CAREER COMPETENCY-ORIENTED INTELLIGENT LEARNING MODEL DEVELOPMENT AND EVALUATION FOR PRIMARY EDUCATION MAJOR IN VOCATIONAL COLLEGES IN YUNNAN PROVINCE

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ABSTRACT

This research addresses prominent issues in the talent cultivation of Primary Education majors in Yunnan's vocational colleges, including the disconnection between curricula and professional demands, the theory-practice divide, and over-reliance on traditional teaching modes. It carries out research with three core objectives: first, to investigate the current learning status and challenges of Primary Education majors through literature analysis and questionnaire surveys; second, to construct an initial career competency-oriented intelligent learning model based on literature analysis and questionnaire findings, and revise and optimize the model framework through three rounds of Delphi expert consultation; third, to comprehensively develop and empirically evaluate the effectiveness of the proposed model.

The research sample includes 309 students for the questionnaire survey, and 40 sophomores equally divided into experimental and control groups for the quasi-experiment. Research instruments involve literature review, questionnaire survey, Delphi method, independent samples t-test, paired samples t-test, descriptive statistics, and Cohen's effect size analysis, etc. The statistics used to analyze the data include percentage, average value, standard deviation, and Cohen's effect size.

The initial intelligent learning model is established on the basis of literature review and questionnaire findings. Through three rounds of iterative optimization via the Delphi expert consultation, all first-level and second-level indicators of the model have been finalized, with the average score of each indicator ranging from 4.45 to 4.80, which proves good scientific rationality and expert consensus.

A 6-week quasi-experimental intervention is implemented in two groups. The statistical results show that the post-test average score of the experimental group using the intelligent learning model is 85.75, obviously higher than the 70.65 of the control group with traditional teaching, and Cohen's d reaches 8.97, indicating an extremely large effect size.

This model integrates online and offline learning resources and builds a multi-subject and process-oriented evaluation system. It effectively remedies the defects of traditional talent training modes and realizes the shift from teacher-centered to student-centered teaching. From a practical perspective, the model covers six core dimensions: Learning Objectives, Learning Content, Learning Resources, Learning Process, Learning Interaction, and Learning Evaluation. It complies with the Professional Standards for Primary School Teachers and the talent cultivation objectives of the Primary Education major in Yunnan's vocational colleges, and gives full play to modern information technologies such as smart education platforms, big data and GAI to support students' independent and personalized learning.

Keywords: Intelligent Learning Model; Primary Education Major; Vocational Colleges; Career Competency; Digital Transformation of Education

Acknowledgement

During the process of exploring and constructing the career competency-oriented intelligent learning model for the Primary Education major, I have not only deepened my understanding of vocational education and smart teaching but also been warmed and supported by many people along the way. With a heart full of gratitude, I would like to express my sincere thanks to them.

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This research is a starting point rather than an end. In the future, I will carry the gratitude from all of you, continue to polish and promote the application of this intelligent learning model, and strive to contribute more to the high-quality development of the Primary Education major in vocational colleges. Once again, thank you to every person who has supported and helped me—your kindness will always be remembered in my heart.

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Introduction

Rationale

With the advancement of vocational education reform in the new era, the traditional training model for primary education majors in higher vocational colleges has struggled to meet the urgent demand for highly skilled teachers in basic education. The main issues currently faced are as follows: on one hand, national policy documents explicitly call for strengthening the cultivation of vocational abilities, but on the other hand, higher vocational primary education still generally emphasizes theory over practice, with a disconnect between the training process and the actual job competency requirements for primary school teachers. This disconnect directly leads to the practical dilemma of graduates from primary education majors facing a long period of job adaptation and insufficient practical abilities, highlighting the urgent need to construct a new training model.

Meanwhile, the rapid development of artificial intelligence technology and the advancement of educational informatization have provided new technical paths for the reform and innovation of vocational education. Intelligent learning technologies, through adaptive learning systems, virtual simulation training, and learning behavior analysis, can effectively achieve personalized ability cultivation and process-based evaluation. This is the key breakthrough to solving the structural contradictions in traditional training models, such as "standardized training versus individualized needs" and "static evaluation versus dynamic development."

Students majoring in primary education need to possess multi-dimensional professional competencies, including subject teaching ability, class management ability, and child development guidance ability. The cultivation of these abilities must be achieved through repeated practice in real situations. However, the traditional training model is constrained by limited resources such as training venues and instructors, making it difficult to provide sufficient practical opportunities. The development of intelligent learning models will focus on addressing this pain point by constructing highly realistic, repeatable, and low-cost practical environments through technical means such as virtual classrooms and teaching behavior simulations.

From the perspective of existing research, although intelligent learning has made some explorations in the field of vocational education, there is still a significant lack of research targeting primary education majors in higher vocational colleges. Current research mainly focuses on the cultivation of technical skills in engineering majors, with insufficient attention paid to the specific field of primary education, and a systematic intelligent learning solution has yet to be formed. In terms of evaluation systems, there is still a heavy reliance on summative evaluation, lacking a process-based, multi-dimensional intelligent evaluation method based on multimodal learning data. Therefore, this study holds significant theoretical innovation value and practical guidance significance.

In summary, this research is based on the needs of vocational education reform, seizing the opportunities of educational intelligence development, targeting the pain points in the development of primary education majors in higher vocational colleges. By developing a career ability-oriented intelligent learning model and establishing a corresponding evaluation system, it aims to provide new solutions for cultivating high-quality primary school teachers and offer theoretical references and practical examples for the development of vocational education informatization. This study not only aligns with the strategic direction of national vocational education development but also directly serves the needs of basic education teacher team construction, possessing significant social value and practical significance.

Research Question (s)

How to develop and evaluate a career-oriented Intelligent Learning Model (ILM) for primary education majors in higher vocational colleges to significantly enhance students' learning outcomes?

Objectives

1. To study the learning status of students majoring in primary education in higher vocational colleges.

2. To design an Intelligent Learning Model suitable for primary education major in higher vocational colleges.

3. To conduct a comprehensive development and evaluation of the Intelligent Learning Model.

Research Hypothesis/Hypotheses

At X Vocational College, students majoring in primary education demonstrated significant improvement in learning quality after applying the Intelligent Learning Model.

Scope of the Research

Population and the Sample Group

Population

Phase 1: All primary education majors at X Vocational College, totaling 1,553 students.

Phase 3: All second-year primary education majors, totaling 404 students.

The Sample Group

Phase 1: Using the classic sample size determination method proposed by Krejcie and Morgan (1970), this study took all 1,553 primary education students at X Vocational College as the overall population. With a 95% confidence level and a 5% sampling error, the minimum required sample size was determined to be 309 participants by referring to the sampling standard table, and simple random sampling was adopted to select the research samples.

Phase 3: A quasi-experimental research design was adopted in this study. Cluster random sampling was used, taking all 404 second-year students majoring in Primary Education at X Vocational College as an intact natural cluster. All students shared the same curriculum, teaching arrangement, teachers and learning environment, ensuring overall group homogeneity. The sample size was calculated using G*Power 3.1.9.7 (Heinrich-Heine-Universität Düsseldorf, Germany). The parameters were set as t-tests for two independent means, effect size = 0.5, α = 0.05, and power = 0.8. The results showed that at least 17 participants were required for each group. Considering the actual teaching situation, 20 students were selected into the experimental group and another 20 into the control group, with a total of 40 participants. The inclusion criteria included full-time second-year students, no participation in similar teaching reform research, and not entering the internship period. Students with unstable learning status, special learning difficulties or obvious gaps in academic foundation were excluded. Pre-test results confirmed no significant difference in learning ability between the two groups ($p > 0.05$), indicating valid and homogeneous grouping.

The Variable

Independent Variable

In phase 1, the independent variables are factors influencing the learning status of primary education majors

In phase 3, the independent variable is the Intelligent Learning Model.

Dependent variable

In phase 1, the dependent variable is the learning status of primary education majors

In phase 3, the dependent variable is the learning quality of primary education major

Contents

The content of this study is to design, apply, and evaluate an Intelligent Learning Model suitable for primary education majors in vocational colleges. The research is divided into three phases, each closely linked to form a complete research process.

1. Focus on learning status analysis. First, a comprehensive literature review is conducted to summarize the learning problems and solutions of primary education majors in vocational colleges. On this basis, a questionnaire survey

method is adopted. According to Krejcie & Morgan (1970) sampling standards, 309 samples are selected from 1,553 students majoring in primary education at X Vocational College for investigation. Quantitative methods such as descriptive statistics are used to deeply diagnose the current learning status and existing core problems, laying an empirical foundation for the subsequent model development.

2. Design of the Intelligent Learning Model. Based on the results of the literature analysis and questionnaire survey in the first phase, the key elements of the Intelligent Learning Model are identified, and the initial ILM is constructed. Then, to ensure the scientificity of the research, 21 experts in the field of primary education are invited to conduct three rounds of argumentation and review using the Delphi method, and the model is continuously improved through multiple rounds of feedback and revision.

3. Development and Evaluation of the Intelligent Learning Model. First, the researchers will compile a test questionnaire specifically for the learning situation of primary education majors in vocational colleges, and invite 5 experts to evaluate the content validity of the questionnaire using the IOC (Item Objective Congruence) method. Second, pre-tests on learning quality are conducted for the experimental group (20 students) and the control group (20 students) respectively to ensure the homogeneity of the initial learning level of the two groups. Subsequently, the 20 students in the experimental group carry out learning activities using the intelligent learning model, while the 20 students in the control group use the traditional teaching method for learning. During this period, irrelevant variables such as teaching content and teaching duration of the two groups are controlled to remain consistent. Finally, post-tests on learning quality are simultaneously implemented for the two groups, and the differences between the pre-test and post-test data are analyzed and compared through statistical methods, thereby completing the effect evaluation of the intelligent learning model.

Time

The specific research phase spans from September 2024 to August 2025.

Advantages

1. Enhancing Career Adaptability: Aligning with the job requirements of primary school teachers, it uses technologies such as virtual classrooms and teaching simulations to build a highly simulated practice environment, helping students accumulate teaching experience, improve professional skills, and shorten the post-adaptation period.

2. Innovating Learning Modes: Integrating AI, big data, and virtual simulation technologies to break through traditional teaching limitations, it realizes customized learning paths through adaptive systems and personalized resource recommendations, improving learning efficiency and providing reference for other majors.

3. Scientific Evaluation and Improvement: Constructing a whole-process evaluation system based on multi-modal learning data, which takes both results and process tracking into account, provides teachers with learning situation analysis reports and students with reflection basis, and promotes the continuous optimization of teaching and learning.

4. Meeting Practical Educational Needs: With X Vocational College as the practice scenario, it empirically verifies the effectiveness of the intelligent learning mode, and the feedback data is directly used for mode optimization, with results effectively serving the construction of primary education teachers.

5. Filling Gaps in Field Research: Aiming at the insufficient research on intelligent learning in the primary education major of vocational colleges, it develops and evaluates relevant modes, providing new ideas for the informatization of vocational education and the reform of other educational fields.

Definition of Terms

1. Vocational Ability Development for Students

Vocational ability development for students refers to the process of helping students acquire the professional knowledge, skills, attitudes, and comprehensive qualities required for specific occupations through systematic educational and teaching activities. In primary education majors, vocational ability development not only includes the imparting of professional knowledge and skills to students but also involves the cultivation of professional ethics, professional qualities, innovation ability, teamwork ability, communication ability, problem-solving ability, and other aspects. It aims to enable students to adapt to the needs of future job positions, possess the ability to effectively perform duties, solve practical problems, continuously develop, and improve themselves in practical work, thereby better fulfilling job responsibilities and achieving career development. Vocational ability development is achieved through various methods such as course teaching, practical training, educational probation, and internships, emphasizing the combination of theory and practice, and focusing on students' ability development and comprehensive quality improvement in real or simulated occupational contexts.

2. Curriculum System of Primary Education Major in Vocational Colleges

The curriculum system of primary education major in higher vocational colleges is a complete set of course arrangements and teaching content systems constructed to cultivate professional talents suitable for primary education teaching needs. This curriculum system covers multiple modules such as public basic courses, disciplinary professional courses, teacher education courses, and practical courses, aiming to help students master the basic theories, professional knowledge, and teaching skills required for primary education. Public basic courses provide students with basic cultural literacy and knowledge reserves; disciplinary professional courses help students master the teaching content and methods of various subjects in primary schools; teacher education courses cultivate students' basic educational theoretical literacy and teacher professional qualities; practical courses allow students to apply theoretical knowledge to actual teaching through educational probation, internships, skill training, and other links, enhancing vocational ability. The design of the curriculum system emphasizes the combination of theory and practice, focuses on the cultivation of students' vocational ability, and takes into account the comprehensive and personalized development needs of students. Through scientific and reasonable course settings and teaching arrangements, it lays a solid foundation for students to engage in primary education work in the future.

3. Smart Classroom

A smart classroom is a teaching environment and teaching model that leverages modern information technologies such as big data, cloud computing, artificial intelligence, and the Internet of Things to create an intelligent, personalized, and highly interactive learning environment. It is student-centered and uses intelligent teaching platforms, learning terminals, and other tools to achieve intelligent push of teaching resources, real-time tracking and analysis of learning processes, and diversified and personalized teaching evaluations. The smart classroom can provide personalized learning paths and learning support based on students' learning situations, support teachers in carrying out various teaching activities such as flipped classrooms, project-based learning, and blended learning, thereby improving teaching effectiveness and students' learning enthusiasm. The goal of the smart classroom is to empower education through technology, enhance teaching effectiveness and students' learning enthusiasm, promote the development of students' higher-order thinking abilities and comprehensive qualities, and at the same time provide teachers with precise teaching decision support and students with more efficient and personalized learning experiences.

4. Learner Profile

A learner profile is a digital model that reflects various aspects of a learner, such as personal characteristics, learning behaviors, knowledge levels, and learning preferences, constructed through the collection, analysis, and mining of a large amount of data generated during the learning process. It is based on data and uses data analysis techniques such as cluster analysis and association analysis to classify and describe learners' characteristics, thereby providing precise decision support for education and teaching. Learner profiles can help teachers better understand students' learning needs and characteristics, provide students with personalized learning resource recommendations, learning guidance, and teaching interventions, and also provide a basis for educational administrators to optimize teaching resource allocation and improve teaching management. The content of learner profiles includes students' basic information, learning behavior data, knowledge levels and learning outcomes, learning preferences, learning styles, and cognitive levels. It can be updated in real-time based on students' learning behaviors and outcomes, providing dynamic feedback for teachers to help them adjust teaching strategies in a timely manner and provide personalized learning support for students.

5. Intelligent Learning Model

The intelligent learning model is an efficient, personalized, and intelligent learning method built on modern information technologies, especially advanced technologies such as artificial intelligence, big data, cloud computing, and the Internet of Things. It uses intelligent learning platforms and tools, combined with learner profiles and learning data analysis, to provide students with precise learning resource push, personalized learning path planning, real-time learning feedback and guidance, and diverse learning interaction experiences. In the intelligent learning model, students' learning processes are fully digitally tracked and analyzed. The system can dynamically adjust teaching content and methods based on students' learning progress, knowledge mastery, learning styles, and preferences, thereby achieving true personalized teaching. At the same time, the intelligent learning model also supports various learning methods such as online and offline blended learning, project-based learning, and collaborative learning, breaking the limitations of time and space to create a more flexible and autonomous learning environment for students. The core goal of the intelligent learning model is to empower education through technology, enhance students' learning efficiency and effectiveness, stimulate students' interest and initiative in learning, and cultivate students' autonomous learning ability, innovation ability, and comprehensive qualities to adapt to future social development.

Research Framework

The research framework is divided into three stages: First, through literature review and questionnaire surveys, a comprehensive analysis of the learning status of primary education major students is conducted to identify existing problems and improvement strategies. Second, based on the results of the literature analysis and questionnaire survey, an intelligent learning model is extracted and optimized using the Delphi method, followed by the implementation of an intelligent learning experiment based on this model for students. Finally, a learning quality assessment questionnaire is developed to systematically evaluate the learning outcomes. The entire process ensures the scientific, systematic, and effective nature of teaching improvements. The framework diagram is shown below.

