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Exploring the Application of the SWOT Model in the Development of a "Dual-Qualified" Teacher Workforce in Higher Vocational Education in the Context of Big Data

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Abstract In higher vocational colleges, the development status of "dual-qualified" teachers profoundly influences the future height and breadth of higher vocational education, and has thus gradually become a top priority in the construction of the teaching staff in higher vocational colleges. This paper selects the SWOT model as a research tool, combining the SWOT model to clarify the internal strengths, internal weaknesses, and external opportunities in the training of "dual-qualified" teachers in higher vocational colleges. Within the framework of constructing a digital portrait of teachers' teaching capabilities based on performance-based evidence, evidence is categorized into five types: text-based, audio-visual, scale-based, platform-based, and product-based. The LDA model is employed to analyze high-frequency words and extract and classify text topics, thereby generating evaluation result features and social relationship features to construct a digital portrait of teachers' teaching capabilities. Department of Natural Resource of this Vocational College were selected as the research sample, and student evaluations of teachers and MPCK knowledge feature extraction were conducted. Based on the extracted teacher MPCK features, the construction of the "dual-qualified" teacher team in Department of Natural Resource of this Vocational College was analyzed. Overall, only the KSU (knowledge related to student understanding) feature value was below the qualified value (6.00), and it is recommended as a key direction for future development and optimization.

Index Terms SWOT model, LDA model, dual-qualified teachers, teaching ability profile

I. Introduction

At a press conference in 2022, the Ministry of Education announced that enrollment in higher vocational education would increase by 4.323 million over three years, with higher vocational (college) enrollment in 2021 reaching 1.8 times that of ten years ago. Vocational education has become central to educational reform and innovation, as well as to socio-economic development [1]. China's vocational education bears the important responsibility of cultivating highly skilled technical professionals needed for the socialist cause, exerting a profound influence on the comprehensive construction of a moderately prosperous society [2]. Its development not only provides strong support for the national economy but also serves as an important base for regional industrial talent cultivation [3]. Additionally, the employment rate and quality of graduates are crucial to national development, making the promotion of high-quality vocational education a top priority at present.

As an important vehicle for vocational education, the advancement of higher vocational colleges has been significantly influenced by "dual-qualified" teachers, who are not only a key force in enhancing the competitiveness and educational standards of institutions [4]. For higher vocational colleges, establishing a team of "dual-qualified" teachers is not only essential for pursuing intrinsic development but also a necessary condition for establishing or upgrading vocational education programs to the undergraduate level [5]-[7]. During the transformation and upgrading of higher vocational colleges, the quantity and quality of "dual-qualified" teachers have played a pivotal role [8]. Their development not only impacts the overall construction of the teaching team but also directly affects the college's overall educational quality and market competitiveness [9]. Therefore, strengthening the construction of the "dual-qualified" teacher workforce has become an inevitable requirement for the development of higher vocational colleges.

Teachers are the core productive force of curriculum construction, and curriculum construction feeds back teachers' professional development. Curriculum construction and reform are the foundation for the optimized development of higher vocational education. To achieve significant progress and results, all educational reforms must deeply explore this theme [10]. In the field of higher vocational education curriculum research, scholars have

consistently focused on the objectives and characteristics of higher vocational education curricula, as well as their structural models. First, regarding the objectives and characteristics of higher vocational education curricula, the most important feature is their practicality, which is the core philosophy of vocational education and a widely recognized reality among vocational education experts [11]-[13]. Literature [14] explores enhancing the quality of higher vocational education by establishing a personality-oriented educational model, aiming to cultivate well-rounded personalities and strengthen talent cultivation and personnel quality, thereby contributing to the fields of vocational education psychology and counseling psychology. Literature [15] discusses the necessity of establishing an internal quality assurance system in higher vocational colleges to improve curriculum planning and personnel training, thereby adapting to the development of modern society and educational reforms. Literature [16] explores the importance of professional competence in higher vocational education and proposes a tripartite cooperation model involving vocational colleges, enterprises, and educational training institutions. This innovative mechanism aims to enhance students' professional competence and quality. Literature [17] analyzes existing higher vocational education models and proposes a student-centered educational reform method. This strategy prioritizes vocational competence and introduces the “mobile education factory” model to enhance the innovation and entrepreneurship capabilities of higher vocational education.

Second, in the vocational education course structure model, Literature [18] optimizes the course training content of specialized vocational education by constructing a structure-function model consistent with occupational standards, ensuring that students can master professional-related skills. Literature [19] applies systems theory to analyze vocational education issues under the Industrial 4.0 context, introducing the concept of an “education supply chain” and proposing a course structure based on systems thinking to address future skill demands and global resource sharing challenges. Literature [20] explores the application of data mining technology in the construction and optimization of higher vocational college curricula, aiming to support decision-making in higher vocational education to enhance its quality. Literature [21] proposes a data-driven framework for mining and analyzing student evaluations in Chinese higher vocational education MOOC courses. This framework utilizes web crawlers, text mining, artificial neural networks, and the KANO model to classify student needs and design strategies for improving the quality of higher vocational education. Overall, research on higher vocational education courses emphasizes the practicality of such courses and highlights the importance of practical courses as a key component of the course structure model.

In recent years, research on the professional development of “dual-qualified” teachers in higher vocational colleges has gained increasing attention. Numerous scholars have conducted studies and discussions on various aspects of “dual-qualified” teachers, providing valuable references for the current construction of “dual-qualified” teacher teams in higher vocational colleges. Literature [22] constructed a competency model for “dual-qualified” teachers in higher vocational colleges, which encompasses aspects such as personal charm, teaching literacy, and practical skills. These elements are interdependent and have a significant impact on both teachers and students. Literature [23] explored the structure of “dual-qualified” teachers and its influence mechanisms, proposing a “Porter Diamond Model” with four dimensions, and pointing out that participation motivation is a key factor influencing training outcomes and capability enhancement. Literature [24] constructs a structural dimension model of the work role transformation ability of “dual-qualified” teachers and its generation mechanism, identifying four key dimensions and four influencing factors to enrich and expand the theory of work role transformation, thereby providing support for practical application in higher vocational education institutions. From the above analysis, it can be seen that although the concept of “dual-qualified” teachers is a China-specific concept proposed in the field of vocational education, due to its late start and lack of experience, there is still significant room for development.

This paper employs the SWOT model matrix to conduct a detailed analysis of the internal strengths, internal weaknesses, and external opportunities of “dual-qualified” teacher training, thereby establishing a research and analysis framework. It then provides a brief overview of the construction scheme for a digital profile of teachers' instructional capabilities, identifies the sources of performance-based evidence of instructional capabilities, and summarizes their types. Additionally, the LDA model is introduced as a document topic generation method, elucidating the process of generating evaluation result features and social relationship features. Subsequently, evaluation data from students at Department of Natural Resource of this Vocational College regarding teachers are selected as the research sample, and statistical analysis is conducted on the frequency and characteristics of high-frequency words in the positive evaluation group and negative evaluation group. Based on the LDA model, the textual topics of the positive evaluation group and negative evaluation group are mined and analyzed. Finally, the MPCK-Map analysis method is used to extract and summarize the knowledge characteristics of teachers at Department of Natural Resource of this Vocational College, and based on these characteristics, the teaching ability profiles of teachers are drawn and compared.

