimensions based on the CEQ questionnaire.

Some studies have measured students' classroom experiences using eight indicators across two dimensions—teaching (cognitive) and relationship (affective): clarity, engagement, interest, creativity, equality and care in teacher-student relationships, and cooperation-competition in student-student relationships (Li, 2015). Other scholars have adapted the CEQ scale to local contexts in developing the University Student Learning Experience Scale with dimensions such as academic challenges, active cooperative learning, teacher-student interaction, provision of rich teaching experiences, and campus environmental support (Wang, 2016). In the vocational education field, Gu (2019) measured vocational students' online open course learning experiences across dimensions including basic skills, learning resources, clear objectives, learning tasks and assessment, quality teaching, intellectual stimulation, student learning support, and learning community. Zhou (2020) developed a vocational entrepreneurship education course learning experience scale comprising five dimensions: learning immersion experience, learning activity experience, learning relationship experience, learning achievement experience, and learning environment experience. As evidenced by the above summaries, scholarly investigations into learning experiences have concentrated primarily on three fundamental domains: curriculum-related experiences, learning activity-based experiences, and learners' affective evaluations and perceptions (Liu *et al.*, 2016). Therefore, considering the characteristics of the dual-system curriculum structure, the present study conceptualizes the measurement dimensions of the vocational education students' learning experience scale as follows: course-related experiences, including curriculum structure and content; learning activity-related experiences, primarily measuring faculty instruction and student cognitive perception; and learners' evaluative perceptions, comprising effectiveness evaluation and satisfaction.

For this study, it is essential to clarify the relationships among the dual-system curriculum structure, learning experiences, and professional identities. Considering the conceptual framework of the dual-system curriculum structure and learning experiences, the six dual characteristics of the dual system directly influence vocational education students' learning experiences, including their course experiences, learning activity experiences, and evaluative perceptions (Li & Yang, 2023). In a conceptual framework integrating dual-system pedagogy and learning experiences, the six dual characteristics inherent in the dual-system model directly shape vocational students' learning experiences across multiple dimensions—namely, curriculum engagement, learning activity participation, and affective evaluations. Furthermore, Erstad and Sefton-Green (2012) pointed

out that the relationship between learning experiences and identity may be bidirectional, with identity serving as a prerequisite for learning engagement and positive learning experiences being necessary for identity formation. From a literature review, we found that Brockmann and Laurie's (2016) research on British apprenticeships revealed that vocational education learners' identities were formed through past learning experiences, apprenticeship content and structure, and discursive interactions in learning and vocational practice settings, demonstrating the impact of learning experiences on vocational education students' professional identities. Therefore, this paper proposes the following hypothesis.

Hypothesis 2: Professional-position-skill alignment in the dual-system curriculum structure influences vocational education students' professional identities through the mediating effect of learning experiences.

DATA, VARIABLES, AND METHODS

Questionnaire development and data sources

This study employed purposive sampling and conducted surveys based on considerations of the geographical locations, urban characteristics, institutional levels, and demographic features of the survey respondents. According to China's administrative divisions, the survey respondents were distributed across six major geographical regions (North China, Northwest China, East China, Central China, Southwest China, and South China) and covered 15 secondary and higher vocational institutions in Beijing, Tianjin, Shandong Province, Hebei Province, Henan Province, Anhui Province, Hunan Province, Jiangxi Province, Jiangsu Province, Guangxi Province, Guangdong Province, and Gansu Province. Between November 2023 and January 2024, 886 valid questionnaires were collected through both offline and online channels, with data analysis conducted using SPSS 26.0.

The questionnaire consisted of three parts. The first part surveyed basic information about the vocational education students, including their gender, grade level, and place of origin, as shown in Table 1. The second part comprised the Vocational Education Student Learning Experience Scale. Reliability and validity tests were conducted using SPSS 26.0. These yielded a reliability coefficient (Cronbach's α) of 0.966 and a KMO test value of 0.958, indicating good reliability and validity with strong explanatory power. The third part consisted of the Vocational Education Student Professional Identity Scale, which demonstrated a reliability coefficient (Cronbach's α) of 0.949, indicating good internal consistency of the scale structure. The validity test yielded a KMO value of 0.965, suggesting that the

scale items met good statistical standards.