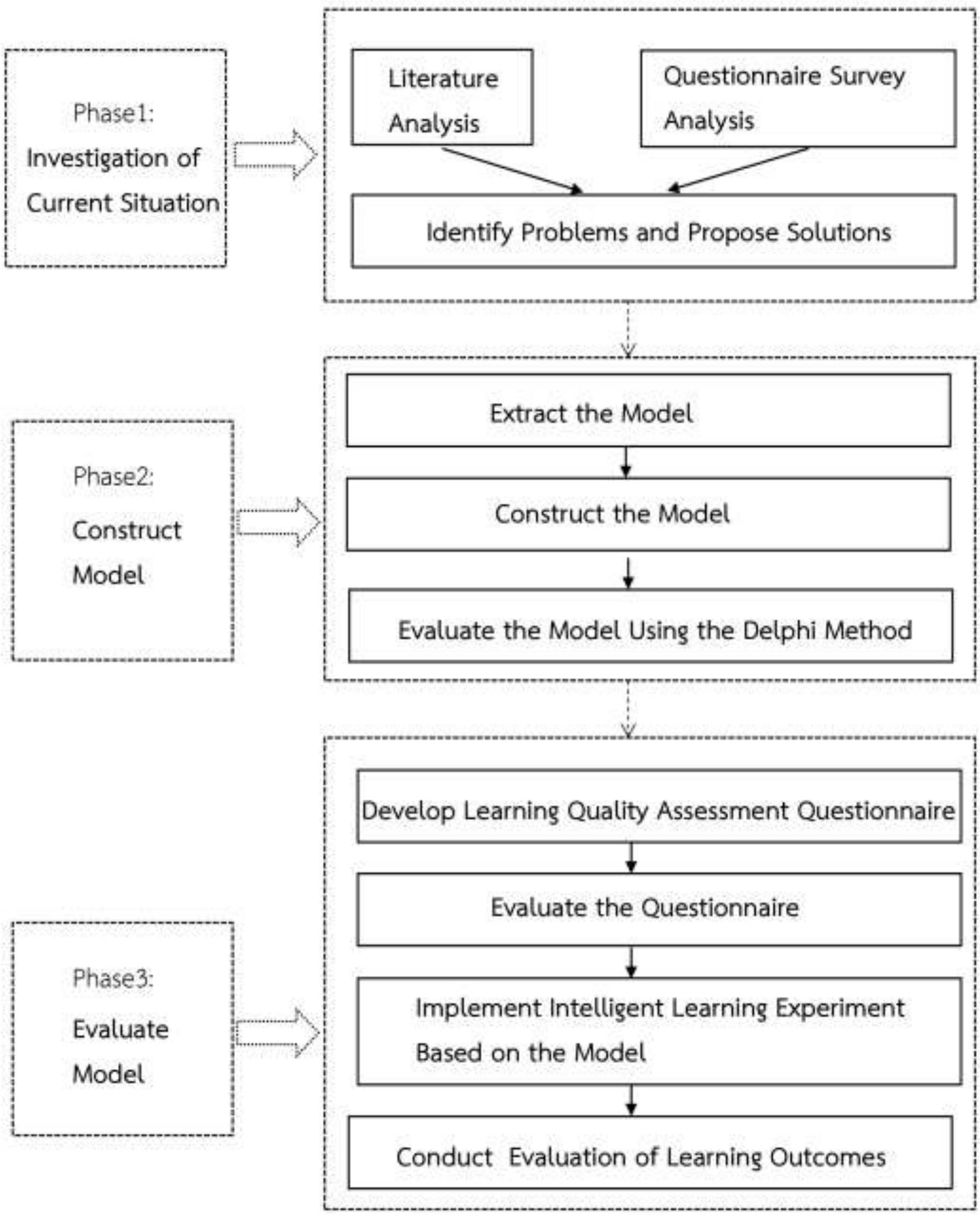

Figure 1.1 Research Framework

Chapter 2
Literature Review

With the rapid development of educational informatization and the deepening of vocational education reform, the training of primary education majors in r vocational colleges is facing new opportunities and challenges. How to construct an intelligent and personalized learning model based on vocational ability standards has become a key issue in improving the quality of teacher training. This chapter conducts a systematic review around five core dimensions. Through multi-dimensional literature analysis, it aims to establish a systematic theoretical foundation for the subseuent development and evaluation of intelligent learning models. The specific five core dimensions are as follows:

1. The Cultivation of Vocational Abilities of Primary Education Majors
2. The Curriculum System of Primary Education Majors in Vocational Colleges
3. Intelligent Learning and Smart Classrooms
4. Learner Profiles
5. Related Research

The Cultivation of Vocational Abilities of Primary Education Majors

Connotation

In September 2012, China’s Ministry of Education issued the Professional Standards for Primary School Teachers (Trial), which stipulates that primary-school teachers are professionals responsible for delivering primary education; they must undergo rigorous preparation and continuous training, uphold sound professional ethics, and master systematic professional knowledge and skills. Their professional competence is organized into three interlocking dimensions: (1) Professional Philosophy and Teacher Ethics—covering understanding of the profession, attitudes and behaviors toward pupils, attitudes and behaviors toward education and teaching, and personal cultivation—subdivided into 19 indicators; (2) Professional Knowledge—

encompassing knowledge of pupil development, subject-matter knowledge, pedagogical knowledge, and general knowledge—subdivided into 17 indicators; and (3) Professional Capability—including instructional design, organization and implementation of teaching, motivation and assessment, communication and collaboration, and reflection and professional development—subdivided into 24 indicators.

In May 2021, the Ministry of Education of the People's Republic of China issued the Standards for Teacher Professional Competence of Primary-Education Majors. This document defines the professional competence of primary-education majors as comprising four domains: the ability to uphold teacher ethics, instructional-practice ability, comprehensive student-cultivation ability, and self-directed development ability. Upholding teacher ethics encompasses two sub-domains—compliance with professional ethical norms and commitment to educational ideals—further divided into 7 indicators. Instructional-practice ability covers mastery of subject knowledge, instructional design, and classroom implementation, broken down into 12 indicators. Comprehensive student-cultivation ability comprises class guidance, curriculum-based moral education, and activity-based moral education, subdivided into 8 indicators. Self-directed development ability includes professional growth and proactive communication and collaboration, with 5 indicators.

Beyond these two government-issued policy documents, scholars have also conducted studies on the connotation of professional competence for students majoring in primary education or teacher-preparation programs.

Xu Chaohui (2015) argues that professional-competence education for primary-education majors is oriented toward professional-competence standards and is designed primarily to prepare students for primary-school teaching posts. It highlights operational and applied professional and practical skills, focusing on cultivating students' comprehensive professional competence. Therefore, the comprehensive professional competence of primary-school teachers includes (1) an emphasis on the practical operational abilities demonstrated on the job—namely, the explicit, operational, and standardized nature of competence—stressing an “employment orientation” and “standards-referenced” approach, and (2) an emphasis on the internal components that form competence, such as integrated knowledge, skills, affective attitudes, and professional ethics.

Wang Miao (2017) defines vocational skills as the techniques and abilities students need for future employment. The vocational skills of primary-education majors—the essential skills for entering the teaching profession—refer to the basic professional skills and techniques required for educational and teaching work. Enhancing these students’ professional competence is the key to the curriculum construction of primary-education programs.

Cai Rui & Liang Hui (2018) contend that professional competence comprises basic professional competence and comprehensive professional competence. Basic professional competence is the fundamental quality and ability an individual must possess to meet the demands of a given occupation. Comprehensive professional competence, or key competence, transcends specific vocational skills and knowledge; it is a cross-occupational ability that is crucial for an individual’s future survival and development. Thus, the cultivation of primary-school teachers’ professional competence must include not only basic abilities such as educational and teaching skills, classroom-management skills, and teaching-research skills, but also key abilities such as innovation, critical reflection, independent learning, and lifelong learning and self-development.

Yang Tao (2018) maintains that the core literacy of higher-vocational normal-school students consists of the key competencies required for the profession—the most fundamental and essential capabilities and necessary qualities needed to adapt to lifelong development and to the reform and development of rural basic education and teaching. Specifically, these are divided into five elements: (1) professional-quality literacy, such as noble teacher ethics and educational ideals and beliefs; (2) subject and interdisciplinary literacy, including the ability to serve as an all-subject primary-school teacher; (3) literacy in educational professional knowledge and skills, such as understanding educational and teaching concepts, laws, and skills, and the ability to communicate with students; (4) comprehensive literacy, the capacity to integrate and apply learned knowledge in authentic teaching situations; and (5) self-directed learning ability, the capacity to keep abreast of new educational and teaching concepts and policies, and to reflect and summarize effectively.

Shao Huailing (2018), through comparative research and practical exploration, established a talent-training objective for primary-education majors aimed at county-level contexts: cultivating primary-school teachers who possess noble teacher ethics, comprehensive qualities, and strong professional competence. He identifies twelve capacities of outstanding primary-school teachers: moral-education ability; instructional-design ability; handwriting and verbal-expression ability; textbook-analysis ability; subject-knowledge-teaching ability; classroom-organization ability; ability to teach students in accordance with their aptitude; instructional motivation and assessment ability; homeroom-teacher work ability; teaching-reflection ability; educational-research ability; and teamwork ability.

Yin Jie (2020), guided by the spirit of "the Professional Standards for Primary School Teachers" and the "Implementation Measures for Certification of Teacher-Training Programs in Regular Institutions of Higher Education" issued by the Ministry of Education, argues that primary-education programs in higher-vocational colleges should adopt a competence-oriented instructional approach. Consequently, primary-school teachers should possess eight professional competencies: professional ability, organizational ability, textbook-grasping ability, classroom organization and implementation ability, language-expression ability, educational-research ability, psychological-counseling ability, and ability to guide students' daily lives.

Terry Oroszi (2020) believes that Competency-based education is an innovative advance in higher education that organizes academic content or delivery according to competencies, what a student knows and can manage, rather than conforming to a more traditional system.

Chen Guoming (2021), through quantitative and comparative analysis of the Ministry of Education's standards for teacher competence among teacher-training students, identifies seventeen high-frequency terms in the standards for primary-education majors. Ten terms—learning, methods, practice, ability, knowledge, activities, information, moral education, and teacher—reflect the focal concerns regarding the professional competence of primary-education teacher-training students. Seven terms—development, mastery, being able to, basic, understanding, possessing, and comprehension—indicate the required levels of competence development.

Current situation and existing problems

Wang Miao (2017) believes that there are many problems in the cultivation of students' vocational skills in primary education major courses: first, the lack of systematic course setting, some colleges rely on some professional basic courses for the cultivation of students' vocational skills, and carry out fragmented training through scattered time before and after class, with poor results; second, the cultivation of vocational skills is mostly limited to the campus, and has not formed a talent training model of "combining skill competitions with professional teaching, combining course setting with teacher positions, and combining individual development with teamwork"; third, the teaching concepts of teachers who teach vocational skills are outdated and cannot keep up with the development of the times.

Yang Ning (2018) believes that there is a problem of imbalance between vocational skills and vocational literacy in the talent training of higher vocational colleges. Specifically, in terms of course setting, there is no clear teaching goal and task for specialized vocational literacy courses and a complete set of core courses for vocational literacy. Although higher vocational colleges have a mechanism for jointly training talents with enterprises, the effect is not obvious. Some higher vocational teachers cannot continuously update their vocational teaching skills and cannot carry out effective practical teaching. Students lack correct career planning and have not made sufficient preparations for employment.

Zhang Jinling (2018) believes that there are problems in the talent system training of primary education majors in higher vocational colleges: first, the lack of advanced talent training concepts, unable to connect with the requirements for talents in basic education, resulting in the trained primary school teachers being unable to adapt to the needs of primary education during the internship period and even the early stage of employment. Second, they cannot conduct in-depth visits and research in primary schools, resulting in a serious disconnect between teaching concepts and primary education concepts. Third, the professional literacy of higher vocational college primary education graduates is not high, with weak basic teaching skills and lack of ability to apply educational technologies, such as not knowing how to apply MOOCs and micro-courses to teaching.

Li Jian (2020) believes that all specialized normal colleges and universities pay great attention to the cultivation of students' vocational abilities, but few schools have established a systematic practical teaching system, resulting in some problems: the lack of practical teaching management systems leads to the inability to ensure standardization in the implementation process of practical teaching; the lack of a comprehensive practical teaching content system leads to scattered and arbitrary course content, which cannot reflect the practical orientation of course teaching; the lack of a whole-process practical teaching education platform leads to the inability to optimize the implementation path of practical teaching; the lack of assessment forms and evaluation standards for practical ability leads to the lack of scientific basis and feedback for the supervision and management of the learning process; the lack of a long-term guarantee mechanism for practical teaching leads to the inability of the practical teaching system to operate normally.

Wang Tao (2021) believes that the course setting of many schools is unreasonable, emphasizing professional theoretical knowledge while neglecting students' practical training and practical abilities, resulting in primary education majors being unable to apply the professional knowledge and skills learned in the classroom to real teaching. Secondly, the concepts and content of teaching materials are outdated and do not meet the requirements of modern social development. Finally, factors affecting the cultivation of vocational abilities of primary education majors include factors from family, employment, social culture, and individual students.

Li Ping (2022) believes that the vocational abilities of primary education majors are mainly defined as: first, excellent teacher ethics and correct teacher style; second, solid basic skills, such as writing and expression abilities; third, higher teaching abilities, including teaching design ability, classroom regulation ability, and teaching organization ability. Fourth, comprehensive abilities, including active learning ability, reflection and innovation ability, job ability, and communication and cooperation ability.

Zhou Rongxiu, Liu Canqun & Zhang Min (2023) found that based on the requirements of the professional ability standards for primary education majors and survey analysis, there are problems in the teaching practice ability of teacher students, such as insufficient target cognition, inadequate teaching material analysis, single teaching methods, insufficient teaching management and adaptability, and lack of classroom teaching evaluation and research abilities.

Wu Xiaoxia & Zhou Jun (2023) believe that there are problems in the cultivation of teaching practice ability of primary education majors: neglecting subject literacy and insufficient cultivation of teaching practice ability; teaching design is detached from the student subject, focusing only on teaching and not on whether students understand; teaching implementation becomes a "performance" without effective teaching evaluation and learning guidance; educational basic knowledge is limited to theory and cannot be applied to teaching practice; normal colleges and primary schools do not cooperate deeply and cannot guide front-line teaching.

Qin Su'an (2023) believes that vocational ability is the ability formed by an individual to apply the knowledge, skills, and attitudes learned in specific professional activities or situations to complete certain professional tasks. Vocational ability is divided into general vocational ability, professional ability, and comprehensive vocational ability. For primary education teachers, general vocational ability includes various basic abilities, such as autonomous learning, interpersonal communication, teamwork, and basic teaching skills; professional ability refers to mastering professional knowledge and professional skills. Comprehensive vocational ability is an important ability for cross-occupational professional ability, independently collecting information, formulating plans and executing them, job competency, and professional ethics cultivation.

Mao Rouxian & Ru Zongzhi (2023) believe that most primary education majors show varying degrees of discomfort with primary education teaching work after entering the school, lacking solid teacher vocational abilities. Specific manifestations are as follows: first, insufficient knowledge reserves in other subjects, making it difficult to connect the subject knowledge taught with other subject knowledge, and unable to flexibly integrate other subject content to optimize teaching; second, insufficient intrinsic motivation for interdisciplinary integrated teaching, lacking autonomy and enthusiasm, and being accustomed to directly copying and imitating others' teaching designs. Third, insufficient emphasis on practical training, with learning situation analysis ability, teaching control ability, and teaching evaluation ability needing improvement. Fourth, weak teaching reflection awareness and insufficient ability.

Ning Chenzhuo & Fan Mengke (2024) believe that due to the lack of classroom teaching and practical opportunities, as well as the defects of traditional teaching methods and evaluation systems, students' application ability and innovation ability are limited, which in turn affects their future career development. Therefore, effectively cultivating the vocational skills of primary education majors in higher vocational colleges has become an urgent problem to be solved.

Liu Zhe, Liu Xiaotao & Wang Liting (2024) take the course construction of "Primary School Chinese Teaching Method" in higher vocational colleges as an example, and believe that there are some common problems in the cultivation of vocational abilities of primary education majors. For example, the nature of the course is not clearly positioned, some colleges position the course as a public basic course, while others position it as a general elective course; the course content arrangement is unreasonable, only emphasizing teaching theory and neglecting practical teaching, with insufficient connections between various modules; teaching methods are single, without adopting diversified teaching methods; the teaching evaluation mechanism is not sound, neglecting process evaluation.

Xue Huiyue & Jin Yongtao (2025) believe that based on the "Professional Ability Standards for Primary School Teachers" issued in 2021, the teacher ethics of primary education teacher students include mastering the characteristics and laws of primary school students' character development, consciously and targeted carrying out moral education work, and helping students develop good behavioral habits; teaching practice ability includes understanding various teaching theories, being familiar with various teaching skills and teaching forms, and strengthening the learning and application of educational information technology. In addition, vocational ability also includes lifelong learning ability, group mutual assistance and cooperative learning ability, self-development ability, the ability to apply modern information technology to teaching, the ability to diagnose teaching practice and propose improvement ideas, etc.

Li Yuping (2025) selected 4 undergraduate and 4 specialized teacher colleges in Guangxi as research objects to gain an in-depth understanding of the current situation of teacher ethics cultivation of primary education teacher students. The survey covered primary education teacher students of different grades and professional directions in these colleges. The results show that there are some problems: first, insufficient integration of educational resources, without forming a mechanism for multi-subject collaborative promotion by schools, teachers, families, and society; second, the content of courses aimed at cultivating teacher professional ethics is not adapted to the changes in the current social and educational environment, and the teaching neglects to combine course theory with primary education practice; third, the form of education is single and lacks innovation, limited to traditional classroom teaching, with fewer diversified campus practice activities and social practice activities.

Strategies for enhancing the vocational abilities of primary education majors

1. Goals and content

Süleyman Göksoy (2014) used qualitative research method to study what are the perceptions of pedagogical formation students (teacher candidates related to their communication skills. It showed they are aware that the prerequisite for being contented, successful and social individuals and professionals is healthy and good communication with themselves and with the others. This finding may be interpreted that teacher candidates are preparing for their profession with more awareness.