II. Elements of “dual-teacher” teachers based on the SWOT model

II. A. SWOT Model

The SWOT matrix analysis method refers to a situational analysis of the internal conditions and external environment of the research subject. It is based on the internal strengths and weaknesses, external opportunities (opportunities) and threats (threats) closely related to the research subject. Various factors influencing these four conditions are listed in matrix form. By matching internal and external factors within these four conditions and applying a systematic thinking approach, a series of corresponding strategies are derived, providing a reference basis for strategic decision-making for the research subject. By conducting a SWOT analysis of the research subject, one can comprehensively, systematically, and accurately describe the current state of the research subject. Based on the analysis results, corresponding strategies can be formulated, and pathways to implement these strategies can be identified. The SWOT model is shown in Table 1.

Table 1: SWOT model

		Internal conditions	
		Strengths	Weakness
External conditions	Opportunities	SO Strategy	WO Strategy
	Threats	ST Strategy	WT Strategy

II. B. Components of “dual-teacher” teacher training

II. B. 1) Internal Strength Analysis

Every higher vocational college has its own environment conducive to the development of its teaching staff. Members of the teaching staff work together and support one another, leveraging the college's unique advantages to maximize the effectiveness of teacher training. This internal advantage enables complementary strengths among teachers of all levels without the need for additional training costs. Furthermore, it allows for the simultaneous improvement of professional theoretical knowledge and educational teaching skills among teachers awaiting training, achieving the goal of cultivating a “dual-qualified” teacher group without relying on external resources. For example, the “dual-qualified” teacher workforce includes young teachers who are well-versed in contemporary advanced educational concepts and proficient in high-tech teaching equipment, as well as experienced senior teachers with deep teaching credentials and rich practical experience. The unique ability of senior teachers to express and impart knowledge and skills is invaluable teaching experience for newly recruited young teachers. At the same time, young teachers are more familiar with emerging professions and new knowledge in today's society, which can also complement the daily teaching activities of senior teachers. Furthermore, the leading figures in each vocational college have achieved unique accomplishments in their respective research and teaching fields and are renowned in the professional academic community. They serve as role models in the cultivation of “dual-qualified” teachers at their institutions, thereby stimulating other teachers to actively improve their teaching skills and professional operational capabilities.

II. B. 2) Internal Disadvantage Analysis

Due to differences in educational background, years of teaching experience, and professional expertise, there are multiple tiers of “dual-qualified” teachers within higher vocational colleges, and the groups of teachers requiring further development exhibit significant variations, with differing training needs. The more diverse the groups of teachers requiring development, the more complex the training strategies schools must formulate, which inadvertently becomes a significant internal disadvantage in the cultivation of “dual-qualified” teachers within higher vocational colleges. For example, young teachers are mostly graduates from various higher education institutions and lack sufficient practical experience in vocational technical positions and production management on the front lines. Their practical skills may not yet meet the standards of a “dual-qualified” teacher. Additionally, their teaching experience is relatively limited, and they have not yet developed a unique teaching methodology. On the other hand, senior teachers are less familiar with emerging disciplines and new knowledge in today's society, and their existing professional knowledge is gradually becoming outdated. Students may find it difficult to adapt to some of their outdated teaching methods, so their training needs will inevitably focus on learning emerging disciplines, new knowledge, and new skills. It is clear that the significant differences among the teaching staff will also constitute one of the internal obstacles for the school in conducting teacher training initiatives.

II. B. 3) External Opportunity Analysis

In the context of teacher training, higher vocational colleges should not only fully leverage their institutional advantages but also effectively tap into all external conditions and opportunities conducive to teacher development.

Engaging the role of enterprises can to some extent enhance teachers' professional skills; cost-effective and operationally convenient inter-institutional teacher exchange and cooperation programs are also external pathways to improve the quality of the faculty; leveraging the opportunity of educational globalization, establishing stable and sustainable “dual-qualified” teacher training cooperation models with vocational colleges in advanced countries worldwide is an advantageous condition for promoting the internationalization and global development of the institution's “dual-qualified” teachers.