Variable design and basic descriptions

The dependent variable in this study was vocational education students' professional identities. The scale was adapted from the Free Medical Students' Professional Identity Questionnaire (Zheng *et al.*, 2018) and modified according to vocational education students' educational experiences to create the Vocational Education Students' Professional Identity Scale. The scale measures professional identities across five dimensions: value identification, behavioral identification, professional identification, environmental identification, and attitudinal identification. It consists of 19 items, with five items each in the first two dimensions and three items each in the latter three dimensions. A four-point scoring system was employed ("strongly disagree" = 1, "disagree" = 2, "agree" = 3, and "strongly agree" = 4), with scores ranging from 5 to 20 for the first two dimensions and from 3 to 12 for the latter three dimensions, with higher scores indicating a stronger professional identity (Table 2).

The independent variable of this study was the degree of vocational program-occupation-skill alignment in the context of the dual-system teaching curriculum system. This variable is based on the question "What is the degree of alignment between the occupation, skills, and vocational program you studied in your training or internship" in the questionnaire, with the option "mainly an observer and intern, with less workload" assigned a value of 1, "position is not closely related to the vocational program and has low technical content" assigned a value of 2, "occupation is related to the vocational program but has low technical content" assigned a value of 3, and "position is related to the major and has low technical content" assigned a value of 4. The score ranged from 1 to 4, and the higher the score, the higher the degree of alignment between vocational program, occupation, and skills (Table 2).

The mediating variable was vocational education students' learning experiences, developed with reference to the CEQ (Ramsden, 1991) by the Australian University Quality Assurance Agency and the localized University Student Learning Experience Scale (Wang, 2016) developed by domestic scholars. The Vocational Education Student Learning Experience Scale measures three dimensions: course-related experiences, learning activity-related experiences, and learners' evaluative perceptions. The scale comprises six indicators—curriculum structure (1 item), course content (2 items), faculty instruction (2 items), student cognitive perception (2 items), effectiveness evaluation (3 items), and satisfaction (1 item)—totaling 11 items. A four-point scoring system was used ("strongly disagree" = 1,

Table 1: Basic information of the sample

Variable	Attribute	Frequency	Percentage (%)
Gender	Male	433	48.9
	Female	453	51.1
Academic grade	First year of high school	38	4.3
	Second year of high school	52	5.9
	Third year of high school	146	16.5
	First year of university	157	17.7
	Second year of university	236	26.6
	Third year of university	242	27.2
	Fourth year of university	15	1.7
Place of origin	Rural area	654	73.8
	Urban area (city)	232	26.2

Table 2: Variable description and descriptive statistics

Variable	Description	Mean	SD
Professional identity	Value identity	15.870	3.121
	Behavioral identity	15.870	3.051
	Professional identity	9.200	1.955
	Environmental identity	9.220	1.924
	Attitude recognition	7.460	1.789
Vocational program-occupation-skill alignment	Vocational program-occupation-skill alignment in training or internship	3.170	0.940
Learning experience	Experience related to the course	9.640	1.847
	Experience related to learning activities	13.050	2.440
	Learners' emotional evaluation	12.870	2.222

SD, standard deviation.

"disagree" = 2, "agree" = 3, and "strongly agree" = 4), with the scores, by dimension, ranging from 3 to 12 (course-related experiences), 4 to 16 (learning activity-related experiences), and 4 to 16 (learners' evaluative perceptions), with higher scores indicating better learning experiences (Table 2). In addition, following previous research (Meng, 2024), the model analysis included three control variables: gender, grade level, and place of origin.