Chen Jie (2017) believes that the cultivation of students' abilities should not only focus on comprehensive development and being specialized and multi-talented, but also consider individual strengths and highlight key points. The cultivation goal is centered on professional emotion cultivation, with basic abilities including observation and judgment ability, communication and cooperation ability, lifelong learning ability, information application ability, active innovation ability, and social adaptation ability. To adapt to the most routine and basic work of primary school teacher positions - subject curriculum teaching and class team management, the teaching skill content system should be constructed based on the above goals.

Dong Jingjing & Jiang Jiaxin (2018) believe that the curriculum system construction of primary education majors originates from the needs of primary school teachers' professional positions, that is, the vocational ability structure. Therefore, the curriculum of primary education majors can be based on the concept of OBE, using reverse design ideas, and forming a curriculum design framework corresponding to the ability indicators of primary school teachers. Course content is determined based on industry needs and job abilities to form core courses. Teaching methods can adopt typical case analysis, special seminars, thematic learning, etc.

Sun Ying (2020) believes that "course and certificate connection" mainly refers to the alignment of school curriculum with the actual needs of job positions, forming a complete knowledge system on this basis, and focusing on cultivating students' vocational abilities. In the "school-enterprise cooperation" dual-subject education model, it is necessary to strengthen cooperation with vocational skill appraisal institutions and implement a "dual certificate" system. Teaching content and teaching plans should permeate the job knowledge, professional skills, and moral literacy required for future actual positions into related teaching courses, achieving the synchronization of professional course assessment and vocational skill appraisal.

Wang Ya & Li Qiang (2021) believe that the construction of teacher students' vocational ability course group can be optimized: first, determine the overall framework of course group construction, clarify talent training positioning, and refine the core teacher vocational abilities that match the vocational position group; second, reconstruct course content and logic based on the development of teacher students' vocational abilities, forming content clusters; third, determine course group evaluation based on learning outcomes, pay attention to the dynamic changes of teacher students' vocational abilities, and strengthen process evaluation; fourth, let learning output drive course implementation, pay attention to students' learning output and ability development, adjust course implementation, pay attention to students' learning achievement, progress, and sense of gain, and optimize course group implementation.

Gu Dingqian (2021) believes that the "Professional Ability Standards" should be aligned with professional certification standards, guided by the basic framework of "one practice, three learnings", adhering to the professional certification concept of "student-centered, output-oriented, continuous improvement", practicing teacher professional ethics, and ultimately implementing the training goal of becoming a "four-have" good teacher.

Hou Yingchao (2025) believes that in terms of course setting and course resource arrangement, dynamic adjustments should be made to increase some high-quality, practical elective courses, especially in the course content, it is necessary to integrate the latest concepts, development trends in the field of primary education, and content that connects with job needs. Secondly, the content of courses should be updated and adjusted in a timely manner, always focusing on the professionalism, forward-looking, subjectivity, and ideological nature of primary education majors to control teaching content. Third, according to the requirements in the "Primary Education Major Certification Standards", the credits and class hours of different courses should be reasonably allocated.

2. Methods

Cai Rui & Liang Hui (2018) believe that practical teaching is an important way to cultivate the vocational abilities of primary education majors. During the course implementation process, starting from the goal of cultivating students' comprehensive vocational abilities, flexibly apply a variety of practical teaching methods, such as action-oriented teaching method, project-guided teaching method, simulation teaching method, case teaching method, task-driven teaching method, etc., to create more opportunities for students to contact actual education and teaching, guide students to learn independently and explore, and develop skills and exercise comprehensive vocational abilities in the process of practice.

Zhang Xiangzhu (2019) believes that according to the talent training goals of primary education majors, in response to students' vocational ability and quality needs, the principles of using teaching methods and means are generally determined by "what to teach" to determine "how to teach". Specifically, first, teaching methods and means must be selected based on the positioning of talent training and course characteristics, and different course types should have their own characteristics in teaching methods and means; second, in the selection of teaching methods and means for the same course, they should be flexibly applied according to the characteristics of specific teaching content. Whether the teaching method is appropriate mainly depends on the practical effect; third, it is necessary to combine "what to teach" and "how to teach" with "what to learn" and "how to learn", select and use corresponding teaching methods and means based on whether they are conducive to student learning, advocate the use of dynamic teaching methods, such as task-driven method, situational simulation method, case teaching method, discussion method, demonstration method, etc.

Li Ping (2022) emphasizes the combination of classroom teaching, social practice, and the second classroom. Classroom teaching is the foundation of vocational ability cultivation. It is necessary to clarify what knowledge and abilities students need after graduation, in order to effectively plan teaching activities. In classroom teaching, students can be divided into groups according to different subjects to conduct simulated teaching training. Social practice should adopt core ability cultivation methods closely related to the major, construct a student vocational skill practice system, and achieve a model that combines classroom and extracurricular, school and off-campus for student vocational ability cultivation. The second classroom focuses on providing students with rich resources, broadening the ways for student vocational ability cultivation, and establishing a space for students to improve their abilities beyond the classroom and social practice.

Zhou Rongxiu, Liu Canqun & Zhang Min (2023) believe that student learning and problem-solving should be the center, adopting open, group cooperation, inquiry-based teaching methods, and applying interactive, task-driven teaching models to teaching according to teaching needs, effectively improving the quality of practical teaching, in order to meet the requirements of the "Primary Education Major Certification Standards" for "a complete practical teaching system, with progressive and interconnected practical links and organic integration with other educational links".

Xia Cong (2024) believes that according to vocational ability standards, the "Basic Writing" course for primary education majors should be oriented towards "practice + development + education", adopting teaching methods such as case teaching, inquiry teaching, and classroom simulation teaching, and strengthening the training of teachers' basic skills.

Liu Zhe, Liu Xiaotao & Wang Liting (2024) believe that the cultivation of students' vocational abilities should be combined with course content and goals, and the following methods should be flexibly applied: first, case teaching method: analyzing and discussing teaching cases can cultivate students' critical thinking and decision-making abilities. The implementation steps include selecting cases, background analysis, designing interactive links, guiding dialogue and exchange, reflecting and summarizing experiences, and expanding reading materials. Second, role-playing method: let students play the role of primary school teachers in simulated professional scenes to cultivate communication and cooperation abilities and adaptability. Third, blended teaching method: combine online and offline resources, use digital tools to promote students' autonomous learning. Students preview online before class, discuss and practice in class, and complete homework and reflection online after class. Big data technology tracks learning behaviors, and information means manage the internship process.

3. Tools

Liao Ting & Xiao Zizhen (2018) believe that in the past, teacher education practical teaching needed to focus on educational internships. In the "Internet +" environment, new educational practical teaching channels can be implemented through big data or corporate online education institutions to help primary education majors implement teaching practice. In addition, various online platforms can be used to transmit teaching content and assign homework in teaching.

Liu Yichang (2020) takes the teaching practice of primary education majors in Shantou Vocational and Technical College as an example, and proposes a joint training model based on the "Innovative Education Practice Community". This model relies on the technical support of smart shared communities and the advantages of teaching resources in co-constructed schools to organize and carry out online and offline exchanges and cooperation activities such as thematic exploration, case demonstration, course sharing, project cooperation, discussion and interaction, and achievement sharing. In addition, due to the real-time feedback function of mobile learning platforms, "Internet + project-based" dual-integration teaching is based on project-based learning, driving students to cooperate, explore, and experience through real situations or tasks, enhancing subject knowledge and abilities.

Li Jian (2020) believes that the core of "Internet thinking" is a thinking mode that comprehensively re-examines the industry ecology based on information technologies such as mobile Internet, big data, and cloud computing. In the practical teaching process of three-year specialized normal students, combining information technology to construct a dynamic tracking system of practical teaching is helpful for cultivating students' vocational abilities. Dynamic tracking refers to the use of network technology to conduct comprehensive records and interactions from two dimensions of training schools and employers, and three aspects of professional teachers, students, and instructors in each link of students' practical teaching. In addition, artificial intelligence and blockchain technologies can be used to intelligently evaluate designated batches of practical teaching links, iterating multiple times to achieve optimal teaching effects.

Wang Ya & Li Qiang (2021) believe that the cultivation of teacher students' vocational abilities can be approached from three aspects: first, guided by the new development concept of "Internet + Teacher Education", integrate information technologies such as cloud computing, big data, and VR to build an information-based teaching platform for teacher students' teaching abilities; second, strengthen the training of modern educational information technology application abilities for college teachers and teacher students, integrate internal and external resources and talents, design training content, and improve application abilities; third, strengthen the construction of online course resources for teacher education, leverage the school's experience advantages, use platforms such as Superstar Learning Pass and Wisdom Tree to strengthen the online construction of school courses, and introduce authoritative online open shared resources from home and abroad such as Coursera, Udacity, edX, Love Courses, and Xuetang Online.

Wang Tao (2021) believes that to enhance students' vocational abilities, schools and teachers can use modern teaching methods, such as carrying out MOOCs and other online and offline combined teaching, using multimedia technology for thematic teaching and classroom cooperative inquiry, and innovating teaching models. At the same time, use information technology to build learning platforms, upload teaching resources and training exercises, break the limitations of traditional teaching time and space, and allow students to arrange learning freely.

Li Yinji (2021) believes that according to the relevant documents of the Ministry of Education, "Primary education majors should master the common operations of information-based teaching equipment, software, platforms, and other new technologies, and understand their supporting role in education and teaching". Primary education majors should be good at using modern teaching platforms, such as "Superstar Learning Pass" and "Chinese University MOOC". Therefore, higher vocational college teachers should use modern teaching methods to promote teaching and also improve students' learning interest and vocational awareness and abilities.

Liu Yuexiang (2022) believes that modern information technology can support and assist subject teaching. In the practical training of normal students' primary school Chinese teaching skills, relying on the support of modern information technology, with group cooperation as the teaching form, a complete operation process is formed according to the three stages of teaching preparation - teaching implementation - teaching evaluation. Make full use of QQ groups, WeChat groups, Learning Pass, and other teaching platforms to integrate and innovate, and carry out online and offline teaching. This can not only motivate normal students to actively participate in practice and improve their comprehensive abilities in primary school Chinese teaching, but also share courses nationwide through the Learning Pass platform, participate in online primary school Chinese teaching seminars, and greatly improve the overall pre-service training effect of primary education majors.

Li Yuping (2025) believes that using "Internet +" technology to build a smart service platform for teacher ethics education can integrate domestic and foreign teacher ethics education resources, such as excellent cases, expert lecture videos, and online courses, providing students with rich learning resources. Teachers can use big data and artificial intelligence technology on the platform to intelligently recommend personalized learning content based on students' learning behaviors and interests, improving the pertinence and effectiveness of student learning. In addition, the forum and online Q&A area of the smart platform can promote teacher-student interaction, allowing students to gain a deep understanding of the latest trends in teacher ethics education. Online assessments, case analyses, and internships can comprehensively and objectively evaluate students.

4. Strategies

Wang Ya & Li Qiang (2021) based on the research status of teacher students' vocational ability cultivation, drawing on the successful experience of the American CBTE project (competency-Based Teacher Education), constructed the "six ones" project training model for teacher students' vocational abilities. This model is composed of three parts: the vocational core ability system, the teacher students' vocational ability improvement community, and the modular teaching system. Applying this model to the Teacher Education College of Aba Teachers' College has achieved good results in improving the vocational abilities of teacher students in the college.

Wang Lele (2021) believes that according to the characteristics of primary education majors, the major should be deeply integrated with the industry and positions. Under the guidance of employment, with comprehensive qualities and vocational abilities as the goal, and with the reform and innovation of talent training models as the theme, a characteristic "three combinations" vocational ability training model for primary education majors has been constructed. This model pays more attention to the vocational ability training of "combining knowledge and skills", "combining teaching and training", and "combining schools and schools", and then cultivates students' basic abilities, professional abilities, and comprehensive abilities in a progressive manner.

Li Ping (2022) from the perspective of three aspects of vocational ability cultivation, aims to promote the cultivation and improvement of vocational abilities of higher normal students, combining "classroom teaching, social practice, and the second classroom" organically, creating a "three combinations" vocational ability training model, and cultivating students' basic abilities, job abilities, and comprehensive abilities through teachers' individual learning, collective collaboration among teachers, and effective guidance from expert teachers.

Wu Xiaoxia & Zhou Jun (2023) believe that the countermeasures for cultivating the teaching practice ability of primary education majors include actively studying and interpreting the new curriculum standards, emphasizing the student subject position; orderly carrying out educational probation, clarifying the differences between teaching and learning; optimizing professional course settings, increasing the proportion of subject professional courses and teaching practice courses; establishing teaching skill training laboratories, strengthening the combination of educational theory and teaching practice; carrying out teaching practice ability competitions, increasing the level of attention; advocating "university-primary school" cooperation, and jointly cultivating teaching practice ability.

Hou Yingchao (2025) believes that the talent training model for primary education majors in higher vocational colleges needs to be reformed and optimized, creating a talent training model of "one whole process, two levels of education, three-party collaboration, and four types of empowerment". Specifically, it involves integrating course resources and dynamically adjusting course content; taking professional education as the foundation and emphasizing art courses; strengthening cooperation among local governments, primary schools, and higher vocational colleges, forming a joint educational force and collaborative education; strengthening practical teaching and promoting the improvement of multiple skills in practice.

5. Implementation methods

Chen Qin (2018) believes that the cultivation of teacher vocational skills for primary education majors needs to start from multiple aspects: first, cultivate educational teaching goals that meet the needs of social development, construct a sound evaluation system, combine student characteristics to formulate diversified teaching models, and strengthen vocational skill training. Second, fully grasp students' individual differences and the degree of mastery of professional knowledge, implement the people-oriented concept, reasonably plan course content design, and promote students to form good teacher vocational skills. Third, strengthen the vocational literacy of the teaching staff and improve professional skill levels. Fourth, emphasize the cultivation of students' vocational skills and create opportunities for practical teaching. Encourage students to carry out practical activities in primary school campuses to enhance good vocational abilities.

Shao Huailing (2018) to further strengthen the cultivation of vocational abilities of excellent teachers in primary education majors, constructed a "five-in-one" teacher vocational ability practical teaching system composed of micro-teaching, experimental teaching, on-campus simulated internship training, internship teaching, and graduation thesis. Integrated external educational resources, established a new mechanism for the collaborative cultivation of excellent primary school teachers with mutual benefits among universities, governments, and schools. In addition, cooperated with the government to carry out the "double improvement" project for rural compulsory education internships and teaching support, with 210 teaching support schools. Applying this model to the primary education major of Liaocheng University, it was found that the students in this major have improved in professional knowledge, professional ability, and comprehensive quality. And this model has been learned and referenced by some colleges and universities.

Luo Hua (2018) takes Yingkou Vocational and Technical College as an example. While primary education majors complete their theoretical knowledge learning in their freshman and sophomore years, they arrange two to four weeks of short-term probation and internship each semester. In their junior year, they concentrate on a one-year internship at the internship unit. Professional course teachers can arrange corresponding practical learning tasks for students based on the teaching content, and let students realize the importance of teacher vocational skill training through actual teaching in primary schools, while strengthening teacher vocational skill practice. During the freshman and sophomore years, after the probation and internship, students can return to the school to complete theoretical knowledge learning in a targeted manner based on the problems found, and strengthen teacher vocational skill training. This model has a great promoting effect on the improvement of vocational abilities of primary education majors in higher vocational colleges.

Zhang Jinling (2018) believes that the reform strategy of the talent training model for primary education majors in higher vocational colleges: first, establish a talent training concept oriented by "practical ability" and implement it into specific educational plans; second, cultivate students' solid skills and basic skills to improve the practical skills of professional talents. For example, hold various forms and rich content normal student skill competitions on campus, encourage students to participate, promote learning and skill training through competitions, and strengthen professional skills; third, establish a U-S (university-school) cooperation model to promote collaborative development between the two parties, strengthen the integration of pre-service and in-service education for primary school teachers, and the standardization of school-based curriculum development.

Zhang Xiangzhu (2019) designed a "three-dominant" teaching model based on vocational abilities around the talent training goals of primary education specialized majors, targeting students' vocational abilities and quality needs. That is, the basic qualities and knowledge abilities that must be possessed for the professional positions of this major should dominate the content of course teaching and skill training; the formation process of the abilities required for professional positions should dominate the organization and operation of professional teaching; the evaluation standards of professional position abilities should dominate the performance assessment of professional teaching. Throughout the entire teaching process, practical teaching links are highlighted.

Sun Ying (2020) in order to better meet the vocational development requirements of higher vocational normal students, adopts the educational concept of "course-job connection and course-certificate integration" to cultivate the practical abilities of higher vocational normal students and enhance their professional abilities through improving the course teaching system, adjusting and optimizing course content and methods, arranging teaching content and teaching plans according to the needs of qualification certificate exams, and reforming the teaching evaluation system.

Ouyang Qin (2020) benchmarks the cultivation goals of excellent primary school general teachers, refers to the core literacy concept of talent cultivation by the Ministry of Education, and focuses on three aspects: teacher literacy, classroom reform, and the cultivation of students' subject thinking. Taking the Chinese literature course of primary education majors in higher vocational colleges as an example, the curriculum reform ideas are: to give play to the decisive role of teachers in curriculum reform; to adopt a problem-oriented classroom teaching approach, training students' language expression ability and subject thinking ability through thematic discussions; to cultivate students' Chinese literacy and thus form subject thinking; to build a large Chinese education environment with communication inside and outside the school, connection between inside and outside the classroom, and integration between subjects; to establish a scientific, reasonable, and feasible teaching evaluation mechanism.