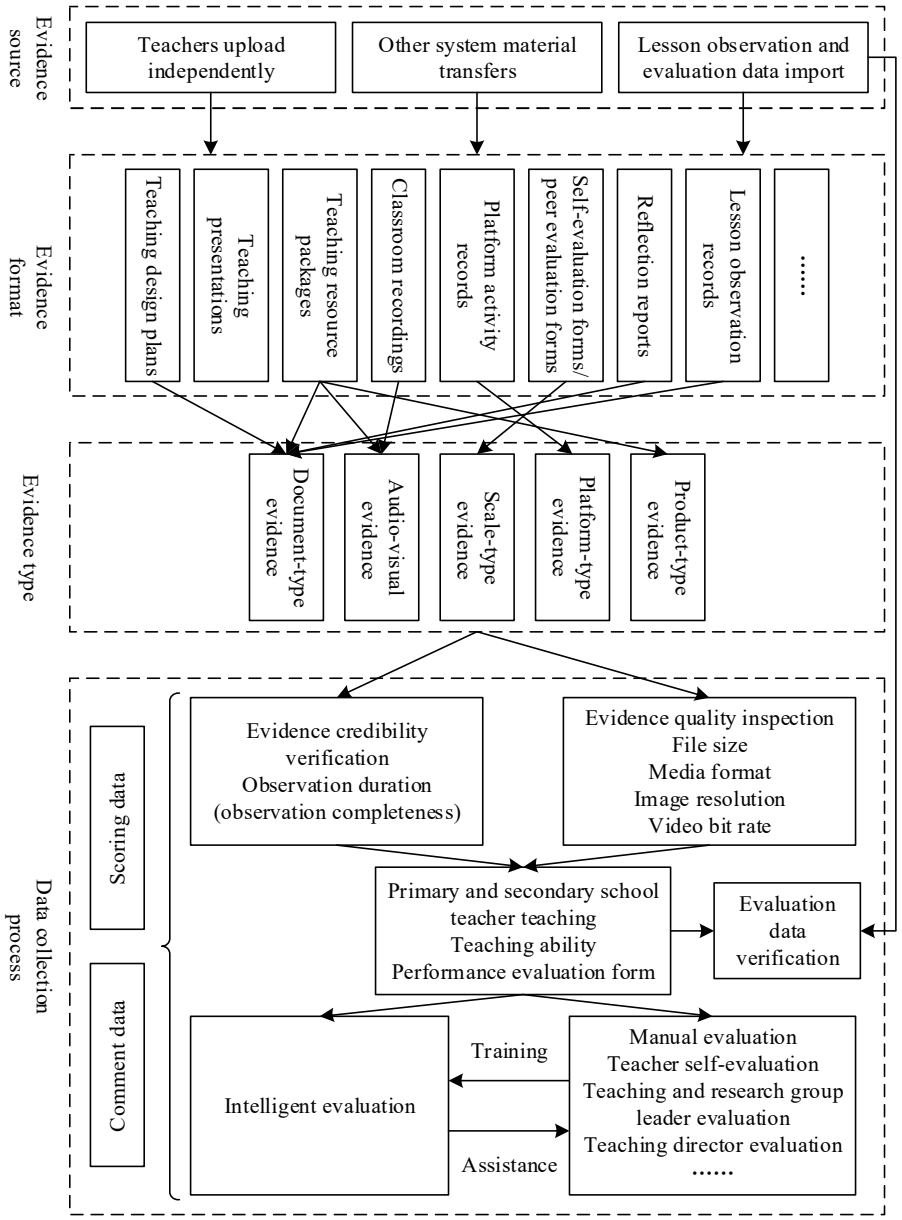

Figure 1: Evidence-based evaluation process

III. Data collection for digital profiling of teachers' teaching abilities

Teacher digital profiles incorporate both general user profile characteristics and specific features unique to the education sector. Therefore, in addition to collecting data on teachers' personal backgrounds, teacher teaching ability profiles must also collect performance-based evidence that demonstrates teachers' teaching abilities, such as teaching plans, classroom recordings, reflection reports, and student assignment analyses. After evidence collection is completed, preliminary screening is conducted to ensure the basic quality of the evidence. Based on this, multiple stakeholders, including teachers, department heads, subject experts, and school administrators, are organized to participate in performance-based evaluations, converting performance-based evidence into data

describing the development level of teachers' teaching abilities, thereby providing direct data sources for profile construction. The processes of evidence collection, quality verification, and evidence-based evaluation are illustrated in Figure 1.

III. A. Types and Sources of Evidence

Teaching evidence refers to a series of materials developed and utilized by teachers during the teaching process, serving as important educational resources. Currently, there are various methods for classifying teaching resources. For example, based on resource format, they can be categorized into text, images or graphics, audio, video, applications, and others; based on the focus of application, they can be divided into “teacher-centered” and “student-centered” resources. The former includes courseware, case studies (such as teaching design plans and subject-specific test questions), etc., primarily aimed at enhancing teaching efficiency. The latter includes multimedia materials and literature resources, which serve to support students' independent and collaborative learning; There are also classification methods based on the actual construction of educational resources, such as dividing resources into nine major categories: media materials, test questions, exam papers, courseware, case studies, literature materials, frequently asked questions, resource directory indexes, and online courses.

For the collected and aggregated teaching evidence, this study first categorizes teachers' teaching ability performance evidence into the following five types based on the form of evidence:

(1) Text-based evidence. This type of evidence is characterized by small file size and ease of editing. Teaching design plans, teaching reflection reports, and lesson evaluation records all fall under this category.

(2) Audio-visual evidence. This type of evidence primarily includes audio-visual resources related to teaching content and classroom recordings.

(3) Scale-based evidence. This type of evidence primarily revolves around activities related to teaching evaluation, such as evaluation scales for student work, self-assessment forms, and peer assessment forms for group inquiry-based learning processes.

(4) Platform-based evidence. This type of evidence primarily focuses on records of teachers' activities conducted using online teaching platforms, such as pre-class preparation task design and student assignment feedback.

(5) Product-based evidence. This primarily includes teaching presentations and subject-related props related to teaching content.

In terms of evidence sources, to ensure that the constructed teacher profile fully and comprehensively reflects the teacher's actual teaching level, the collected teaching evidence should cover all stages of the teacher's teaching activities and multiple teaching scenarios, including teaching preparation, implementation of teaching activities, evaluation of student learning outcomes, and post-class reflections on teaching effectiveness. Additionally, teachers' activity performance, such as their behavior and related works when serving as the main speaker in collective lesson preparation activities, can fully demonstrate their understanding of teaching and serve as strong evidence of their teaching performance.

In line with the fundamental goal of companion-based, non-disruptive evaluation, evidence collection primarily involves retrieving relevant activity materials through open interfaces of various educational and teaching systems, such as classroom recordings from lesson observation and evaluation systems, teaching case studies from research and development platforms, and assignment feedback from online teaching platforms. After evidence is automatically transferred, a confirmation request is sent to the teacher, who can then verify and include it in their personal evidence repository. The platform also provides an evidence upload channel, allowing teachers to upload local electronic documents, audio-visual files, and other materials to the platform. For handwritten lesson observation records, reflection logs, and other paper materials, teachers can upload photos or scanned copies. Additionally, in addition to uploading outcome-related materials, teachers can also submit supplementary materials related to design concepts and application effects. For example, when submitting a micro-video, teachers can also submit the micro-video's design documentation and details of its application in the teaching process, including students' experiences using the micro-video, thereby comprehensively showcasing the entire process from conception, development, application, to effect analysis of the teaching materials. During the evidence collection phase, teachers should be given ample autonomy, guiding them to consciously review the entire process of the phase-based teaching, analyze, and distill evidence materials that demonstrate their teaching performance.

The evidence collection process primarily involves teachers uploading materials related to their teaching activities. Department heads and other teachers may also supplement these materials. For example, photographs of board work taken during classroom observations or recorded segments of teacher-student interactions can serve as effective supplements to teachers' teaching evidence, corroborating the materials submitted by teachers themselves and enhancing the authenticity of the evidence.

III. B. LDA model

Currently, there are two most common types of topic models. The LDA model is one of the most mature and widely used topic models. The LDA model is a Bayesian probability model that integrates three layers of structure: words, topics, and documents. When conducting topic analysis on one or a series of articles, the first step is typically to analyze each word within the text. This is because, in most cases, a word or phrase that appears multiple times in an article may serve to highlight the topic. These words and the topic must have some kind of association, so it is necessary to analyze these words in detail. In the LDA model, the indirect associations between different words in a document can be represented, and multiple different topic vectors can be generated based on different documents. Finally, the probability of the topic is calculated through the model. For each document in the corpus, the process of generating document topics using LDA is as follows:

(1) Extract a topic from the topic distribution of each document.

(2) Repeat the above process until every word in the entire document set has been traversed.

In corpus D, each document is denoted as d. Suppose that document d contains n words, each of which is denoted as w_i. The entire corpus is represented by the topic set T. All distinct words in the corpus can form a set, denoted as β. LDA trains the corpus D to obtain two result vectors, as shown below:

(1) For each document d, the set of all topic probabilities it contains is denoted as $\theta_d = \{P_{t1}, P_{t2}, \cdots, P_{tn}\}$, where P_{ti} represents the probability of the i th topic in T corresponding to d. The calculation formula is shown in Equation (1).

$$P_{ti} = \frac{n_{ti}}{n} \tag{1}$$

Here, n_{ti} denotes the number of words corresponding to the i th topic in document d, and n denotes the total number of words in d.