Analytical strategy

This study aims to explore the influence mechanism of vocational program-occupation-skill alignment on vocational education students' professional identities within the dual-system curriculum framework and the role of learning experiences in students' dual identity transition. All data analyses were conducted using SPSS 26.0. First, a multiple linear regression analysis was employed to examine the impact of vocational program-occupation-skill alignment on professional identities among vocational education students, with binary logistic regression models used for robustness checks. Second, the mediating effect of the learning experience was introduced and tested. Controlling for gender, grade

level, and place of origin, bootstrap confidence interval estimation was performed using the Process macro in SPSS 26.0 with 5000 resampling iterations to calculate 95% confidence intervals. Finally, heterogeneity tests were conducted by gender to examine the differential impacts of vocational program-occupation-skill alignment on professional identity across gender groups.

EMPIRICAL RESULTS

Baseline regression of vocational program-occupation-skill alignment's impact on professional identity

After examining the basic sample characteristics and scale scores, a baseline regression analysis was conducted (Table 3). First, Ordinary Least Squares regression was used to test whether the independent variable (vocational program-occupation-skill alignment) influences the dependent variable (professional identity). The regression results showed a significant positive impact (Model 1). Second, after incorporating the control variables (gender, grade level, and place of origin), the results remained significant (Model 2),

Table 3: Baseline regression of vocational program-occupation-skill alignment's impact on professional identity

Variable	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
Alignment	3.012***	1.139	2.994***	0.344
Gender	-	-	1.582**	0.648
Grade	-	-	-0.109	0.226
Place of origin	-	-	1.952***	0.732

** $P < 0.01$, *** $P < 0.001$. SE, standard error.

indicating that higher vocational program-occupation-skill alignment corresponds to higher levels of professional identity (supporting Hypothesis 1).

Robustness test of vocational program-occupation-skill alignment's impact on professional identity

Robustness tests were conducted by altering the model specification and replacing the multiple linear model with a binary logistic regression model (Table 4). The mean score of the Vocational Education Student Professional Identity Scale was 57.62. Scores below 57.62 were assigned a value of 0, while those above 57.62 were assigned a value of 1, and the variables were then reentered into the model for testing. The results show that the independent variable (vocational program-occupation-skill alignment) has a significant impact on the dependent variable (professional identity; $P < 0.001$; Model 1). The model's odds ratio (OR) was 1.941, indicating that for each unit increase in vocational program-occupation-skill alignment, professional identity increased by 94.1%. Furthermore, after incorporating the control variables (gender, grade level, and place of origin), the independent variable maintained its significant impact on professional identity ($P < 0.001$, Model 2), with an OR of 1.958, specifically showing that each unit increase in vocational program-occupation-skill alignment corresponds to a 95.8% increase in professional identity. These findings demonstrate that the significance levels and coefficients remained largely consistent after changing the model specification, confirming the robustness of our earlier estimates.

Influence pathway of vocational program-occupation-skill alignment on professional identity: mediation effect analysis

First, all variables were standardized, with demographic information (gender, grade level, and place of origin) included as the control variables. Second, to explore the internal mechanism of the significant positive influence of the independent variable (vocational program-occupation-skill alignment) on the dependent variable (professional identity), learning experience was

introduced as a mediating variable in the structural equation model. Using Hayes' Process Macro Model 4 in SPSS, we tested the mediating effect of learning experience between vocational program-occupation-skill alignment and professional identity (Hayes, 2013). As shown in Figure 1, high professional-position-skill alignment can enhance vocational education students' professional identity by promoting learning experiences. The path coefficients among vocational program-occupation-skill alignment, learning experience, and professional identity are illustrated in Figure 1.

As shown in Table 5, the bootstrap 95% confidence intervals for the mediating effects of vocational program-occupation-skill alignment (independent variable) on professional identity (dependent variable) through learning experience (mediating variable) did not contain zero at either the upper or lower limits. This indicates that vocational program-occupation-skill alignment not only has a direct effect on professional identity but also exerts a mediating effect through learning experience. The direct effect (0.955) and mediating effect (2.003) accounted for 32.285% and 67.715%, respectively, of the total effect (2.958, supporting Hypothesis 2).