Liu Yi (2020), taking the primary education major at Liuzhou City Vocational College as an example, designed practical teaching that reflects the characteristics of overall design and gradual progression, integrating both in-class and out-of-class, as well as on-campus and off-campus activities to achieve the goal of progressive comprehensive development of abilities. In terms of the cultivation model for practical abilities, a "dual-tutor" system is adopted, integrating "on-campus instructors + off-campus instructors". Meanwhile, a relatively stable "U-G-S" model is established, which is a tripartite collaborative cultivation of teacher students by universities, governments, and frontline primary schools, forming an effective pattern that connects pre-service and in-service education. This is more conducive to the pre-service growth of teacher students and the in-service development of primary school teachers, thereby enhancing their professional abilities.

Lin Tiansheng (2021) takes Putian University as an example. The construction of a practice-oriented talent training model for primary education should focus on the professional characteristics of primary school teachers. Its framework can be summarized as comprehensive cultivation, directional development, whole-process practice, and emphasis on reflection. This model includes: first, establishing a multidisciplinary and harmonious teacher team. Teachers should have both theoretical and practical skills, and their academic research should focus on primary education themes. Second, constructing a community of collaborative education between universities and primary schools. Universities should serve basic education by training primary school teachers, cooperate with primary schools to carry out subject research and school-based research, and share resource information. Third, constructing teacher education experimental training facilities and practice bases. A teacher education experimental training center has been established on campus, including three major training platforms: teacher professional basic skills, education and teaching basic skills, and reflective research ability. Eleven educational practice bases covering different regions and development levels have been established off-campus. Fourth, creating a special campus culture for primary teacher education.

Wang Lele (2021) believes that the "Three Combinations" vocational ability cultivation model achieves the integration of knowledge and skills, teaching and practical training, as well as collaboration between schools through a full-time work-integrated learning approach. Specifically: first, the primary education major in higher education institutions and talent-receiving units jointly establish a professional guidance committee, consisting of experts and teachers, to manage and monitor the training plan, process, and outcomes; second, collaborative schools are established, with higher education institutions providing priority services to collaborative primary schools, and collaborative primary schools offering internship and practical training venues for students, achieving complementary advantages, enhancing students' vocational abilities, and improving the educational benefits of primary schools; third, an alliance of professional teacher resource pools and a part-time teacher talent pool for schools are established, with collaborative primary schools serving as a base for teacher communication and cooperation. Teachers from both sides give lectures and hold positions in each other's institutions, promoting the in-depth development of the profession.

Han Zhihua (2022) believes that a more scientific and complete talent training mechanism should be established. Specifically, local normal colleges can do the following: first, sign cooperation agreements with local governments to adjust teaching goals and teaching plans according to actual conditions; second, sign cooperation agreements with internship base primary schools to provide experienced instructors for intern normal students, so as to guide normal students in a targeted manner; third, explore new mechanisms for teacher development to ensure teaching advancement; fourth, establish a practical teaching system to provide students with rich experience for future employment through practice.

Hou Yingchao (2025) believes that local governments, primary schools, and higher vocational colleges should, based on a common training goal, create a talent training model that promotes the comprehensive development of students. Higher vocational colleges are the direct subjects, and they should carefully formulate talent training plans based on the commonalities and individualities of students, ensuring that the quality of the talents output can meet the standards of employers. Higher vocational colleges need to strengthen contact with educational administrative departments and primary schools, and cooperate with multiple primary schools to establish a sound guidance system. Local administrative departments should build communication channels between primary education professional course teachers in higher vocational colleges and front-line teachers in primary schools, guiding the cross-school flow of teacher resources.

Tang Huiyu (2025) believes that to improve students' practical abilities, higher vocational colleges should establish on-campus and off-campus practical teaching bases, and establish long-term cooperative relationships with primary schools and community education institutions, allowing students to regularly go to schools to carry out volunteer teaching activities. In a real teaching environment, students can not only apply the educational theoretical knowledge they have learned to actual teaching, but also improve their communication skills, teaching skills, and vocational abilities through interaction with children.

6. Evaluation methods

Fu Xiao (2016) believes that students majoring in elementary education in higher vocational colleges receive a dual-track vocational education, that is, half of the time is spent learning subject knowledge and education and teaching theoretical knowledge in school, and the other half is spent on education and teaching practical skills training in public primary schools or private training institutions, with teaching observation, teaching records, or simulated teaching as the training content, improving the pertinence of learning. The evaluation system of the dual-track vocational education is composed of an examination committee formed by industry associations, employers, and schools, with formative evaluation scores and "qualification certificates" constituting the evaluation system, enriching the content of the graduate evaluation system.

Li Xiaomei, Hou Yanbin, Cai Zhaomei, and Qin Jicui (2020) believe that skill training and assessment are important components of talent cultivation programs and a crucial link in strengthening the development of teaching skills among primary education majors. Using the example of skill training and assessment for primary education majors at L College, they closely integrate the implementation of relevant courses while also conducting various activities and competitions, ensuring that the acquisition of basic primary school teaching skills is integrated throughout the entire talent cultivation process. The content of skill training and assessment is divided into three categories: handwriting skills training and assessment, teaching skills training and assessment, and artistic skills training and assessment. Under these three categories, there are eleven specific indicators. Through multiple rounds of skill training and assessment, students' basic teaching and educational skills are solidified, highlighting the practical orientation of the training.

Yao Wenwen, Guo Miaomiao & Yang Jinyue (2022) believe that for the design of the primary education major course evaluation system, it is necessary to follow: first, increase the clarity of the course evaluation system; second, clarify the completeness of the course evaluation system execution. Specifically, under the background of teacher professional certification, from the perspectives of confirming evaluation goals, improving course design, increasing subject connections, setting up course practice activities, and integrating with primary education course content, the primary education course evaluation system can be reasonably optimized, thereby effectively improving the execution effect of the primary education course evaluation system.

Zhou Rongxiu, Liu Canqun & Zhang Min (2023) believe that to improve the practical ability of primary education majors, it is necessary to improve the assessment and evaluation system and emphasize process evaluation. First, form a relatively comprehensive evaluation basis, and conduct a comprehensive evaluation of normal students' teaching practical ability training in terms of learning attitude, process performance, training effects, and independent training situations. Second, establish an assessment and evaluation team, and formulate assessment methods that combine quantitative and qualitative, stage and summary evaluations according to different types of teaching practical abilities.

Xia Cong (2024) believes that a scientific, practice-oriented comprehensive evaluation should be established. The evaluation method combines quantitative and qualitative approaches to make it more reasonable and objective. Process evaluation includes students' learning attitudes, such as attendance, actively answering questions, participating in discussions, pre-class sharing, in-class exercises, independent training, and group collaboration, for a comprehensive assessment, with the Learning Pass automatically calculating the scores.

Liu Yan (2025) emphasizes that in the process of cultivating primary education majors, the ability to organize and implement effective teaching evaluations is crucial. It is important to scientifically select evaluation methods, reasonably use evaluation tools, properly apply evaluation language and strategies, focus on encouraging students, and stimulate their learning enthusiasm. Teachers should form comprehensive and objective evaluations from multiple dimensions and angles, allowing students to recognize their own issues in the teacher's evaluation, feel the teacher's encouragement, and turn evaluation into a means of promoting student progress.

The Curriculum System of Primary Education Majors in Vocational Colleges

Problems

Gong Meng & Hu Jinling (2017) selected students majoring in five-year elementary education as the research subjects and, through questionnaires and interviews, found the following problems: first, students have little understanding of the curriculum plan and talent training plan implemented by the school, which prevents them from conducting targeted learning and reduces their learning initiative; second, the curriculum is too academic and theoretical, lacking practicality, and cannot fully meet students' practical needs; third, the proportion of students who are "very satisfied" with the elective courses is relatively small, indicating that the design of elective courses needs improvement.

Li Ying & Yi Bin (2020) believe that taking a vocational and technical college in Sichuan Province as an example, by analyzing the curriculum in the talent training plan, from the perspective of the teacher qualification examination, the following problems exist: first, the general education curriculum is unreasonable and cannot meet the needs of students for the examination; second, the proportion of subject professional courses and education professional courses is inappropriate, the education courses are disorganized and lack integration, and repetition is likely to occur during the implementation of the courses; third, there are many theoretical courses in education courses, but relatively insufficient practical courses. The time for primary and secondary school observation and learning, teaching skills training, and internship is less than that of other non-teacher education majors; fourth, the timing of course offerings is unreasonable and does not consider students' examination needs.

Yao Lin (2021) believes that the theoretical basis of the primary education major curriculum system includes the theory of human all-round development, the idea of competency-based education, teacher knowledge theory, teacher professional development stage theory, etc. When constructing a primary education major curriculum system for students to choose from, colleges and universities face problems such as curriculum not matching training goals, incomplete curriculum content, unreasonable curriculum structure, and single teaching methods. The reasons behind this are the lack of recognition of the importance of primary education majors, the lack of cooperative training mechanisms with primary schools, and the significant influence of traditional educational concepts on teachers, making it difficult to adapt to curriculum reform.

Wang Yanbo & Zhu Qianying (2023) believe that from the perspective of the integration of "job, course, competition, and certificate," there are still many problems in the primary education major curriculum system: first, the training goals and job requirements have a low degree of fit, and the students' subjectivity is not effectively utilized; second, the integration of national, industry, and competition standards is low, making it difficult to leverage the advantages of their comprehensive education mechanism; third, the course content of the primary education major is outdated and updated slowly, making it difficult for students to connect the knowledge and abilities learned in school with the job requirements of primary school teachers; fourth, the proportion of theoretical courses in the curriculum structure is much greater than that of practical courses, and the lack of practical courses makes it difficult for students to apply the theories they have learned to practical applications, which is not conducive to the cultivation and improvement of students' vocational skills; fifth, the curriculum system of the primary education major has not been integrated with various competitions at the national, provincial, municipal, and school levels.

Ma Zhifang & Xue Jihong (2023) believe that although most higher vocational colleges emphasize the foundational and comprehensive nature of the content of primary education major courses, the following prominent issues still arise: first, there are many subject-specific courses and few integrated courses, lacking curriculum integration. Excessive emphasis on subject-based approaches, with too many subjects and crossovers, leads to high learning pressure for students, who end up learning a little of everything but not mastering anything; second, there are many theoretical courses and few practical courses, and the curriculum standards and teaching arrangements of many courses are not tailored to the needs of primary education majors, lacking practical training; third, there are many required courses and few elective courses, lacking quality improvement. The cultivation of students' autonomous development ability, teaching reflection ability, lifelong learning ability, and artistic literacy is neglected.

Strategy researchs

Fu Xiao (2016) believes that the curriculum system of higher vocational elementary education majors based on the dual-track system should combine theory and practice, be employment-oriented, and integrate the professional standards and quality education concepts of elementary education teachers. The knowledge and skills of pedagogy, psychology, teaching methods, etc., should be optimized and combined with professional course content. Promote the connection between professional settings and professional course content with professional standards, and promote the connection of training goals, professional settings, teaching processes, etc., between secondary and higher vocational education, forming a closely connected and dynamically adjusted vocational education curriculum system. Fully implement quality education, integrating professional ethics and humanistic quality education throughout the entire training process.

Chen Jie (2017) believes that the primary education major in higher vocational colleges should be positioned in rural primary schools, and the curriculum should be student-centered, focusing on cultivating students' knowledge, qualities, and abilities. First, improve practical courses, increase the time for educational probation and internships, and enhance students' social practice abilities; second, increase music, art, and skill-based courses to allow students to develop comprehensively and become all-around talents; third, emphasize education courses to reflect professional characteristics; fourth, broaden elective courses to reflect students' personalized development. The curriculum is divided into four major modules: public courses, professional courses, comprehensive practical training, and innovation and entrepreneurship.

Zhang Jinling (2018) believes that under the background of the unified teacher qualification examination, the strategies for the construction of the curriculum system for primary school teacher training are: first, determine course goals based on the vocational abilities of primary school teachers; second, the curriculum structure should focus on the concept of "ability first," that is, organically combining subject knowledge, educational theory, and educational practice, finding a reasonable balance among professional, general, and ability courses to set up academic courses, which can effectively cultivate the core abilities required for primary school positions; third, the curriculum system should not only be rich in types but also highlight professional characteristics; fourth, the course evaluation mechanism should highlight the assessment of students' vocational abilities.

Tao Yuqin, Yang Ying & Yang Haifeng (2018) take the five-year primary education major curriculum of Ma'anshan Normal College as an example and determine that the curriculum system of the primary education major consists of five major course groups: teacher education courses, subject professional courses, professional elective courses, vocational ability courses, and public basic courses. Public basic courses help students establish correct worldviews, outlooks on life, and values, improve their humanistic qualities, and enhance professional ethics. Teacher education courses are oriented towards training rural teachers, cultivating students' vocational skills and qualities. Professional elective courses broaden students' knowledge and improve their knowledge structure. Vocational ability courses include military training and entrance education, professional probation, professional internships, internships, and graduation theses (designs), etc.

Cai Rui & Liang Hui (2018) believe that practical teaching of primary education majors refers to teaching activities that, under the guidance of teachers, apply theoretical knowledge to practice through classroom practical teaching activities, probation, internships, etc., to develop and enhance the vocational abilities of primary education majors. Based on this, the development of practical courses emphasizes the importance of vocational elements in course design, constructing a practical teaching content system from three aspects: basic practice, professional practice, and comprehensive practice. Course design and implementation focus on the specific work tasks of primary school teachers, integrating the work tasks of primary school teacher positions into on-campus teaching practice, educational probation, and educational internships, designing more practical and realistic educational teaching events and situations, and creating more opportunities for students to practice and experience.

Zhang Yanyan (2019) believes that to optimize and integrate the professional curriculum system for primary general teachers, first, a modular general teacher education curriculum system should be established based on students' subject backgrounds and knowledge structures, with additional general education modules to highlight the cultivation of students' comprehensive qualities in humanities, science, and arts. Second, integrate professional courses and core courses. Break the curriculum structure of pedagogy, psychology, and subject teaching methods, adjust the proportion of each subject course, and focus on the deep integration of theoretical and practical courses. Third, teachers should make full use of modern information technology to transform teaching and learning methods, focus on cultivating students' learning, practical, and innovative abilities, and make full use of high-quality online course resources such as "MOOCs" to improve teaching quality.

Liu Yi (2020), based on the concept of OBE, examines the talent training model of higher vocational primary education majors, that is, designing a scientific and reasonable curriculum system based on the level and abilities that students should achieve after graduation. The first step is to position the talent training goal as "cultivating qualified teachers who are rooted in rural primary schools and love the cause of rural primary education." According to relevant policies, establish indicators covering four dimensions: practicing teacher ethics, learning to teach, learning to educate, and learning to develop, with secondary and tertiary indicators under the four dimensions to refine the graduation requirements. The second step is to decompose course objectives level by level according to graduation requirements and establish a course matrix; the third step is to re-integrate teaching content based on the "ability-based" concept to effectively avoid repetition and omission of teaching content. The fourth step is to select appropriate teaching methods based on the characteristics of teaching content; the fifth step is to set up an assessment method that combines process evaluation and summative evaluation, clarifying the correspondence between assessment indicators and course objectives and their levels.

Bai Li (2021) takes the curriculum reform of Longnan Normal College as an example and believes that teacher professional certification should focus on the concept of "student-centered, output-oriented, continuous improvement," focusing on "educational output" and students' ability to analyze and solve problems. Therefore, the teacher professional training plan should formulate talent training goals based on the needs of basic education for teacher qualities, design graduation requirements according to the needs of teacher teaching positions, and further adjust the training plan and curriculum system based on the feedback and evaluation of basic education on talent training results, achieving continuous improvement.

Liu Hongxiang, Zhu Mingxia & Guo Xiaoju (2021) believe that taking mathematics courses in higher vocational primary education majors as an example, the principles of curriculum setting are to strengthen the comprehensiveness, coherence, and selectivity of courses. Comprehensiveness includes theoretical knowledge, teaching design, and teaching skills, aiming to cultivate students' core qualities; coherence refers to the overall arrangement of courses over the three years of higher vocational education based on the laws of students' physical and mental development and the internal logic of subject knowledge. Selectivity is to improve the course selection mechanism according to the requirements of "comprehensive literacy and specialized development," providing students with personalized and diversified course choices.

Yang Feixue (2023) believes that taking the dance course system construction of primary education majors in higher normal colleges as an example, the principles of curriculum setting are the principle of scientificity and the principle of matching. Scientificity refers to scientific planning based on the actual situation of primary education majors, such as students' physical conditions, learning abilities, and course foundations; matching refers to the matching of curriculum content planning with the specific situation of primary education teaching. Curriculum setting should focus on the process of students acquiring knowledge and skills, teach students to master methods of analysis, innovation, and practice in the process, and continuously expand and improve students' knowledge systems; finally, scientifically plan the proportion of class hours and content between required and elective courses, constructing a curriculum system with required courses as the leading factor and elective courses as a supplement.