(2) For each topic in t, generate the probabilities of different words $\varphi_t = \{P_{w1}, P_{w2}, \cdots, P_{wm}\}$, where P_{wi} represents the probability of t generating the i th word in β. The calculation formula is given by Equation (2).

$$P_{wi} = \frac{N_{wi}}{N} \tag{2}$$

where N_{wi} denotes the corresponding word in β for the i th word, and N denotes the total number of words in topic t.

Each topic is denoted as t, and the probability formula for w in d is given by equation (3).

$$P(w \mid d) = P(w \mid t) \times P(t \mid d) \tag{3}$$

The LDA model uses topics as an intermediate layer and can give the probability of word w appearing in document d through θ_d and φ_t.

III. C. Generation of Teacher Profiles

III. C. 1) Generation of teaching evaluation results characteristics

The teacher evaluation results feature includes two types of attributes: evaluation scores and evaluation label vectors. Evaluation scores are obtained through statistical analysis by the evaluation system and can be directly extracted from the student evaluation system. Evaluation label vectors consist of primary evaluation label vectors and secondary evaluation label vectors. The primary evaluation label vector for a teacher is represented by the Main Tag, with weight indicating the degree of alignment with that primary evaluation label. Similarly, the secondary evaluation label vector for a teacher is represented by EvaTag, with weight indicating the degree of alignment with each secondary evaluation label. Using the above method, the overall evaluation label vector can be represented by the tuple $(MainTag, EvaTag)$. Since the secondary evaluation label vector and the primary evaluation label vector have a subordinate relationship, the weight value of the primary evaluation can be calculated as the sum of the weight values of the secondary labels belonging to the primary evaluation label. Therefore, the specific generation steps of the EvaTag vector will be detailed below.

In most recommendation systems, the most important aspect is the model construction based on the recommendation ontology, which accounts for approximately 70% of the system, while the recommendation algorithm accounts for only about 30%. Therefore, the EvaTag vector of the teacher's secondary evaluation label features is a key factor in this chapter and serves as the foundation for recommending methods to enhance teaching capabilities. The teacher's secondary evaluation label features in this paper are primarily derived by extracting keywords from student evaluation texts to describe the teacher. In the evaluation label system introduced in Chapter

3 of this paper, a total of 30 secondary evaluation labels were constructed. Therefore, the teacher's secondary evaluation label vector can be represented as $EvaTag = \langle EvaTag_1, EvaTag_2, \cdots, EvaTag_{30} \rangle$. Input: a set of student evaluation texts for a teacher; output: keywords and keyword sets. The steps for establishing the teacher's secondary label vector extraction model are as follows:

Step 1: Text feature extraction

Text features are extracted from the student evaluation text set using the Word2Vec feature value extraction algorithm, and a text feature vector space $D = \langle D(S_1), D(S_2), D(S_3), \cdots, D(S_n) \rangle$ is constructed, where n represents the number of input text sets.

Step 2: Generation of text label vectors

The text feature vectors obtained in the first step are input into the LDA model algorithm to calculate the classification probabilities of teachers on 30 secondary evaluation labels, yielding the probability vectors $P = \langle P_1, P_2, P_3, \cdots, P_n \rangle$ for secondary label classification. The classification probability calculation formula for documents is shown in Equations (4)-(5).

$$P(C_j \mid D) = P(C_j) \times \prod_{i \in n} P(W_i \mid C_j) \tag{4}$$

$$P(W_i \mid C_j) = \frac{N(W_i \in C_j) + 1}{N(C_j \in D) + 1} \tag{5}$$

In equation (4), $P(C_j \mid D)$ represents the probability of the secondary evaluation label C_j in the text feature vector space D of the teacher, i.e., the proportion of times C_j appears in all student evaluation texts D of the teacher. In formula (5), $P(W_i \mid C_j)$ represents the frequency of occurrence of keyword W_i under a specific secondary evaluation label C_j, and $N(W_i \in C_j)$ represents the number of evaluation texts containing keyword W_i in all evaluation texts included in the j th secondary evaluation label. To prevent the denominator from being zero and thus uncalculable, both the numerator and denominator of the formula need to be increased by 1.

Step 3: Calculation of the secondary evaluation label vector

By simply adding together all the word vectors obtained in Step 2 for the 30 secondary evaluation labels, we can obtain the final secondary evaluation label vector.

III. C. 2) Generation of social relationship characteristics

This paper uses the similarity between teachers to represent the social relationship model attributes of teachers, i.e., $Relation = (Similarity)$ in the teacher profile model. Among them, the social relationship attribute vector of teachers is represented by $Similarity$, and the process of constructing the $Similarity$ vector for teacher profiles is as follows:

As mentioned above, the similarity attribute of teachers is represented by $Similarity = \langle Similarity_{a1}, Similarity_{a2}, \cdots, Similarity_{an} \rangle$, where $Similarity_{ai}$ denotes the similarity between teacher a and teacher i. The $Similarity_{ai}$ vector proposed in this paper is the similarity between the primary evaluation label vector $MainTag_a$ of teacher a and the primary evaluation label vector $MainTag_i$ of teacher i. The similarity is calculated as in equations (6)-(7).

$$Similarity\left(\overrightarrow{MainTag_a}, \overrightarrow{MainTag_i}\right) = \cos\left(\overrightarrow{MainTag_a}, \overrightarrow{MainTag_i}\right) \tag{6}$$

$$\cos\left(\overrightarrow{MainTag_a}, \overrightarrow{MainTag_i}\right) = \frac{\overrightarrow{MainTag_a} \cdot \overrightarrow{MainTag_i}}{\left|\overrightarrow{MainTag_a}\right| \times \left|\overrightarrow{MainTag_i}\right|} \tag{7}$$

$MainTag_a$ denotes the primary evaluation label vector of teacher a, and $MainTag_i$ denotes the primary evaluation label vector of teacher i. $Similarity\left(\overrightarrow{MainTag_a}, \overrightarrow{MainTag_i}\right)$ represents the similarity between the first-level evaluation labels of teacher a and teacher i. $EvaTag_a$ denotes the second-level evaluation label vector of teacher a, $EvaTag_i$ denotes the secondary evaluation label vector of teacher i, then $Similarity\left(\overrightarrow{EvaTag_a}, \overrightarrow{EvaTag_i}\right)$ denotes the similarity between the secondary evaluation label vectors of teachers a and i. $Similarity\left(\overrightarrow{MainTag_a}, \overrightarrow{MainTag_i}\right)$ is obtained by simply superimposing all secondary evaluation label vectors $Similarity\left(\overrightarrow{EvaTag_a}, \overrightarrow{EvaTag_i}\right)$ and is finally processed using regularization.