Gender-based analysis of vocational program-occupation-skill Alignment's impact on professional identity

Occupational gender discrimination and social gender conditioning lead to varying levels of employment awareness among vocational education students of different genders, which in turn affects their professional identities (Jiang, 2010). Therefore, this study further explored differences in professional identity among vocational education students across genders. The regression results in Table 6 indicate that the independent variable (vocational program-occupation-skill alignment) maintains a significant impact on professional identity (dependent variable) and shows significant effects across gender groups. Notably, the impact of alignment on professional identity was stronger among male students than among female

Table 4: Binary logistic regression of vocational program-occupation-skill alignment's impact on professional identity

Variable	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
Alignment	0.663***	0.088	0.672***	0.089
Gender	-	-	-0.317**	0.147
Grade	-	-	0.044	0.052
Place of origin	-	-	0.270	0.165

** $P < 0.01$, *** $P < 0.001$. SE, standard error.

Table 5: Total effect, direct effect, and mediation effect decomposition

Item	Effect value	SE	LLCI	ULCL	Effect size
Total effect	2.958	0.344	2.282	3.634	-
Direct effect	0.955	0.210	0.543	1.367	32.285%
Mediating effect	2.003	0.285	1.469	2.578	67.715%

LLCI, lower limits of confidence interval; ULCL, upper limits of confidence interval; SE, standard error.

Table 6: Regression results of vocational program-occupation-skill alignment on professional identity for vocational education students of different genders

Variable	Male		Female	
	Coefficient	SE	Coefficient	SE
Alignment	3.416***	0.485	2.494***	0.485
Grade	0.354	0.284	-0.916*	0.368
Place of origin	-2.845**	1.043	-0.953	1.021

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$. SE, standard error.

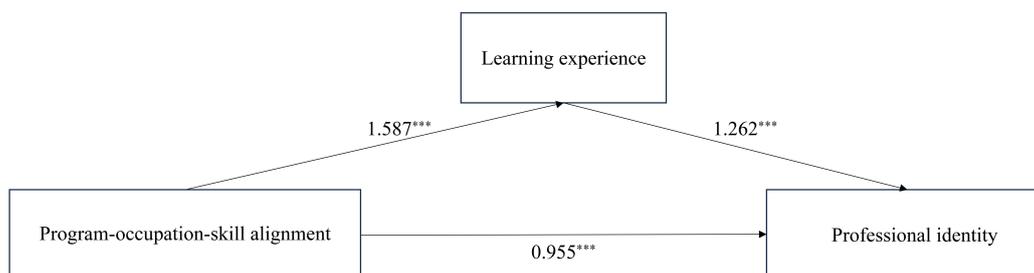


Figure 1. Path coefficients among vocational program-occupation-skill alignment, learning experience, and professional identity. *** $P < 0.001$.

students.

CONCLUSION AND DISCUSSION

This study investigated the impact mechanism of vocational program-occupation-skill alignment on vocational education students' professional identities under the dual-education system and the role of learning experience in students' dual identity transition. Through binary regression, mediation effect tests, and hetero-

geneity tests, the main findings were as follows.

First, vocational program-occupation-skill alignment under the dual-education system significantly influences vocational education students' professional identity, supporting previous research findings. Unlike previous studies that divided the dual-education system into school learning spaces and off-campus practice locations from a spatial perspective, this study focused on

students' dual-identity transitions across both spaces. Using the vocational program-occupation-skill alignment framework, we explained the effectiveness of the dual education system arrangement. High alignment indicates good coherence and connectivity between various interactive components under the dual-training model, enabling students to learn by doing and combine work with study, thus matching their capabilities with job requirements and enhancing their professional identities.