Kuai Xiuli (2025) believes that when formulating the curriculum system for primary general teacher training in higher education institutions, these factors should be fully considered, highlighting comprehensive characteristics, mainly including public basic courses, subject basic courses, professional basic courses, teacher education courses, information technology and application courses, education management and research courses, etc. Through the study of these courses, primary general teacher students can master the basic theories, knowledge, and skills required to be competent in teaching various subjects in primary schools, have a broad and multi-disciplinary knowledge structure, and lay a knowledge foundation for enhancing their career planning abilities.

Intelligent Learning and Smart Classrooms

Definition

Jiang Wenying, Yang Fenhong & Fan Luning (2017) believe that the "smart classroom" is guided by constructivist learning theory and utilizes new technologies such as big data, mobile internet, and cloud computing in the "Internet +" era to construct an information-based, intelligent, and highly interactive classroom. Through intelligent push, dynamic learning data collection, and real-time analysis, it realizes data-based teaching decision-making, real-time and comprehensive teaching evaluation, full-process communication and interaction, and personalized resource push, thereby transforming and improving the structure and mode of classroom teaching.

Qu Na (2020) believes that a smart classroom refers to the use of new information technologies, such as big data, cloud computing, and the Internet of Things, to create an innovative, intelligent, digital, and personalized multi-form learning environment, transform teaching methods, highlight the student's central role in the learning process, and cultivate students' creative thinking and problem-solving abilities.

Liu Bangqi (2023) points out that Smart Classroom 3.0 utilizes new-generation artificial intelligence, brain science, and other technologies, adopts a new system architecture of "cloud, brain, and end," constructs an intelligent brain for the classroom, develops new products such as smart sports, smart mental education, and smart aesthetic education, and upgrades an integrated intelligent learning environment. Based on big data intelligence and cognitive large models, it constructs a new teaching ecology that is "online and offline, in-class and out-of-class, virtual and real multi-dimensional integration."

Wang Yingxing, Li Yuanyuan, Zhou Huan & Zha Qingyun (2025) believe that the smart classroom can be understood from two perspectives: first, from the perspective of education and teaching, by leveraging the "wisdom" of teachers in teaching, innovating teaching design, and optimizing teaching organizational forms, etc., to impart knowledge to students and inspire their wisdom, emphasizing the principle of people-oriented. Second, from a technical perspective, based on information technologies such as big data and machine learning, combined with hardware devices such as intelligent learning terminals, to construct a virtual and real symbiotic smart learning classroom.

Zhang Yanchun (2025) believes that the smart classroom refers to the use of various new information technologies such as big data, the Internet, cloud computing, the Internet of Things, and artificial intelligence to create a digital and intelligent teaching environment, in order to achieve learning situation tracking and analysis, and intelligent push of learning resources. Such classrooms can prompt teachers to optimize teaching forms in all aspects, such as pre-class preview, class check-in, knowledge teaching, skill teaching, assessment and evaluation, etc., and can also change students' learning methods, enabling them to enhance learning ability and cognitive effects through autonomous learning, contextualized learning, and virtual experiential learning.

Theoretical basis

Wang Xiaoxiao (2014) believes that situated cognition learning theory provides a solid basis for mobile learning, and mobile learning also supports situated cognition learning theory at the technical and application levels. Situated cognition learning theory believes that the essence of learning is the process of interaction and mutual influence between an individual and other people and the surrounding environment during the participation in specific application activities, and the process of continuous improvement of an individual's practical ability and social level, emphasizing the significant impact of the external environment on learning. In the process of mobile learning, learners can make full use of wireless mobile devices to enter the learning system anytime and anywhere, obtain the relevant knowledge they need, and apply it to the solution of practical problems.

Li Xinyi & Liu Bangqi (2018) believe that constructivist theory points out the direction for classroom teaching reform in the Internet era. "Constructivism" reveals the essence, characteristics, and implementation methods of learning in the context of the Internet, and proposes the elements of an ideal learning environment. Based on constructivist theory, using "Internet +" thinking and advanced information technology means, such as perception technology based on the Internet of Things, big data analysis technology, artificial intelligence technology, etc., to meet the needs of the whole process application of classroom teaching before, during, and after class, is conducive to creating a highly perceptive, interconnected and shared, collaborative service smart education environment.

Liang Xinglian, Zhang Shiya & Luo Jianghua (2019) believe that with the advent of the "Internet +" era, the trend of artifact culture represented by smartphones, educational apps and their resources, behavior culture represented by smart teaching, and the concept culture of interconnection and interoperability is gradually emerging, giving birth to a new educational technology cultural paradigm of teacher-led and student-centered. The conceptual and cultural coordinates of "Internet +" to reform college teaching are connectivism learning theory. This theory believes that knowledge resides in the network, takes diverse, autonomous, interactive, and open "connected knowledge" as the epistemological basis, and creatively explains the form, existence space, change, and meaning of knowledge.

Wang Zhijuan (2024) believes that the "smart classroom" teaching model utilizes information technologies such as cloud computing, big data, and the Internet of Things to achieve personalized teaching. It is built on constructivist learning theory, which believes that learning is an active process of constructing knowledge, emphasizing students' initiative and interactivity. In addition, the smart classroom also integrates modern educational psychology theories such as multiple intelligences theory, affective computing technology, and cognitive load theory, helping teachers better understand students' learning status and adjust teaching strategies through intelligent teaching aids and methods.

Huo Liting, Zhang Yuhua & Chen Zhiying (2024) believe that the constructivist curriculum view advocates the integration between disciplines, guiding students to explore and solve problems through careful teaching design, discovering and establishing the internal connections between disciplines, and achieving the transfer and comprehensive application of knowledge. Based on the constructivist learning environment view and technology application view, explore the use of multimodal teaching resources, diversified teaching methods, multi-dimensional teaching situations, and smart teaching platforms to carry out theoretical and practical teaching. Using constructivist learning theory to guide the construction of smart classrooms in higher vocational ideological and political courses is conducive to achieving the organic combination of educational concepts and educational practices, as well as deepening the application of educational technology.

Xie Piao (2024) believes that the construction of smart classrooms is mainly based on the following theoretical foundations: first, learner-centered theory. This theory believes that smart classrooms emphasize students' subjectivity and transform the role of teachers into guides and facilitators. Through the design of personalized learning paths, students are encouraged to be creative, actively explore knowledge, and cultivate problem-solving abilities. Second, technology-enabled education theory. This theory achieves the personalization, flexibility, and lifelong learning of education through technological means. It not only changes traditional teaching methods and learning methods but also provides possibilities for the personalization, fairness, and innovation of education. Third, teaching ecology reconstruction theory. This emphasizes the use of modern information technology to fundamentally transform and optimize traditional teaching models, teaching environments, and teaching processes to build a more efficient, flexible, and interactive teaching ecosystem. Based on this, curriculum settings in the smart classroom environment are more flexible and can be adjusted according to students' learning progress and interests.

Importance

Qi, Y., & Huang, Y. F. (2022) believe that society confronts new opportunities and challenges driven by mobile Internet, cloud computing, and the Internet of Things. Leveraging mature data-information collection, analysis, and processing technologies enables comprehensive student evaluation. Consequently, big-data applications—learning analytics, online platforms, educational-information systems, education apps, and smart campuses—are proliferating. Instruction must therefore become more open, integrating existing IT with modern datasets and learning analytics to enhance teaching quality.

Zhang Yali & Zhang Juan (2024) conducted a questionnaire survey on the impact of smart classrooms on the academic self-efficacy of higher vocational students. After analyzing the samples with SPSS, they found that more than half of the students believe that smart classrooms are more interesting, can present richer information, are conducive to improving students' learning interest and teacher-student communication, create a free classroom atmosphere and equal teacher-student relationships, and to a certain extent, have a positive impact on students' self-academic self-efficacy.

Zhu Bin (2025) believes that smart classrooms emphasize the leading role of teachers and the main role of students, build mutual trust and interactive classrooms and learning communities, and actively explore interactive, heuristic, inquiry-based, and experiential classroom teaching based on situations and problem orientation through complex situation settings, problem challenges, and project completion, to stimulate students' internal drive, enable students to achieve deep learning, and promote the development of students' higher-order thinking.

Yang Ya (2025) believes that smart education has become a new trend in vocational education in the new era. With the support of advanced information technologies such as the Internet, big data, and artificial intelligence, by integrating, optimizing, and innovating a curriculum system that is systematic, scientific, and practical, and setting differentiated teaching goals and content according to the characteristics and needs of student learning, the quality of vocational education teaching can be improved.

Zhao Ying, Huang Ge & Zhang Lei (2025) believe that the talent training model through the integration of industry and education can meet the requirements of society for high-quality talents. With its intelligent technology, diversified teaching methods, and precise teaching strategies, smart classrooms can comprehensively compensate for the shortcomings of traditional classrooms, improve student participation, cultivate students' higher-order thinking and qualities, and thus achieve the integration of industry and education.

Ma Minghai (2025) believes that higher vocational students must have the concept of lifelong learning, and continuously update their professional knowledge and vocational skills with social development to cope with the challenges faced in future careers. The smart education platform can organically combine online learning with classroom teaching, guide autonomous preview before class, highlight discussion and interaction during class, and strengthen extended training after class, fully mobilizing students' learning initiative and participation, enabling students to acquire knowledge and skills in autonomous learning and active exploration.

Content or composition

Tang Chunhua (2024) constructed a new ecological implementation model of human-machine collaborative interconnected symbiotic smart classroom teaching based on the understanding and analysis of digital intelligence elements. The implementation of smart classroom teaching adopts the "three drivers and seven steps" model to lead the generation of wisdom. The "three drivers" of the smart learning guidance process: "task-driven" before class to guide students' autonomous learning; "problem-driven" during class to lead students' thinking construction; "homework-driven" after class to guide students' flexible application. The "seven steps" leading the smart learning method: pre-class task introduction; in-class problem presentation, discussion and analysis, problem-solving, cooperative inquiry, and comments; post-class consolidation and improvement.

Wang Zhijuan (2024) believes that the "smart classroom" teaching model integrates modern information technology, emphasizes interaction and feedback, and achieves personalized teaching. Its practical application is mainly reflected in: first, the intelligent teaching platform: supporting functions such as digital display of course content, interactive learning, and online assessment. Second, personalized learning paths: using big data analysis and artificial intelligence technology to recommend personalized learning content and paths based on students' learning history, ability levels, and preferences, improving learning pertinence and efficiency. Third, interaction and cooperative learning: with the help of online discussion areas, virtual laboratories, collaboration tools, and other technical means, it is convenient for students to carry out group cooperation and communication. Fourth, contextualized learning: creating real or virtual learning situations through VR and AR technology, allowing students to learn in a simulated practical environment, enhancing the practicality and experience of learning.

Zhu Bin (2025) believes that smart classrooms emphasize the leading role of teachers and the main role of students, and through the support of the learning environment, the stimulation of students' autonomous learning, and the teaching methods of knowledge construction, achieve the development goals of core literacy and generate students' key abilities; smart classrooms focus on integrating teaching, learning, and evaluation into an organic whole, combining diagnostic evaluation, formative evaluation, and summative evaluation, emphasizing a continuous cycle and continuous improvement process. The evaluation results of the previous cycle provide important reference information for the next learning cycle, ensuring that teaching activities always revolve around students' needs and progress.

Yang Ya (2025) takes the logistics management major in higher vocational colleges in Lanzhou City as an example to explore the establishment of a precise teaching model relying on advanced information technologies such as the Internet, big data, and artificial intelligence, aiming to improve the quality of vocational education teaching and cultivate compound talents. The specific content of the model is: using big data technology to analyze teaching objects and reconstruct the professional curriculum system, and to identify students' learning performance, thereby accurately matching teaching content; in terms of teaching methods, using big data technology to innovate online + offline blended teaching; adopting differentiated teaching strategies to formulate teaching plans that meet the learning situation; and using smart education technology platforms to construct a multi-dimensional evaluation system.

Liu Hailong (2025) believes that there are several typical models of smart classroom teaching in higher vocational colleges: first, the flipped classroom teaching model, which uses smart platforms throughout the entire teaching process (before, during, and after class). Second, the blended teaching model, which combines online teaching with offline teaching, with the online part including online course learning, online testing, discussions, etc., and the offline part including face-to-face explanations, experiments, and practical training. Third, the project-driven teaching model, where teachers design projects, students obtain relevant knowledge and resources online, and complete project tasks through offline group collaboration. Fourth, the personalized intelligent teaching model, which uses big data analysis and artificial intelligence technology to push personalized learning content and paths for each student. Fifth, the situational simulation teaching model, which uses virtual reality (VR), augmented reality (AR), and other technologies to create realistic teaching situations. Sixth, the remote collaborative interactive teaching model, which uses network platforms to collaborate remotely with other institutions or enterprises to jointly complete teaching projects or practical activities. Seventh, the inquiry-based teaching model, where teachers pose questions or tasks, and students use Internet resources for independent inquiry and learning.

Liu Yinfeng (2025) points out that the core literacy-oriented smart classroom construction strategy includes: first, combining professional characteristics to formulate a core literacy training plan that matches industry needs. Provide teacher training to enhance teachers' ability to use smart classroom technology; second, build a learning community to promote students' active learning, adopt teaching models such as flipped classrooms, design student-centered activities, and create learning communities and interactive communities; third, strengthen practice and practical training, continuous evaluation and feedback, increase practical training courses and simulation operations, use smart classroom resources, implement formative evaluation, and adjust teaching strategies and content using data analysis tools.

Principles

Shao Jianhua (2024) believes that the core of talent training in higher vocational colleges is to cultivate applied talents and talents that meet the needs of vocational abilities. The school-enterprise collaborative education model based on smart classrooms leverages the power of modern information technology, takes industry needs as the guide, focuses on practical ability training, and uses the combination of industry, academia, research, and application as the approach to achieve the integration of professional education, technological innovation, and industrial services. From the perspective of innovating classroom teaching models, it reconstructs the smart classroom teaching model, striving to achieve the integration of theory and practice, the combination of work and learning, and the integration of industry and education to meet the needs of students, schools, and enterprises.

Liu Hailong (2025) believes that the design principles of smart classroom teaching in higher vocational colleges under the background of "Internet + Education" are: first, pay attention to students' differences and formulate personalized learning plans according to different learning needs and interests; second, support teachers and students' independent creation and sharing, promote the co-construction and sharing of knowledge, and achieve real-time interactive communication between teachers and students, as well as among students; third, deeply integrate information technology with teaching content, teaching methods, teaching resources, teaching models, and teaching evaluation, providing teachers with precise teaching decision support and enabling personalized teaching for students.

Yan Guibin, Yan Zijia & Wang Yan (2025) based on the smart classroom-based higher vocational ideological and political course teaching model, innovate in teaching design, teaching methods, teaching resources, and teaching evaluation.

Teaching design is student-centered, combining teaching content to create vivid and interesting teaching situations; teaching methods mainly adopt the flipped classroom teaching model and project-based teaching method; teaching resources are enriched by independently developing or integrating other network or multimedia resources to enrich the teaching resource library; in teaching evaluation, a diversified evaluation system is established, combining process evaluation and summative evaluation.

Wang Fang (2025) points out that precise teaching in smart classrooms uses intelligent systems to collect relevant data on students' learning processes in real-time, and teachers make teaching decisions based on this to improve students' learning efficiency. First, in terms of learning situation analysis, collect student data to understand their learning status and needs. Second, set goals, determine goals based on learning situation analysis, consider individual differences among students, and formulate personalized plans. Third, in terms of content selection, choose content and methods according to learning goals, focusing on pertinence, practicality, and interest. Fourth, in terms of process monitoring, focus on collecting data during teaching to monitor students' learning progress and effects. Fifth, in terms of effect evaluation, evaluate students' learning effects after teaching to encourage teachers to reflect on and improve teaching methods and means.

Wang Yingxing, Li Yuanyuan, Zhou Huan & Zha Qingyun (2025) point out that the smart classroom framework of higher vocational colleges driven by digital twin (Digital Twin) technology should follow three principles: intelligence, integration, and forward-looking. The principle of intelligence emphasizes the use of information technology to achieve the transformation from informatization to intelligence, driving the learner profile model through collecting learning data to achieve personalized and inquiry-based learning. The principle of integration requires the integration of skill training and quality cultivation, various module support technologies, virtual and real learning spaces, etc., to construct an immersive learning space. The principle of forward-looking points out that the collection and transmission of student learning data, the construction of student profile models, and the intelligent upgrading of practical training systems are currently in the exploration stage. When constructing models, future functional and technological development trends should be considered, such as full life-cycle learning monitoring and intelligent guidance functions for practical training skills.

Process or steps

Zhao Haiou, Ye Youpan, Liang Chen & Huang Yu (2025) explored a higher vocational English smart classroom teaching model based on "OBE + BOPPPS," constructing a student-centered and teacher-guided classroom model. Teaching activities follow the BOPPPS main line, closely revolving around six parts through the Learning Pass platform. The steps are: first, the Bridge-in stage, where teaching resources are released on the Learning Pass platform; second, the Objective stage, where learning objectives and knowledge frameworks are uploaded; third, the Pre-assessment stage, where students' cognitive levels are tested before the new lesson, and pre-test questions are released. After the pre-test, teachers adjust teaching plans and course designs based on student performance; fourth, the Participatory Learning stage, where students are divided into groups, scenarios are set up, and students are guided to role-play. Students can ask questions on the platform, which are answered by teachers; fifth, the Post-assessment stage, where corresponding knowledge point tests are conducted on the platform to check the achievement of teaching objectives; sixth, the Summary stage, where online homework of varying difficulty is set to encourage students to actively reflect on and consolidate their learning outcomes.