IV. Drawing and analyzing the portrait of a “dual-role” teacher

This chapter selects first-year teachers at Department of Natural Resource of this Vocational College as the research subjects. After the end of the spring semester of the first year, a teacher teaching ability evaluation survey questionnaire (professional core courses) was designed and distributed online to the students of different grades for completion. A total of 1,423 questionnaires were distributed, with 1,334 valid questionnaires returned, resulting in a response rate of 93.74%. After preprocessing the questionnaire data, it was categorized into two groups based on textual content and emotional characteristics: the positive evaluation group and the negative evaluation group.

IV. A. High-frequency vocabulary analysis

This section conducts further qualitative analysis on two sets of evaluation texts: positive comments on teachers' teaching and negative comments on teachers' teaching. Based on the results of keyword extraction using TF-IDF, we statistically analyze the high-frequency words in the two sets of text data and preliminarily interpret the teaching characteristics of teachers that are the focus of the two sets of comments.

IV. A. 1) Frequently used words in the positive evaluation group

After classifying and matching teacher teaching dictionaries based on emotional polarity, a total of 65,897 positive comments were obtained. Using word frequency analysis to identify and extract the key content of positive comments, the top 15 high-frequency keywords were selected through screening and ranking (W1: explanation, W2: Interesting, W3: Case Studies, W4: Clear, W5: Teaching, W6: Knowledge, W7: Accessible, W8: Understanding, W9: Detailed, W10: Approach, W11: Innovative, W12: Well-Organized, W13: Gains, W14: Problem-Driven, W15: Key Points) are shown in Figure 2.

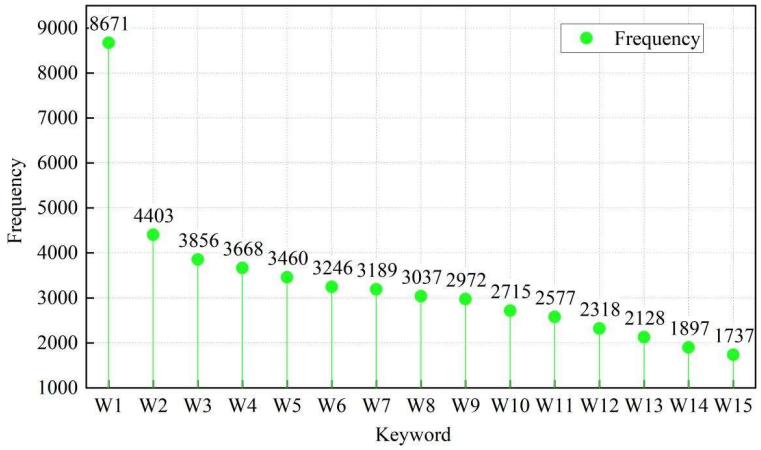

Figure 2: The top 15 high-frequency words in the positive evaluation group

It can be observed that the term P1: explanation appeared 8,671 times, with the highest frequency. This indicates that positive evaluations primarily revolve around the teacher's explanations, with learners placing greater emphasis on the teacher's explanations and expressing affirmation and recognition of them. The next highest frequencies were for P2: interesting (4,403) and P3: case studies (3,856). The terms P4: Clear, P5: Teaching, P6: Knowledge, P7: Simplifying Complex Concepts, and P8: Understanding all appear more than 2,000 times. Among the remaining terms, only P14: Problem-Driven and P15: Key Points appear less than 1,000 times, while the others all fall within the 1,000 to 2,000 range.

Terms like “explanation” and ‘interesting’ reflect learners' direct experience of the teacher's explanations as engaging. Terms like “case study,” “teaching,” “knowledge,” “understanding,” and “practical” indicate learners' focus on the content of the teacher's lectures. Overall, the high-frequency terms in the positive evaluation group indicate learners' attention to the teacher's teaching methods, content, logical thinking, and language style.

IV. A. 2) High-frequency words in the negative evaluation group

After classifying and matching the emotional polarity of teacher teaching dictionaries, a total of 1,014 negative evaluations were obtained. Using word frequency analysis, the top 15 high-frequency keywords were extracted (W1: explanation, W16: hope, W17: teaching, W18: too fast, W19: examples, W20: reading from the textbook, W21: none, W8: understanding, W22: reading the PowerPoint, W23: unable to understand, W15: knowledge points, W24: speaking speed, W3: case studies, W10: method, W25: explanation) are shown in Figure 3.

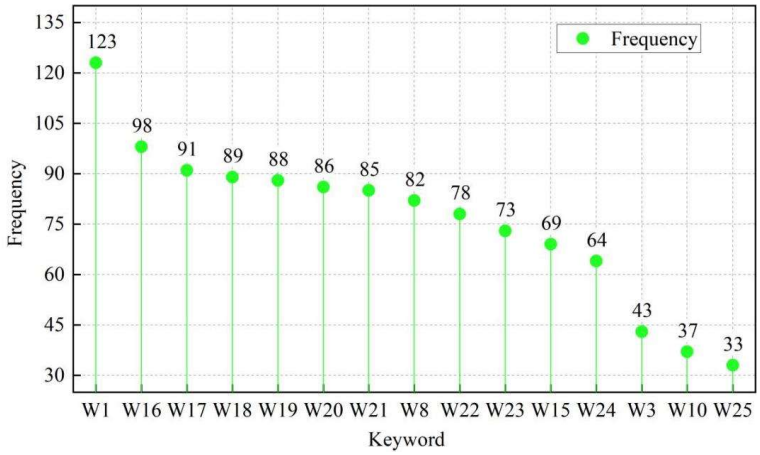

Figure 3: The top 15 high-frequency words in the negative evaluation group

The most frequently occurring word is W1: explanation (123), followed by W16: hope (98) and W17: teaching (91), which also appear with high frequency. There are five terms with frequencies between 80 and 89 occurrences: W18: too fast, W19: example, W20: reading from the textbook, W21: no, and W8: understanding. There are four terms with frequencies between 50 and 79 occurrences: W22: reading the PowerPoint, W23: not understanding, W15: knowledge points, and W24: speaking speed. The remaining three terms—W3: case study, W10: method, and W25: explanation—appeared less than 50 times.

A comparison of the high-frequency words in the positive evaluation group and the negative evaluation group revealed that “explanation” was a common central word in the evaluation texts of both groups. This central word was often associated with aspects such as methods, approaches, and content, indicating that these aspects may be the main factors influencing the effectiveness of teachers' teaching.

IV. B. Evaluation of Text Topic Mining

This section is based on the LDA model and extracts three topics with significant probabilities according to the probability distribution of topics of interest to learners in different groups. In each topic, eight words are sorted according to their probability values to obtain the granularity and content of each topic.

IV. B. 1) Positive evaluation group topics

The topic word matrix for the positive evaluation group is shown in Table 2. Topics 1 and 2 focused on the most information, accounting for 62.00% of all topics, reflecting the topics that learners with a positive attitude were most interested in and eager to discuss.