Second, vocational program-occupation-skill alignment influences professional identity through the mediating effect of learning experience, with high alignment enhancing professional identity by promoting students' learning experiences. As a powerful indicator for examining the learning process, learning experience reveals the influence mechanism. That is, the dual education system, which encompasses two training subjects, two types of teaching content, two types of faculties, two types of certificates, and students' dual identities, directly affects students' course experiences, learning activity experiences, and perceptual evaluations. These learning experiences and the discourse interaction between dual spaces and identities, in turn, influence students' professional identities.

Third, while vocational program-occupation-skill alignment significantly affects professional identity across genders, its impact is stronger among male students than female students. Female vocational education students may face gender discrimination in job seeking, and traditional gender conditioning has shaped weaker employment awareness among women, leading to some arbitrariness and blindness in their career choices (Jiang, 2010). In addition, female students are more prone to feelings of inferiority (Li & Li, 2018) and perceptions of discrimination (Zhao, 2014). The combination of educational and gender discrimination has shaped gender differences in professional identities to some extent.

Recommendations

Professional identity development is a key outcome of vocational education and plays a vital role in student development. At present, while the state provides guidelines through institutional documents, such as the new Vocational Education Law, and supports rational recognition of vocational education through institutional reforms, the lack of internal motivation is a key limiting factor. Focus should be placed on the effectiveness of the vocational education learning process and on strengthening the internal drive for social comparison (Peng & Zhang, 2023). Based on this, our research suggests improving vocational students' professional identities through two aspects: enhancing vocational program-occupation-skill alignment under the dual education system and improving students' learning

experiences.

First, using skill formation as the core approach and supply-demand matching as the main objective will achieve effective linkages across all stages of the dual-training model. Skill formation theory suggests that skills not only affect individual work performance and life quality but also relate to organizational and social efficiency and innovation capacity. This requires joint promotion by individuals, educators, and enterprises (Liao, 2023) and demands that vocational education both understand specific requirements for skilled talent from the enterprise demand side and achieve integration between skilled talent supply development and market needs. At present, insufficient integration between vocational institutions and industry, along with incomplete school-enterprise dual-cultivation mechanisms, are the main causes of the skilled talent supply-demand mismatch. This requires government policies, enterprises supporting resources and actively participating in talent cultivation, and vocational institutions optimizing teaching processes and integrating faculty resources to establish a training model supported by government, led by schools, and centered on school-enterprise collaboration, thereby promoting a smooth dual-identity transition and effective skill formation for vocational education students.

Second, capability development should be used as the main thread and teaching improvement as support to enhance vocational education students' learning experiences. Skilled talent cultivation requires hands-on practical experience, necessitating adherence to a dual-education philosophy that combines learning with work and theory with practice (Zhang *et al.*, 2015). Vocational institutions should first establish curriculum standards emphasizing professional capability development, standardize basic teaching requirements, improve teaching quality, and promote a reform of the *dual-certificate* assessment system to strengthen student capability development. In addition, through deep school-enterprise cooperation, a "high-quality, well-structured, distinctive, and relatively stable" dual-qualified faculty team should be built (Hong, 2010), strengthening exchange and cooperation between enterprise technical personnel, management staff, and full-time faculty members to provide reliable information for curriculum development.

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Author contributions

Wang X: Visualization, Supervision, Resources, Project

administration, Funding acquisition. Zhou ZL: Software, Validation, Formal analysis, Investigation, Writing—Original draft. Wu C: Conceptualization, Data curation, Methodology, Writing—Review and Editing. All authors have read and approved the final version.

Ethical approval

Not applicable.

Informed consent

All participants provided written informed consent. Personal identifiers (e.g., names, ID numbers) were removed to ensure confidentiality, and data were anonymized before analysis.

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Conflict of interest

Xing Wang is an Editorial Board Member of the journal. The article was subject to the journal's standard procedures, with peer review handled independently of the member and research group.

Data availability statement

Data used to support the findings of this study are available from the corresponding author upon request.

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