Li Xiaohui (2025), based on the DIKW (Data-Information-Knowledge-Wisdom) model, always adheres to the goal of "core literacy improvement." Before class, smart tools are used to integrate unit-based learning modules based on professional talent training objectives and preset textbook objectives, guiding higher vocational students in autonomous preview, cooperative learning, and problem-solving. During class, smart classrooms are utilized, such as information systems, information technology, and interactive large screens, to facilitate the creation of learning environments and promote the implementation of task-based learning (TBL) and project-based learning (PBL). After class, teachers comprehensively analyze the learning situations of each group and push learning resources suitable for individual student needs. Additionally, higher vocational colleges and enterprises maintain close contact through platforms to jointly design course systems, practical projects, and evaluation standards, ensuring that teaching content is closely aligned with actual job requirements, effectively enhancing students' professional literacy and professional skills.

Wu Jian (2025), based on the CDIO engineering education concept, explored the optimization design strategies for higher vocational computer major network smart courses: first, guided by the CDIO engineering education concept, align talent training goals with enterprise job requirements, focus on "output orientation," and reconstruct the knowledge and ability training system; second, incorporate cutting-edge technology hotspots into course content, update course content, introduce real cases, enhance the vocational relevance and practical application effects of practical courses, and achieve the integration of "teaching, learning, and doing"; third, rely on smart teaching platforms in course implementation to construct a new "IEET" teaching model, namely Internet-based Learning, Enquiry-based Teaching, Experiential Practice, and Team Project. This model is based on students' cognitive characteristics and learning needs, emphasizing independent inquiry, practical experience, and collaborative innovation, achieving a paradigm shift from "teaching-centered" to "learning-centered"; fourth, build diverse practical platforms, such as developing virtual simulation experiment teaching platforms and introducing online programming practice platforms, to expand practical teaching resources.

Liu Man, Yue Zongjie & Yu Bo (2025) attempted to construct a smart teaching model in higher vocational colleges. The first step is to build a smart teaching platform. Teachers integrate school online teaching platforms, XuetangX online teaching cloud platforms, etc., into classroom teaching and management, integrating high-quality resources; the second step is to reconstruct the course teaching system based on professional talent training goals and vocational abilities. The third step is to reset the teaching process. In the pre-class stage, teachers release preview tasks and learning resource information on the teaching platform to guide students in group learning; in addition, teachers release pre-class test content based on key learning content and teaching difficulties determined by vocational abilities, guiding students in independent inquiry. During the in-class stage, create learning situations. Use teaching methods such as project teaching, task-driven teaching, case teaching, and demonstration teaching to guide students in group learning, brainstorming, etc., and carry out "online + offline" blended integrated teaching activities. In the post-class stage, targeted after-class tutoring is implemented based on classroom reports and teaching data feedback from the platform. The fourth step is to reconstruct the course evaluation system, adopting a process-based diversified evaluation method.

Zhong Si & Tu Jing (2025), based on precise thinking, explored and practiced the reform of artificial intelligence-enabled teaching models, constructing a "teacher-student-machine" ternary precise collaborative education model. This model has three new human-machine collaborative teaching models, providing valuable experience for education and teaching supported by intelligent technology. First, use AI technology to integrate ideological and political education courses in higher vocational colleges into various courses, making educational content more relevant to students' actual lives through personalized push and virtual simulation practice; second, integrate digital teaching resource libraries, use AI algorithms to accurately match student needs, and provide customized learning materials; third, construct an intelligent evaluation system, based on big data analysis of student learning behaviors and outcomes, to achieve full-process, multi-dimensional academic evaluation.

Learner Profiles

Concept

Wang Yajun & Hu Dong (2021) believe that the connotation of "learner profile" includes: first, a learner profile is a description and collection of learners' basic information, an objective evaluation; second, a learner profile is not only an objective evaluation of learners but also an abstract description of learner characteristics, the basis for constructing a labeled model of learners; third, a learner profile ultimately needs to output the profile model in a visual way, providing data support and services for specific teaching purposes.

Lin Longcheng & Wang Fangfang (2022) believe that as a product of the era of educational big data, a learner profile is a user conceptual model containing multiple sub-structures of labels, which collects and describes personal data reflecting learners' personal characteristics and knowledge levels, and labels learner groups. With the help of data analysis methods such as cluster analysis, different characteristic learner groups can be formed, providing solutions for better recommending personalized learning resources.

Zhang Xingxu & Xing Lei (2023) point out that profile technology is a big data application technology that actively or passively collects various data left by users on the Internet and processes them into a series of labels for accurate depiction and portrayal of users. A "learner profile" focuses on group characteristics, classifying and describing learners in groups, thereby providing personalized learning services for learners and ultimately promoting the improvement of student learning outcomes.

Xie Dingfeng, Zhou Anzhong & Li Jieqin (2024) believe that learner profile construction refers to the use of data analysis and presentation technologies in big data to collect learner learning data and extract learner characteristics from the data, including interest characteristics, behavioral characteristics, knowledge levels, etc. Data-driven profile research can mine learners' different learning styles, personal information, academic information, relationship information, preference information, interests, psychological characteristics, engagement, concentration, network enthusiasm, learning goals, learning motivation, knowledge base, and other characteristics, with higher accuracy. The quantification of learner data can provide customized and pushed personalized information resource services, recommending suitable learning resources to learners.

Feng Yujia, Sun Houju & Yu De (2024) believe that learner profile construction is the foundation of personalized recommendation models for online learning resources. First, it is necessary to collect learners' basic attribute information, learning preference information, learning behavior processes, and other data, and then analyze and process these data, assigning digital labels. Through profiles, learners' learning styles and cognitive levels are mined, and personalized learning needs are dynamically obtained, so as to push suitable resources to learners and improve the accuracy and interpretability of recommendation results.

Xu Yahong & Liu Ningjing (2025) believe that learner profiles, supported by big data, can collect different types of learner data, providing targeted suggestions for teachers in the teaching process, thereby optimizing teaching. In the evaluation process, due to the timeliness and efficiency of data acquisition, learner profiles are conducive to carrying out accompanying evaluations integrated into the entire teaching process and can comprehensively present the most objective and scientific evaluation results of learners.

Methods and applications

Hasan Altun (2019) used 12-item Kolb Learning Inventory to determine the learning styles of primary education mathematics teacher candidates, aiming to investigate the problem solving skills of primary education mathematics teacher candidates according to their learning styles. As a result of the study, when students' learning styles are examined it was observed that the students with converging learning style are 42.3%, students with assimilating learning style are 38.5%, students with diverging learning style are 11 .5% and students with an accommodating learning style are 7.7%%. It showed that skills of students can be improved better by revealing the relationship between learning styles and problem-solving skills of the students and by implementing teaching methods suitable for their learning styles.

Lin Longcheng & Wang Fangfang (2022) designed and constructed a learner profile based on online learning behavior through learner group identification and feature analysis, and combined it with the Moodle online learning platform to provide more accurate personalized learning resource recommendation services that match the characteristics of learner groups. This meets students' personalized learning needs, stimulates their learning potential, and provides guidance for more accurate personalized resource push in online learning platforms.

Zhang Xingxu & Xing Lei (2023) selected the multi-dimensional teaching effectiveness evaluation system of Shanghai Jiao Tong University as the data source, which includes several major categories of data such as students' evaluations of teachers' teaching, learning methods, class enthusiasm, course characteristics, demographic information, and academic performance. Cluster analysis was used to classify learners, with deep learning methods, surface learning methods, and academic performance as classification indicators, and K-Means cluster analysis was performed using SPSS 22.0. The cluster analysis results showed significant differences in the performance of the three groups of learners on the three indicators of grade T-scores, deep learning methods, and surface learning methods, indicating the effectiveness of the clustering model, i.e., the clustering results are valid.

Rong Hui, Li Shuzhou & Ning Jinye (2023) took the electrical technology and application course under the SPOC blended teaching mode as the research object, collected the comprehensive course scores of 854 students from 6 majors, and used big data analysis and cluster analysis methods to construct and analyze group learner profiles and individual learner profiles in the course, drawing group and individual learner profiles from dimensions such as learner background characteristics, behavioral characteristics, and course learning engagement. Learner types are divided into three categories based on scores: the first category of learners scores 80-100; the second category of learners scores 60-79; the third category of learners scores 0-59. The study shows that the first category of students has a higher utilization rate of course network resources, stronger autonomous learning ability, can better complete the learning and testing of related course content, and can timely review and consolidate the knowledge learned in class through homework. The second and third categories of learners require teachers to continuously pay attention to and analyze their learning dynamics in subsequent course learning and provide timely guidance.

Huang Jinjing & Chen Yuanyuan (2024) proposed an analysis method for higher vocational students' online learning behavior based on learner profiles and feature clustering. The first step is data preprocessing. Collect relevant data on the blended teaching of the "Information Technology" course for some classes at Suzhou Industrial Vocational and Technical College, and then perform data cleaning and data conversion. The second step is the construction of dimension labels. Construct five dimensions: learner basic information, learning engagement, interaction, learning outcomes, and timeliness information, and select corresponding labels for each dimension and annotate label values. For example, take homework submission data as an example, annotated as four situations: all submitted, most submitted, few submitted, and none submitted. The third step is profile analysis and presentation. Use cluster analysis and K-Means algorithm to form learner group profiles and individual learner profiles.

Lijun Pan (2024) proposes an intelligent learning construction method based on cluster analysis and deep learning algorithms. First of all, the intelligent learning model construction process is sorted out by clarifying the idea of clever learning model construction and extracting model elements; then, the intelligent learning model is constructed through a K-means clustering algorithm and deep compression sparse self-encoder; finally, the effectiveness and high efficiency of the proposed method is verified through simulation experiment analysis.

Dong Zhiyou & Huang Jingwei (2025) collected online learning data of 69 learners through the "Comprehensive Business English 3" course on the Chaoxing Fanya online learning platform, including attendance records, chapter learning times, homework completion status, final exam scores, etc. In addition, a questionnaire survey was conducted on these 69 students through Wenjuanxing to collect basic attribute data, online learning behavior data, learning preference data, and learning attitude data. The valid data were then clustered into five categories: basic attribute data, learning behavior data, learning preference data, learning attitude data, and learning outcome data. Tableau 2023.2 data analysis and visualization system was used to visually analyze the relevant learning data, generating individual and group learner profiles. Through the analysis of learner profiles, a sustainable evaluation system for online open courses was constructed, continuously adjusting the learning objectives of the course, enriching course resources, and providing precise learning interventions and resource push for learners.

Related Researches

Josephine Chinying Lang (2017) describes a competency-based pedagogical framework as the basis for designing a flipped classroom. Its theoretical underpinnings are culled from the literatures on learner empowerment, epistemological belief systems, and the social construction of knowledge. The desired learning outcomes of this pedagogical framework include the development of cognitive competencies, collaborative knowledge acquisition skills, and motivational skills. This competency approach seeks to liberate the student from a blind acquiescence in and acceptance of received wisdom; and, to encourage her, instead, to critically examine the relevance and validity of information encountered. The upshot is to impel the student into embracing an authentic learning mindset.

Zhang Xuejia (2022) believes that smart teaching aims to cultivate students' core literacy and key abilities, can stimulate students' learning motivation and interest, guide students' personalized learning, and achieve differentiated teaching. Through investigation and analysis, she identified four key factors affecting the smart teaching model, namely, smart learning environment, smart classroom, smart teaching evaluation, and smart teaching management. The smart learning environment is mainly composed of four factors: smart tools, course resources, learning communities, and teaching communities. The smart classroom achieves knowledge transmission, knowledge construction, and internalization through three major stages: pre-class learning plan design and result analysis, in-class teaching interaction and differentiated guidance, and post-class personalized learning expansion. Smart teaching evaluation combines process and summative evaluations, online and offline evaluations, and knowledge skills and wisdom thinking. Smart teaching management should be oriented towards three dimensions: teachers, students, and leadership decision support.

Yue Mei (2024) believes that smart classrooms are different from traditional classrooms, focusing on students' unique learning experiences. It has the following characteristics: first, tracking the entire learning process. Teachers become organizers and guides of the classroom, using smart technology to obtain student learning data, comprehensively supervise the learning process, and formulate targeted teaching strategies, while students become the main body of learning; second, precise resource push. Smart classrooms use smart technology to analyze learning data and push learning resources accordingly, improving learning effectiveness; third, strengthening classroom communication. Teachers analyze learning data to provide precise guidance, cultivate students' communication and collaboration skills, and introduce smart technology and equipment to break time and space limitations, making teacher-student communication and student collaboration more convenient; fourth, achieving immediate evaluation and feedback. Smart classrooms can conduct targeted evaluations of students in the three stages of pre-class, in-class, and post-class, reflecting the wisdom of teaching evaluation and having a positive impact on student development.

Chen Xi (2024) believes that higher vocational colleges should not only teach students knowledge but also cultivate their vocational core literacy. In this context, a dynamically adaptive learner profile model is particularly critical. It can collect student learning data, practical training performance, and work scenario feedback in real-time, including skill mastery, project participation, work attitude, etc., to ensure that the profile reflects the latest learning situation and development status of students. Data sources include learning management system records, online learning platform activities, physical classroom interactions, social media, questionnaire surveys, exam and assessment scores, etc. Through multi-dimensional data analysis and cluster analysis, learning behavior analysis, learning outcome quantification, and comparison of individual and group profiles can generate detailed and dynamic learner profiles.

Shao Jianhua (2024) believes that the school-enterprise collaborative education teaching model based on "smart classrooms" relies on the resources of schools, enterprises, and vocational qualification certification agencies to achieve the goals of knowledge sharing, resource integration, and mutual benefit. On the one hand, by constructing multi-level work tasks, the knowledge and ability modules of higher vocational professional courses are graded and connected with vocational ability goals. With the help of information technology, the "live teaching + online tutoring" school teacher and enterprise mentor-driven training model is innovated to achieve the connection between professional course learning content and job abilities, and enhance the sense of participation in on-site work through teacher-student interaction. Teaching evaluation focuses on the entire teaching process, combining quantitative and qualitative evaluations, combining reward and punishment evaluations with developmental evaluations, centering on summative and formative evaluations, and supplementing with self-evaluation and peer evaluation, school evaluation, and social evaluation. On the other hand, with "smart classrooms" as the carrier, enterprises participate in the entire process of talent training through online teaching, improving educational efficiency, achieving two-way empowerment between schools and enterprises, enhancing the quality of collaborative education, and assisting in the modernization of vocational education.

Qiang Xiaohua (2024) believes that smart education is an important driving force for the innovation of talent training models in higher vocational colleges. The principles of talent training models in higher vocational colleges under the background of smart education are: first, innovate the concept of education, establish a direction based on industry development needs and promoting the development of students' vocational abilities, and clarify the goals of talent training. Second, adhere to the application first, and digital technology empowers teaching innovation. Use smart technology to achieve integration in educational teaching concepts, goals, and plans, professional settings, curriculum systems, and teaching content, teaching models, teaching environments, and management. Third, strengthen digital literacy and improve teachers' digital competence. Only by improving the digital literacy and skills of teachers in higher vocational colleges can the integration of digital technology into teaching be promoted. Fourth, adhere to demand orientation and continuously optimize the smart learning environment. The smart learning environment should not only focus on the supply of technical facilities and equipment but also on the improvement of teaching methods and practices, always putting the needs of serving and supporting teachers' and students' teaching and learning first.

Li Bo (2024) holds that vocational training improves students' practical competence, and flipped classroom under smart education can upgrade training quality and satisfy diverse learning demands. Vocational colleges ought to perfect teaching systems via optimizing smart environment, online learning platforms, learner demand analysis, layered goals, teaching approaches and evaluation. Intelligent platforms need management systems, course resources, micro-lectures, online Q&A and testing modules to serve teachers and students. Big data helps analyze learners' demands and practical levels to design targeted teaching strategies.

Zhao Ying, Huang Ge & Zhang Lei (2025) put forward a smart classroom model. First, colleges cooperate with enterprises to develop training resources and digital platforms based on cloud computing, big data and AI for enterprise-oriented training. Second, optimize courses by shifting from theory to practice and incorporating industrial knowledge. Third, apply simulation, practical and interactive teaching in whole teaching procedures. Fourth, organize targeted training to advance teachers' digital and professional competence.

In summary, improving the vocational competency of Primary Education majors via modern information technology has become a popular research focus in China. Existing studies cover diverse fields with varied research subjects and adopt targeted and scientific research methodologies. In terms of research objects, most existing studies center on teachers' IT-assisted instruction and school-based smart classroom construction to improve students' academic performance and professional literacy, while student-oriented research on promoting autonomous learning and constructing learner profiles with information technology remains insufficient. In terms of research content, relevant findings are scattered across talent cultivation, curriculum reform, smart classroom development and learner profiling, and few integrated models are developed to enhance students' vocational competency by comprehensively optimizing curriculum, classroom teaching and self-directed learning. Therefore, this study focuses on constructing an effective intelligent learning model oriented toward improving the vocational competency of vocational college Primary Education students. Four research implications are summarized after literature review:

1. The framework of the intelligent learning model shall conform to national vocational competency criteria and employment requirements of primary schools, with the cultivation of qualified primary school teachers as the core design goal.