Table 2: The word matrix of the topics in the positive evaluation group

Topic 1(0.323)		Topic 2(0.297)		Topic 3(0.156)	
Word	Probability	Word	Probability	Word	Probability
Explain	0.108	Teaching	0.156	Harvest	0.217
Case	0.067	Enhance	0.099	Understand	0.178
Logic	0.066	Amusing	0.098	Help	0.101
Improve	0.063	Attract	0.069	Instruct	0.072
Method	0.05	Way	0.064	Wonderful	0.059
Offer	0.046	Acquire	0.06	Deserve	0.046
Structure	0.046	Form	0.056	Practical	0.044
Enlighten	0.044	Benefit	0.055	Time	0.04
Topic 4(0.121)		Topic 5(0.103)			
Word	Probability	Word	Probability		
Teach	0.347	Explain	0.338		
Knowledge	0.087	Comprehend	0.087		
Good	0.056	In place	0.07		
Organization	0.056	Teaching	0.04		
Language	0.043	Speed	0.038		

Significance	0.039	Provide	0.037		
Method	0.035	Theory	0.036		
Head First	0.031	Interaction	0.034		

Based on the probability ranking of words in the topic, infer the implied meaning of the topic and analyze the content of the first three topics:

Topic 1: Focusing on teaching strategies, learners are concerned with the content and logical structure of the teacher's lectures. Learners believe that the teacher's teaching content is rich in “cases,” “problem-driven,” and structurally rigorous, which inspires learners and helps improve their skills and abilities in certain areas.

Topic 2: Focusing on teaching methods, this topic concerns the teaching methods and language style of the instructor. Learners not only agree with the instructor's teaching style and methods but also find the instructor's lectures easy to understand, humorous, and engaging. These characteristics attract learners to study, not only improving their learning efficiency, quality, skills, and motivation but also enhancing the instructor's teaching efficiency.

Topic 3: Focusing on the practicality of content. This primarily reflects learners' direct experiences of how the content, explanations, or teaching methods used by instructors help them understand or learn knowledge and course content. The teaching process is connected to “reality,” the ‘time’ allocation is reasonable, and it has “practicality.”

IV. B. 2) Negative evaluation group topics

The topic word matrix for the negative evaluation group is shown in Table 3. Learners paid high attention to topics 1 and 2, accounting for 83.60% of the total topics.

Table 3: The word matrix of topics in the negative evaluation group

Topic 1(0.427)		Topic 2(0.409)		Topic 3(0.164)	
Word	Probability	Word	Probability	Word	Probability
Hope	0.056	Teaching	0.041	Harvest	0.043
Living example	0.036	Enhance	0.037	Understand	0.034
Voice	0.031	Amusing	0.034	Help	0.033
Explain	0.029	Attract	0.033	Instruct	0.031
Cannot understand	0.028	Way	0.033	Wonderful	0.029
Thorough	0.028	Acquire	0.028	Deserve	0.029
Comprehend	0.027	Form	0.026	Practical	0.029
insufficient	0.026	Benefit	0.025	Time	0.028

Based on the probability ranking of words in the topic, we can infer the implied meaning of the topic. Let's analyze the content of the three topics:

Topic 1: Focus on language clarity. The keyword with the highest probability in this topic is “hope,” which indicates that online learners have high expectations for course improvements, with rational encouragement outweighing stubborn criticism. They hope that teachers can combine examples with practical applications and explain concepts in a more in-depth and easy-to-understand manner.

Topic 2: Focuses on the similarity of teaching language. This topic highlights keywords such as “reading from the textbook,” “explanation,” and “book-based,” primarily focusing on the overly formulaic nature of teachers' teaching and explanation methods. Teaching that strictly follows the textbook completely ignores the active role of teachers and students in ‘creating’ course events, leading learners to feel “dissatisfied.”

Topic 3: Focusing on speech rate characteristics. This topic primarily focuses on teachers' “speech rate” and “pacing” during lectures. Learners believe that unreasonable pacing, slow speaking speed, non-standard Mandarin, and directly reading from slides are areas where teachers need to improve.

Based on Tables 2 and 3, there are some similarities between the topics of concern for both the positive and negative groups of learners. Compared to the positive evaluation group, the negative evaluation group more explicitly expressed their disagreement or lack of recognition of the possible reasons for the teacher's teaching level, while the positive evaluation group more subtly expressed their agreement or recognition.

IV. C. Exploration of Teachers' Knowledge Characteristics

IV. C. 1) Determining classroom teaching slices

Using a complete teaching activity as the observation point, video clips were selected from five first-year teachers at Department of Natural Resource of this Vocational College, resulting in a total of 147 teaching clips. Using the MPCK-Map analysis method, teacher behaviors were recorded during the slicing process to complete MPCK knowledge encoding. The categories include: OR (subject teaching positioning knowledge), KC (course knowledge), KSU (knowledge related to student understanding), KIR (teaching strategy knowledge), KA (knowledge related to evaluating learning), and KTU (knowledge related to technology use).

The classroom teaching knowledge of the five high-quality classroom teachers is shown in Table 4. The most frequently occurring knowledge was course knowledge (KC), with 95 occurrences. The least frequently occurring knowledge was subject teaching positioning knowledge (OR), with 12 occurrences, while the frequency of other knowledge ranged between 60 and 90.

Table 4: The frequency of MPCK knowledge for high-quality classroom teachers

Teacher Number	OR	KC	KSU	KIR	KA	KTU
ET1	2	23	15	14	5	11
ET2	1	17	17	12	7	20
ET3	2	17	9	18	12	7
ET4	1	12	15	13	18	6
ET5	2	12	7	8	14	11
Total	2	14	13	15	4	19
Average	10	95	76	80	60	74

In the teaching practices of high-quality classroom teachers, the integration frequency of each pair of MPCK knowledge (the first 8) is shown in Table 5, and the integration frequency of each pair of MPCK knowledge (the last 7) is shown in Table 6. By combining Tables 5 and 6, it can be seen that the highest integration frequency is between course knowledge (KC) and knowledge related to student understanding (KSU), with an average integration frequency of 15.80. The lowest integration frequency is between subject teaching orientation knowledge (OR) and knowledge related to technology use (KTU), with an average integration frequency of 2.20.

Table 5: MPCK Knowledge Integration Frequency (Top 8)

Teacher Number	OR- KC	OR- KSU	OR- KIR	OR- KA	OR- KTU	KC- KSU	KC- KIR	KC- KA
ET1	4	4	3	2	3	18	18	12
ET2	3	3	2	2	2	15	13	12
ET3	2	3	2	2	1	11	10	8
ET4	3	3	3	2	2	17	15	12
ET5	4	4	3	4	3	18	15	17
Total	16	17	13	12	11	79	71	61
Average	3.20	3.40	2.60	2.40	2.20	15.80	14.20	12.20

Table 6: MPCK Knowledge Integration Frequency (the last 7)

Teacher Number	KC- KTU	KSU- KIR	KSU- KA	KSU- KTU	KIR- KA	KIR- KTU	KA- KTU
ET1	13	17	12	13	12	12	6
ET2	13	12	11	11	11	11	10
ET3	8	10	8	8	7	7	5
ET4	15	14	11	11	13	13	9
ET5	16	15	17	17	13	13	14
Total	65	68	59	60	56	56	44
Average	13.00	13.60	11.80	12.00	11.20	11.20	8.80

IV. C. 2) Analysis of the MPCK Knowledge Structure of Ordinary Classroom Teachers

In order to determine the starting point for teachers' professional learning, this section explores the knowledge structure of five ordinary classroom teachers. The frequency of MPCK knowledge in the classroom teaching of the five ordinary classroom teachers is shown in Table 7. The most frequently appearing knowledge is curriculum

knowledge (KC), with a total of 62 occurrences. The least frequently appearing knowledge is subject orientation knowledge (OR), with a total of 14 occurrences. The frequency of other knowledge ranges from 35 to 60.

Table 7: The frequency of MPCK elements for ordinary classroom teachers

Teacher Number	OR	KC	KSU	KIR	KA	KTU
OT1	3	9	11	7	7	12
OT2	3	14	13	8	11	9
OT3	2	14	13	10	10	12
OT4	3	13	12	8	9	8
OT5	3	12	10	6	10	8
Total	14	62	59	39	47	49
Average	2.8	12.4	11.8	7.8	9.4	9.8

In the teaching practices of ordinary classroom teachers, the frequency of integration between any two types of MPCK knowledge is shown in Table 8 for the first 8 types of MPCK knowledge and in Table 9 for the last 7 types of MPCK knowledge. Combining Tables 8 and 9, it can be seen that the highest integration frequency is between course knowledge (KC) and knowledge related to student understanding (KSU), with an average integration frequency of 10.00. The lowest integration frequency is between subject positioning knowledge (OR) and knowledge of teaching strategies (KIR), with an average integration frequency of 2.00.

Table 8: The frequency of MPCK integration for regular classroom teachers(Top 8)

Teacher Number	OR- KC	OR- KSU	OR- KIR	OR- KA	OR- KTU	KC- KSU	KC- KIR	KC- KA
OT1	2	1	1	2	2	6	6	5
OT2	3	3	3	2	4	13	9	11
OT3	2	2	2	2	2	11	10	9
OT4	3	2	2	2	2	10	8	7
OT5	4	4	2	3	4	10	7	9
Total	14	12	10	11	14	50	40	41
Average	2.80	2.40	2.00	2.20	2.80	10.00	8.00	8.20

Table 9: The frequency of MPCK integration for regular classroom teachers(the last 7)

Teacher Number	OR- KC	OR- KSU	OR- KIR	OR- KA	OR- KTU	KC- KSU	KC- KIR	KC- KA
OT1	9	7	4	7	4	7	4	9
OT2	7	9	11	7	8	7	6	7
OT3	9	9	8	8	8	8	7	9
OT4	4	8	10	6	7	5	5	4
OT5	6	7	9	7	7	6	6	6
Total	35	40	42	35	34	33	28	35
Average	7.00	8.00	8.40	7.00	6.80	6.60	5.60	7.00

IV. D. Profile creation and analysis based on group characteristics

Based on the above feature analysis, combined with the evaluation results features and social relationship feature generation methods extracted in Chapter 3, a total of six MPCK features were determined as the group features used in this section. The feature values were set to a maximum of 10, a minimum of 0, and a passing value of 6.

Figure 4 is shown for a comparison between the teaching ability of first-year teachers in vocational college and the "double-teacher" norm portrait. It can be seen that on the whole, the value of KSU (knowledge related to students' understanding) is less than 6.00 for first-year teachers in vocational colleges, which is the direction of improvement. In addition, three characteristics of OR (subject teaching orientation knowledge), KIR (knowledge of teaching strategies) and KTU (knowledge about the use of technology) exceeded the "dual-teacher" norm portrait standard, while KC (curriculum knowledge) and KA (evaluative learning knowledge) were slightly lower than the "dual-teacher" norm portrait standard. It shows that the construction of the "double-teacher" team of vocational colleges has certain results and advantages.

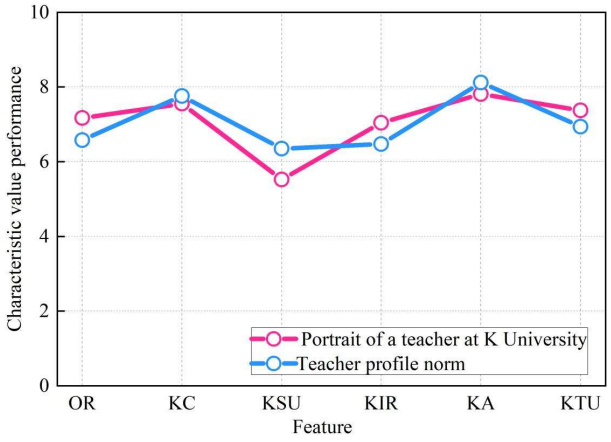

Figure 4: A comprehensive picture of teaching and research in the entire district

A comparison of the profiles of Professional general teachers (OT) and Professional technical teachers (ET) at Department of Natural Resource of this Vocational College across six characteristics is shown in Figure 5, with characteristic values still set within the range of 0 to 10. The comparison of the six characteristics of the professional general education teachers (OT) and professional technical teachers (ET) in the natural resources Department of this vocational college is shown in Figure 5, and the characteristic values are still set within the range of 0 to 10. It can be seen that the six characteristic values of both the professional general education teacher (OT) and the professional technical teacher (ET) are 6 or above, indicating that the overall level of the construction of the "dual-qualified" teacher team in the college is relatively high.

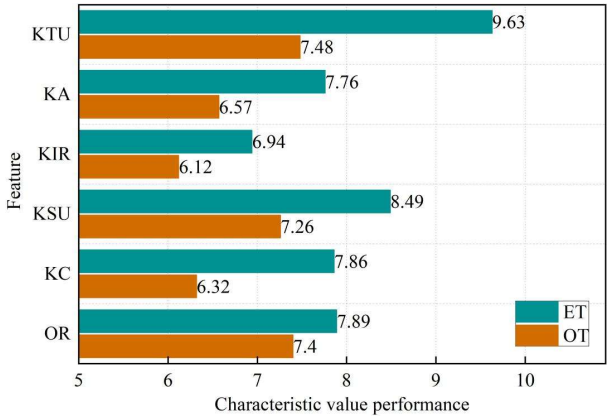

Figure 5: A comparison of portraits of different types of teachers

In addition, the overall performance of professional and technical teachers (ET) is superior to that of professional general education teachers (OT) in six characteristics, which is consistent with the analysis of the characteristics of the two types of teachers discussed earlier. In addition, both professional general education teachers (OT) and professional technical teachers (ET) scored only between 6 and 7 points on the KIR (Knowledge of Teaching Strategies) feature. Therefore, it is suggested that in the future construction of the "dual-qualified" teacher team, higher vocational colleges should focus on developing and improving the mastery of teaching strategy knowledge.