2. The curriculum structure of the model draws on existing curriculum reform findings to overcome drawbacks of conventional curriculum systems and realize in-depth integration of curriculum content with vocational posts, qualification examinations and skills competitions.

3. Supported by well-established research on smart classrooms and intelligent platforms, the model implements a three-stage teaching mode including pre-class resource distribution, in-class interactive inquiry and after-class personalized consolidation.

4. Learner profiling is embedded into the model. Data from preview tasks, assignments, practical training and assessments are collected via the intelligent platform to build personalized vocational competency profiles and realize differentiated teaching.

Chapter 3
Research Methodology

In order to effectively design and apply an Intelligent Learning Model (ILM) tailored to the Primary Education major in vocational colleges, this study is divided into three sequential stages, each employing targeted research methods to systematically advance the research process and achieve the preset research objectives. The first stage focuses on fulfilling the first research objective: gaining an in-depth understanding of the current learning status, existing problems, and core needs of students majoring in Primary Education in vocational colleges. The second stage emphasizes the implementation of the second research objective: designing, optimizing, and initially applying an ILM suitable for Primary Education majors in vocational colleges. Finally, the third stage is dedicated to achieving the third research objective: conducting a comprehensive, multi-dimensional evaluation of the ILM to verify its effectiveness in improving students' learning quality, professional competencies, and learning experience. Through these three stages of systematic, progressive research, this study aims to provide more precise, efficient, and personalized learning experiences for Primary Education majors in vocational colleges, and further promote the reform of talent training models in this field.

Phase 1: Investigation on the Learning Status of Students Majoring in Primary Education in Yunnan Province.

The core purpose of this phase is to systematically investigate and analyze the learning status of students majoring in Primary Education in vocational colleges in Yunnan Province, clarify the key problems existing in their learning process, and explore the underlying causes of these problems. To ensure the comprehensiveness, depth, and scientificity of the investigation, a series of standardized steps and activities are carried out, as detailed below.

Research steps

The phase 1 consists of six steps, as detailed in the framework diagram below.

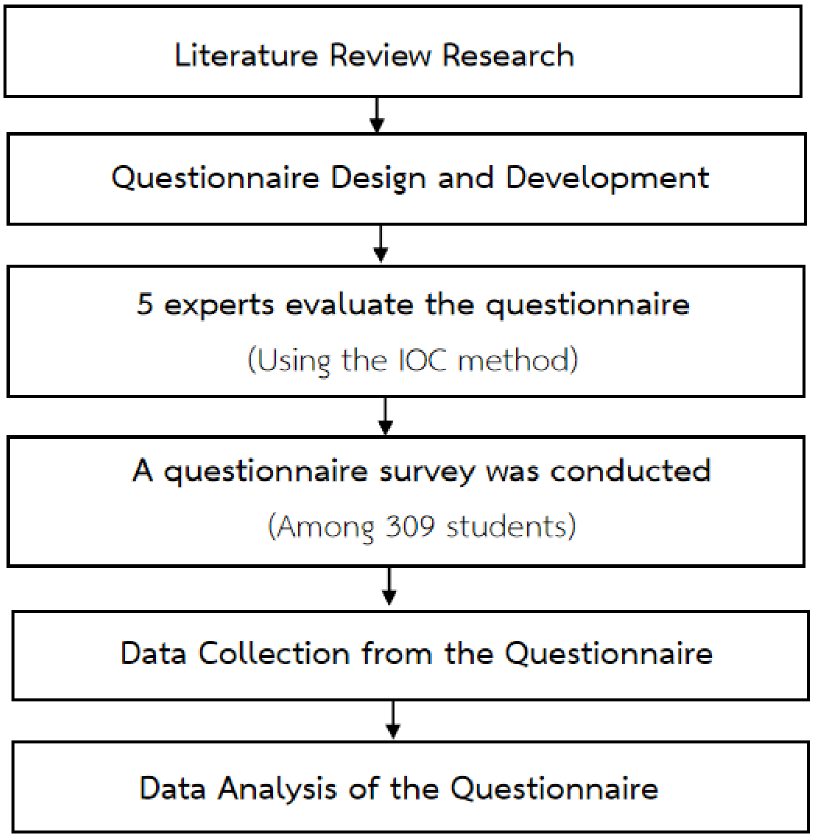

Figure 3.1 Framework diagram of Phase 1

1. Literature Review Research

By systematically reviewing relevant domestic and international literature, policy documents, and research reports, this study comprehensively sorts out the research status, core viewpoints, and existing gaps in the field of learning status of Primary Education majors in vocational colleges, as well as the application of intelligent learning technologies in this field. Specifically, the literature review focuses on analyzing the main problems (such as the disconnection between theory and practice) and their underlying causes in the learning process of these students, laying a solid theoretical foundation, clear research direction, and practical basis for the subsequent questionnaire design and model construction.

2. Questionnaire Design and Development

Based on the results of the literature review, the characteristics of Primary Education majors in vocational colleges, and the research objectives of this phase, a questionnaire titled "Questionnaire on the Learning Status of Primary Education Majors in Vocational Colleges" was designed (see Appendix C1 for details). The questionnaire content covers multiple dimensions closely related to students' learning status, including learning objectives, learning content, learning methods, practical links, learning evaluation, and demand for intelligent learning, to ensure a comprehensive, accurate reflection of the research questions and avoid omissions of key information.

3. Applicability Test of Questionnaire Data (KMO Test and Bartlett's Spherical Test)

the KMO test and Bartlett's spherical test were used to analyze the applicability of the questionnaire data, so as to judge whether the sample data is suitable for factor analysis. Among them, the KMO test is used to evaluate the suitability of the sample data (rather than directly evaluating the construct validity), and its judgment criteria are as follows: a KMO value > 0.8 indicates high sample suitability and suitability for factor analysis; 0.7 < KMO value ≤ 0.8 indicates good sample suitability; 0.6 < KMO value ≤ 0.7 indicates acceptable sample suitability; a KMO value < 0.6 indicates poor sample suitability and poor factor analysis effect; a KMO value < 0.5 indicates that the sample data is extremely unsuitable for factor analysis. Bartlett's spherical test is used to test whether there is a significant correlation between the items (variables) of the questionnaire. If the variables are independent of each other, it is impossible to extract common factors, and factor analysis is meaningless. This test takes the significance level (p-value) as the judgment basis. When $p < 0.05$, it indicates that there is a significant correlation between the variables, and the sample data is suitable for factor analysis; if $p \geq 0.05$, it indicates that the variables are highly independent and not suitable for factor analysis.

4. Expert Evaluation of the Questionnaire (IOC Method)

To ensure the scientificity, validity, and representativeness of the questionnaire content, five experts in the field of education were invited to form a review panel, and the IOC (Item-Objective Congruence) method was used to conduct professional evaluation of the questionnaire items. The evaluation focused on three core aspects: the relevance of each item to the research objectives, the accuracy and clarity of expression, and the effectiveness of measurement, so as to eliminate inappropriate items and optimize the questionnaire.

5. A questionnaire survey was conducted among 309 students

Using simple random sampling, 309 students were selected from all Primary Education majors at X Vocational College (Yunnan Province) to conduct the questionnaire survey. Before the formal survey, a pilot survey was conducted with 30 students (not included in the formal sample) to test the operability, clarity, and rationality of the questionnaire, and adjust and revise the ambiguous or inappropriate items according to the pilot results, ensuring the quality of the formal survey data. The formal survey was conducted anonymously to improve the authenticity of students' responses.

6. Data Collection from the Questionnaire

After the questionnaire distribution, the returned questionnaires were strictly screened and organized to eliminate invalid questionnaires (such as those with incomplete answers, obvious logical contradictions, or excessively short filling time). The valid questionnaires were sorted and coded to prepare for subsequent data analysis.

7. Data Analysis of the Questionnaire

Quantitative analysis methods were used to deeply explore the questionnaire data. Through descriptive statistics (frequency, percentage, average, standard deviation) and inferential statistics (correlation analysis, factor analysis), the learning status, existing problems, and core needs of Primary Education majors in vocational colleges were systematically revealed, providing accurate data support for the subsequent model design.

Population / Sample Group

The population

All primary education majors at X Vocational College, totaling 1,553 students.

The Sample Group

Based on Krejcie & Morgan's (1970) sample size determination table, a simple random sample of 309 students was drawn from all primary education majors at X Vocational College.

Research Instruments

1. Literature Review

Literature Databases: Chinese databases include CNKI (China National Knowledge Infrastructure), Wanfang Data, and VIP Journal; international databases include Google Scholar, ScienceDirect, Web of Science, and Scopus. These databases cover academic papers, dissertations, monographs, and research reports related to Primary Education, vocational education, intelligent learning, and other fields.

Policy Documents: Relevant policy documents issued by the Chinese Ministry of Education, such as the "National Vocational Education Reform Implementation Plan" and the "Guidelines for the Training of Primary Education Majors in Vocational Colleges", are collected to clarify the policy orientation and requirements for the training of Primary Education majors in vocational colleges.

Literature Screening Criteria: Clearly defined screening criteria include: (1) Time frame: Publications from 2015 to 2025 (the past 10 years), ensuring the timeliness of the literature; (2) Research content: Literature closely related to the learning status of Primary Education majors in vocational colleges, intelligent learning models, and vocational ability cultivation; (3) Research quality: Core journals, CSSCI journals (Chinese Social Sciences Citation Index), and SCI/SSCI journals (for international literature) are given priority to ensure the academic quality of the literature.

Literature Analysis Results: Through systematic literature review and thematic analysis, this study identifies common issues in the learning process of students in higher vocational Primary Education programs, such as the disconnection between theory and practice, unreasonable curriculum design, insufficient practical opportunities, single learning methods, and a lack of diversified assessment methods. These findings provide a clear direction and theoretical basis for the subsequent questionnaire design and model construction.

2. Questionnaire Survey

Questionnaire Design Tool: The questionnaire was designed and edited using the WJX online platform. The platform offers advantages such as ease of operation, diverse question types, and automatic data summarization, effectively improving the efficiency and quality of questionnaire design. Question types include single-choice questions, multiple-choice questions, Likert scale questions, and open-ended questions, ensuring the diversity and depth of data.

Questionnaire Distribution Tool: The distribution and collection of the questionnaire were also completed through the WJX platform. Researchers sent the generated questionnaire link to student class WeChat or QQ groups to ensure coverage of the target sample group. Students could anonymously fill out the questionnaire via mobile phone or computer, with a completion time controlled within 10–15 minutes to improve filling efficiency and data quality.

Additionally, the platform supports automatic recording of filling time, IP address, device type, and other information, facilitating subsequent data screening and quality control. The questionnaire distribution period was 7 days, with 2 reminders sent during this period to increase the response rate.

3. Expert IOC Evaluation Tool

Expert Selection Criteria: A total of five experts were invited to evaluate the content validity of the questionnaire. All experts met two inclusion criteria: first, holding a master's or doctoral degree in Primary Education, Vocational Education, Educational Technology or related fields; second, having more than five years of working experience in higher vocational colleges or universities in primary education teaching, curriculum design, educational evaluation or intelligent learning research, with solid theoretical foundation and practical experience in vocational competency training and educational assessment. The background information of the experts is presented in Appendix C2 to enhance evaluation credibility.

Evaluation Process: All experts conducted the evaluation independently to ensure objectivity and impartiality. The researcher delivered the draft questionnaire, research objectives and unified scoring guidelines to each expert. Experts rated the relevance of each questionnaire item to the research objective according to a three-point scale: +1 = relevant, 0 = uncertain, -1 = irrelevant. Revision suggestions for inappropriate items were also collected.

Calculation and Criterion of IOC: This study adopted the Item Objective Congruence (IOC) index to examine content validity (Rovinelli & Hambleton, 1977). The standard IOC formula is as follows:

$$\mathrm{IOC} = \frac{\sum \text{Expert Scores}}{\text{Number of Experts}}$$

∑Expert Scores: total sum of expert scores for a single item.

Number of Experts: The number of experts participating in the evaluation.

In this study, a questionnaire item was retained in the final version only if its IOC value reached or exceeded 0.5. If the IOC value fell below 0.5, the item was deemed insufficient in content relevance and required modification or deletion. Through this rigorous evaluation process, the questionnaire's content validity was ensured, enabling it to accurately and effectively capture the information necessary for the research objectives.

Data Collection

1. Literature Data Collection

In terms of literature data collection, this study adopts the Systematic Literature Review (SLR) method to ensure the comprehensiveness, scientificity, and rigor of the literature. The specific steps are as follows:

Establish Search Strategy and Screening Criteria: First, determine the core keywords (e.g., "Primary Education major in vocational colleges", "learning status", "intelligent learning model", "vocational competency") and their synonyms, and formulate search strategies for different databases. At the same time, clearly define the screening criteria, including database selection, time frame, research subjects, and methodologies, to guarantee the representativeness and authority of the collected literature.

Literature Management and Organization: Create a literature management database using NoteExpress (a professional literature management software) to categorize, organize, and annotate the collected literature. The literature is classified into themes such as "learning status of Primary Education majors", "vocational competency cultivation", "intelligent learning technology application", and "vocational education reform", facilitating subsequent retrieval and analysis. Each literature is annotated with key information such as research methods, research subjects, data sources, and main findings.

Literature Extraction and Analysis: Extract key information from the collected literature, including research conclusions, research gaps, and research methods, and conduct thematic analysis to summarize the existing research achievements and deficiencies. Finally, compile a literature review report to systematically sort out the research status of the field, providing a solid theoretical foundation and clear research direction for this study.

2. Questionnaire Data Collection

Questionnaire data was collected via the WJX online platform, and strict quality control measures were implemented throughout the collection process to ensure the quality of the data. The specific steps are as follows:

Invalid Questionnaire Exclusion: After the questionnaire collection, first exclude invalid responses based on the following criteria: (1) Excessively short completion time (less than 3 minutes, considering that the questionnaire takes 10–15 minutes to complete); (2) Obvious logical inconsistencies (e.g., selecting "strongly agree" and "strongly disagree" for conflicting items); (3) Duplicate IP addresses (to avoid duplicate filling); (4) Incomplete answers (more than 10% of items are unanswered).

Data Cleaning and Preprocessing: Employ SPSS 26.0 statistical software for data cleaning and preprocessing, including: (1) Missing value handling: For items with a small number of missing values (less than 5%), the mean substitution method is used to fill in; for items with a large number of missing values (more than 5%), the corresponding samples are excluded; (2) Outlier detection and correction: Use Z-score method to detect outliers (Z-score > 3 or Z-score < -3), and verify whether the outliers are valid data; if they are invalid, correct or exclude them. Through these measures, the integrity, consistency, and reliability of the data are ensured, laying a robust foundation for subsequent statistical analysis.

Data Analysis

Through a questionnaire survey of 309 students from X Vocational College, this study conducted a detailed descriptive statistical analysis of the collected data, mainly using three types of analysis: frequency, percentage, and average. The details are as follows:

1. Frequency and Percentage Analysis: Calculate the frequency and percentage of each option to intuitively describe the distribution characteristics of students' responses to each question. The calculation formula is:

$$\text{Percentage} = \left(\frac{f}{n}\right) \times 100\%$$

f represents the frequency of a specific response (i.e., the number of people who choose this option);

n represents the total number of respondents

2. Average Analysis: For ordinal categorical questions (such as Likert scale items), first assign numerical values to the options, and then calculate the average using a formula to reflect the central tendency of students' responses. The calculation formula is:

$$\text{Average} = \frac{\sum(v_i \times f_i)}{n}$$

v_i represents the numerical value assigned to the i-th response option

f_i represents the frequency of the i-th response option;

n represents the total number of respondents

The above formulas and methods can meet the basic needs of questionnaire data analysis, help summarize the current situation, identify potential problems, and provide data support for proposing targeted improvement suggestions in the follow-up.

3. KMO Test and Bartlett's Spherical Test: This study adopted SPSS 26.0 statistical software for quantitative analysis of the questionnaire data. The data analysis methods included quantitative analysis and content analysis, and the statistical results were presented in the form of percentages. To test the construct validity of the questionnaire and determine whether the sample data is suitable for factor analysis, this study used the KMO (Kaiser-Meyer-Olkin) test and Bartlett's Spherical Test to conduct applicability analysis of the questionnaire data. Specifically, the KMO test is used to evaluate the partial correlation between variables, whose value ranges from 0 to 1; the closer the KMO value is to 1, the stronger the partial correlation between variables, and the more suitable it is for factor analysis. The Bartlett's Spherical Test is used to test whether the correlation matrix between variables is an identity matrix, that is, to judge whether there is a significant correlation between variables.

$$KMO = \frac{\sum\sum_{i \neq j} r_{ij}^2}{\sum\sum_{i \neq j} r_{ij}^2 + \sum\sum_{i \neq j} \alpha_{ij}^2}$$

r_{ij} is the simple correlation coefficient between variable and variable

a_{ij} is the partial correlation coefficient between variable and variable after controlling the remaining variables.

$$Bartlett = (k-1)\ln(S^2) - \sum\left[\frac{\ln(S_i^2)}{n_i - 1}\right]$$

k represents the number of populations,

S^2 represents the combined variance of all samples (estimated variance of the population),

S_i^2 represents the sample variance of each population,

n_i represents the sample size of each population.