V. Conclusion

This paper analyzes the application of the SWOT model in the training of “dual-qualified” teachers in higher vocational colleges and proposes a method for creating a digital profile of teachers' teaching abilities based on performance-based evidence, which is adapted to the characteristics of the big data era. This provides effective references for improving and optimizing the current training and development of “dual-qualified” teacher teams in higher vocational colleges.

Using the SWOT model to analyze the teaching capabilities of “dual-qualified” teacher teams in Department of Natural Resource of this Vocational College, the term “explanation” was a common central word in both the positive and negative evaluation groups' texts, often associated with aspects such as methods, approaches, and content,

indicating that these areas may be key factors influencing teaching effectiveness. In the topic mining of evaluation texts, the positive evaluation group's topics focused on teaching strategies, teaching methods, and the practicality of content, while the negative evaluation group's topics centered on language clarity, teaching language similarity, and speaking speed characteristics. Through profiling, it was found that the construction of the “dual-qualified” teacher workforce at Department of Natural Resource of this Vocational College has achieved certain results, but the feature value for KSU (knowledge related to student understanding) is below the qualified value (6.00), necessitating improvements.

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References

[1] Chen, J., & Cai, M. (2024). Analysis on the Reform of Vocational School Curriculum Mode under the Perspective of" Generative Doctrine. Journal of Higher Vocational Education (ISSN: 3005-5784), 1(1), 35.

[2] Li, J. (2023, August). Evaluation Method of Hybrid Teaching Reform System Based on the Analysis of Characteristics of Higher Vocational Schools. In International Conference on E-Learning, E-Education, and Online Training (pp. 190-206). Cham: Springer Nature Switzerland.

[3] Liu, Y. (2025, May). Enhancing Professional Qualities, Implementing the “Three Educations” Reform, and Cultivating the Craftsman Spirit—Reflections on the Specialty Upgrading of Higher Vocational Colleges. In 2nd International Conference on Educational Development and Social Sciences (EDSS 2025) (pp. 315-321). Atlantis Press.

[4] Zhu, Y. (2025). Research on the Teaching Competence of Double-qualified Teachers in Vocational Colleges in the New Era. International Journal of Social Science and Education Research, 8(6), 16-26.

[5] Song, Y. (2024). Research on the Training Path of “Dual-Qualified” Teachers in Higher Vocational Colleges under the New Vocational Education Law. Journal of Modern Educational Theory and Practice, 1(4).

[6] Shen, M., Jin, Y. Y., & Liu, X. (2024). The Intrinsic Motivation and Cultivation Paths for the Professional Development of “Dual-Qualified” Teachers in Vocational Colleges. Educational Innovation Research, 2(1), 57-64.

[7] Mou, W., & Jiang, M. (2022, March). The Construction of “Double-qualified” Faculty in the Context of the One Million Enrollment Expansion of Higher Vocational Education: Status Quo, Breakthroughs and Approaches. In 7th International Conference on Economy, Management, Law and Education (EMLE 2021) (pp. 412-417). Atlantis Press.

[8] YANG, C. (2021). A Studyon the Connotation, Professional Developmentand Training Path of the" Dual-Qualified" Teacher of Higher Vocational Colleges. Journal of Teacher Education, 8(2), 40-48.

[9] Liu, J., & Zhou, F. (2019). Reflections on" Double-Professionally-Titled" Teachers in Higher Vocational Education. In 2019 9th International Conference on Education and Management (ICEM 2019). doi (Vol. 10).

[10] Ge, H. (2022). Construction and Application of The Evaluation Index System of Doublequalified Teachers’ Professional Quality in Higher Vocational Colleges. Int. J. Educ. Humanit, 5(2), 79-83.

[11] Chen, T. (2017, February). Higher Vocational Education Project Curriculum Practice. In 2016 International Conference on Modern Management, Education Technology, and Social Science (MMETSS 2016). Atlantis Press.

[12] Liu, Z., & Zhang, S. (2018, June). A Study on Teaching Reform of Higher Vocational Courses Based on Constructivism. In 2018 2nd International Conference on Education, Economics and Management Research (ICEEMR 2018) (pp. 691-694). Atlantis Press.

[13] Liu, G. (2019). Research on the Reform of the Reverse Construction Model of the Practical Teaching System of Higher Vocational Public Courses. Management Science and Research, 8(1).

[14] Ling, Y., Chung, S. J., & Wang, L. (2023). Research on the reform of management system of higher vocational education in China based on personality standard. Current Psychology, 42(2), 1225-1237.

[15] Xun, H. (2020). Construction of Internal Quality Assurance System in Undergraduate Level Vocational Colleges. Lifelong Education, 9(7), 189-191.

[16] Gangtian, C. (2019). Research and practice of promoting the professional cultivating ability in higher vocational colleges by ternary construction. International Journal of Information and Education Technology, 9(4), 314-317.

[17] Wu, Z. W., & Zhu, L. R. (2017). Cultivating innovative and entrepreneurial talent in the higher vocational automotive major with the “on-board educational factory” model. Eurasia Journal of Mathematics, Science and Technology Education, 13(7), 2993-3000.

[18] Dorozhkin, E. M., Kalimullin, A. M., Migacheva, G. N., & Sokolova, T. B. (2017). Optimization of the Subject Matter of Profile Training Disciplines for Bachelors’ Vocational Education on the Basis of Occupational Standards. EURASIA Journal of Mathematics, Science and Technology Education, 14(3), 859-876.

[19] Li, L. (2020). Education supply chain in the era of Industry 4.0. Systems Research and Behavioral Science, 37(4), 579-592.

[20] Zeng, Y. (2022). Credit Certification System of Higher Vocational Education Based on Data Mining Technology. In Innovative Computing: Proceedings of the 4th International Conference on Innovative Computing (IC 2021) (pp. 1473-1477). Springer Singapore.

[21] Li, H., Gu, H., Hao, X., Yan, X., & Zhu, Q. (2024). Data-driven analytics for student reviews in China’s higher vocational education MOOCs: A quality improvement perspective. Plos one, 19(3), e0298675.

[22] Li, Y., & Mao, J. (2021, January). Development of “Double-Qualified” Teachers in Higher Vocational Colleges: Dilemma, Framework and Path. In 6th Annual International Conference on Social Science and Contemporary Humanity Development (SSCHD 2020) (pp. 346-352). Atlantis Press.

[23] Cheng, Q., Zhao, L., & Li, W. (2025). The Internal Structure and Influence Mechanism of Double Qualified-Teachers’ Quality and Competence. Education and Urban Society, 57(1), 13-39.

[24] Li, Z., & Li, Y. (2022). The Structural Dimensions of “Double-Qualified” Teachers’ Work Role Transition Competence and Its Generation Mechanism. Sustainability, 14(14), 8237.