This phase completes the investigation on the learning status of Primary Education majors in vocational colleges through seven standardized steps, using literature review, questionnaire survey, and expert evaluation as research instruments. The collected and analyzed data clarifies the core problems and needs of students' learning, laying a solid foundation for the design and construction of the Intelligent Learning Model in Phase 2.

Phase 2: To design a Career Competency-Oriented Intelligent Learning Model for Primary Education Major in Vocational Colleges in Yunnan Province.

Research steps

The second research phase is broadly divided into 2 steps, as shown in the figure 3.2 below.

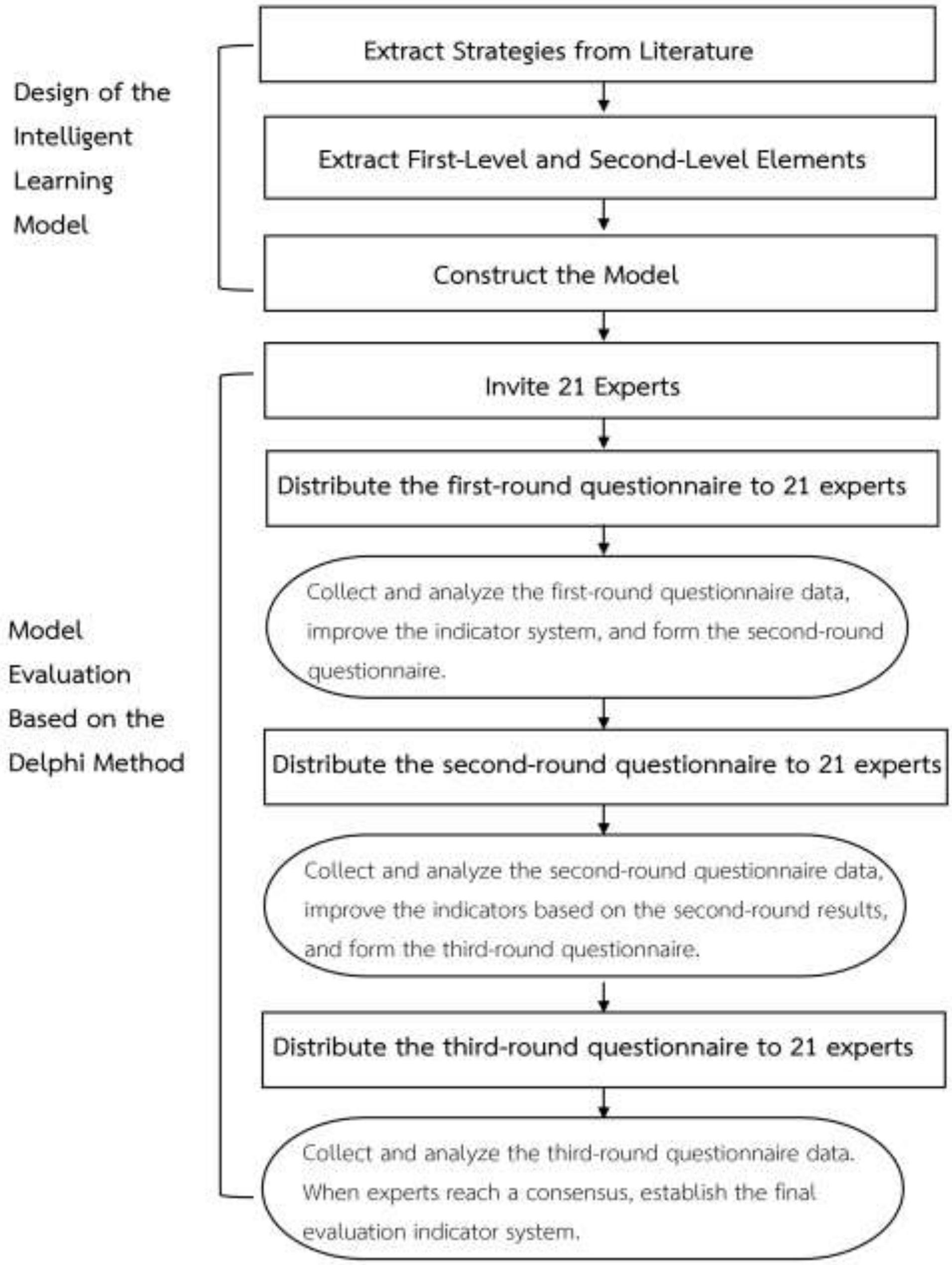

Figure 3.2 Framework diagram of Phase 2

1. Design of the Intelligent Learning Model

The design of the intelligent learning model for primary education majors in higher vocational colleges is rooted in the systematic empirical findings of Phase 1 of this study. Following a comprehensive systematic literature review, this research first identified some specific, context-specific issues in the intelligent learning practice of primary education majors in higher vocational colleges, which served as the core problem-oriented foundation for model construction.

Building on this, the study integrated the results of the pre-stage questionnaire design, expert validation, large-scale survey implementation, data collection, and data analysis, to extract the core dimensions, influencing factors, and optimization strategies of intelligent learning. Based on the empirical evidence, the intelligent learning model was constructed with primary element framework, each dimension corresponding to the key pain points and demand orientations identified in the survey, with secondary elements embedded to detail targeted solutions and operable implementation paths.

2. Model Evaluation Based on the Delphi Method

In this research phase, 21 eligible experts are invited to conduct three rounds of evaluation using the Delphi method to gradually optimize the model structure until expert opinions converge and the final model is determined.

Research Instruments

Delphi Expert Review: 21 experts are invited through the Delphi method to review the designed intelligent learning model, collecting expert feedback and opinions to ensure the scientific and practical nature of the model.

The rationale for selecting 21 experts to conduct the Delphi method review is as follows: Among high-quality Delphi studies (including those indexed in SCI/SSCI) published between 2020 and 2025, over 80% of the actual expert samples fall within the range of 15 to 30 participants. When the number of experts exceeds 15, the statistical indicators of the distribution of experts’ opinions begin to stabilize, and further increasing the number of experts yields limited improvement in the results.

Table 3.1 Distribution Chart of the Qualifications of 21 Delphi Method Experts

NO	Qualification of Expert	Number of Experts
1	Possess a master's degree in relevant majors such as Primary Education, Vocational Education, or Educational Technology; have more than 5 years of work experience in primary education teaching, curriculum design, or educational evaluation at higher vocational colleges or institutions of higher education; and be familiar with the theories and practices in fields such as intelligent learning, vocational competence development, and educational assessment.	14
2	Possess a doctoral degree in relevant majors such as Primary Education, Vocational Education, or Educational Technology; have more than 5 years of work experience in primary education teaching, curriculum design, or educational evaluation at higher vocational colleges or institutions of higher education; and be familiar with the theories and practices in fields such as intelligent learning, vocational competence development, and educational assessment.	7

1. Expert Selection

In this research phase, 21 experts are invited to participate in the review, who must meet the following two conditions: (1) Professional background requirements: Possess a master's or doctoral degree in related fields such as primary education, vocational education, educational technology; (2) Industry experience requirements: Engaged in primary education teaching, curriculum design, or educational evaluation in vocational colleges or higher education institutions for more than five years, familiar with the theory and practice of intelligent learning, vocational ability cultivation, and educational assessment.

2. Delphi Method Expert Questionnaire

The Delphi expert questionnaire is designed to evaluate the rationality, importance, and operability of the primary and secondary elements of the ILM. The specific design is as follows:

Questionnaire Content: The questionnaire includes the primary and secondary elements of the intelligent learning model, with each element listed clearly and accompanied by a brief explanation of its connotation and implementation ideas.

Scoring Standard: A 5-point Likert scale is used for scoring, with the criteria: 1 = Very unimportant (or very unreasonable/very unoperable), 2 = Unimportant (or unreasonable/unoperable), 3 = Neutral, 4 = Important (or reasonable/operable), 5 = Very important (or very reasonable/very operable). Experts score each element based on its importance, rationality, and operability, and provide specific modification suggestions in the open-ended part of the questionnaire.

Questionnaire Quality Control: The questionnaire is clearly and specifically worded to avoid ambiguity or ambiguity; unified scoring standards and detailed filling instructions are attached to ensure that experts have a consistent understanding of the evaluation requirements, facilitating subsequent statistical analysis.

3. Expert Evaluation Process

Step one, the first round of consultation is conducted, explaining the research background, content, and purpose to the experts, and sending the electronic version of the evaluation questionnaire with scoring criteria. In this study, questionnaires were distributed to 21 experts, involving a 5-point evaluation of primary and secondary indicators, and soliciting modifications from experts.

Step two, the first round of questionnaires is collected, and the data is summarized and analyzed. Based on the analysis results and expert modifications, the initial evaluation indicator system is refined, and a second questionnaire is formed and distributed to experts for the second round of review.

Step three, the second round of questionnaires is collected, and the data is again summarized and analyzed. The expert opinions converge and are considered reliable, thereby establishing the final evaluation indicator system.

Data Collection

The data collection in this phase focuses primarily on expert review data from the Delphi method, with the aim of obtaining experts' evaluations and revision suggestions for the model and providing a basis for model optimization. The specific steps and quality control measures are as follows:

Data Collection: After Each Round of Consultation: Following each round of Delphi expert evaluation, we collect experts' scores for each primary and secondary element of the model, recording each expert's specific ratings on the model's structure, content, implementation pathways, and operability. Simultaneously, we collect the open-ended opinions, revision suggestions, and additional content submitted by experts in the questionnaire, and organize them item by item.

Data Sorting and Extraction: We classify the collected expert revision suggestions according to the model's primary elements, extract key revision points and consensus opinions, and exclude individual extreme suggestions that are inconsistent with the research objectives and practical conditions.

Data Organization and Storage: We use Excel and SPSS 26.0 statistical software to organize, code, and store the collected expert score data and suggestion data. Each round of data is numbered and backed up to ensure the completeness, accuracy, and traceability of the data, which facilitates subsequent statistical analysis and model revision.

Data Analysis

Data analysis using the Delphi method: In this study, the coefficient of variation (CV) and the consistency coefficient (W) are calculated to determine whether there is significant disagreement among experts regarding the evaluation of each indicator, thereby assessing the reliability of the scoring results from this round of experts.

(1) The coefficient of variation (Coefficient of Variation, abbreviated as CV) is used to measure the dispersion of the experts' scores. The calculation formula is:

$$CV = \frac{\sigma}{\mu}$$

σ represents the standard deviation of the data, indicating the average deviation of data points from the mean.

μ denotes the mean of the data, representing the average value of all data points.

The coefficient of variation is typically expressed as a percentage and is used to assess the relative variability of data points relative to the mean value. In this study, when screening indicators, those with a mean value exceeding 3 and a coefficient of variation less than 0.25 are retained, while other indicators are excluded. This criterion is applied to the statistical analysis of each round of the survey. If the experts' opinions are still not unanimous after the first round of the questionnaire survey, the data will be optimized, and the second and third rounds of questionnaires will be formed until the experts' opinions are unified and the final evaluation indicators are determined.

(2) This study calculated Kendall’s coefficient of concordance (Kendall’s W) using statistical software to measure the degree of expert agreement. The W value ranges between 0 and 1, where a higher value indicates stronger consensus among experts. If the corresponding p-value < 0.05, the ratings were considered statistically consistent. The formula for W is as follows:

$$W = \frac{12S}{m^2(N^3 - N)}$$

S is the sum of squared deviations of the rank sums.

m is the number of experts.

N is the number of items being ranked.

Phase 3: To conduct a comprehensive development and evaluation of the Intelligent Learning Model

Research steps

The third research phase is broadly divided into 7 steps, as shown in the figure below.

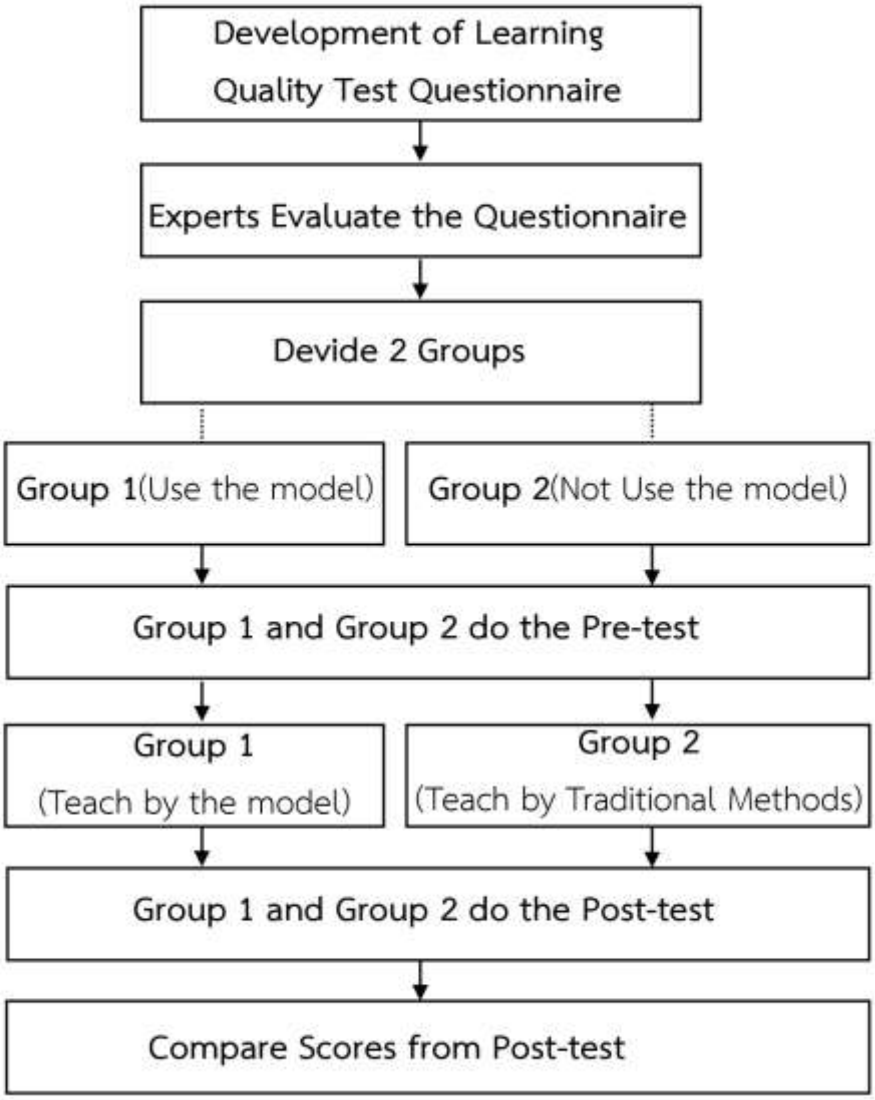

Figure 3.3 Framework diagram of phase 3

1. Development of Learning Quality Test Questionnaire

Centering on the core vocational competencies of the primary education major in higher vocational colleges and the training objectives of the intelligent learning model (e.g., personalized learning effects, improvement of practical skills), and combining with the curriculum design of X Vocational College, questionnaire items are formulated, with Likert 5-point scale items as the main type.

2. Experts Evaluate the Questionnaire

Invite five qualified experts to evaluate the items of the learning quality test questionnaire using the Item-Objective Congruence (IOC) method, so as to ensure the content validity, scientificity, and effectiveness of the questionnaire. Items with an IOC value of ≥ 0.5 are retained; items with an IOC value of < 0.5 are revised or deleted based on the experts' suggestions, and the official version of the learning quality test questionnaire is finalized.

3. Divide 2 Groups (Sample Grouping)

From 404 sophomore students majoring in Primary Education at X Vocational College, 40 students are selected by simple random sampling and divided into an experimental group (20 students) and a control group (20 students). To reduce grouping bias and ensure the comparability of the two groups, the following measures are taken: (1) The two groups are matched in terms of gender, academic performance (average score of the previous semester), and learning foundation (pre-test results); (2) An independent samples t-test is conducted on the pre-test scores of the two groups to ensure that there is no significant difference ($p > 0.05$) in the initial learning quality and career competencies between the two groups.

4. Group 1 and Group 2 do the Pre-test

One week before the start of the experiment, both groups take a centralized pre-test on learning quality in a fixed classroom, filling out the official questionnaire uniformly. The filling time (10 minutes) and environment are controlled. After collecting the questionnaires, invalid ones are eliminated. An independent samples t-test is used to verify the scores of the two groups ($p > 0.05$), so as to confirm that the initial level of the two groups is homogeneous.

5. Experimental Intervention

Based on the final version of the intelligent learning model established through three rounds of Delphi expert consultation and statistical validation, a quasi-experimental teaching intervention was designed and implemented in this study. During the intervention period, the experimental group received teaching and learning activities supported by the optimized intelligent learning model. Guided by the model, the experimental group was provided with intelligent learning environments, personalized learning paths, interactive learning activities, and data-driven evaluation mechanisms supported by modern information technologies such as smart education platforms, big data analysis, and generative artificial intelligence (GAI). In contrast, the control group maintained the conventional teaching arrangement and adopted the traditional learning model, which mainly relied on classroom lectures, paper-based materials, conventional homework assignments, and summative assessment without systematic intelligent technology support. The teaching intervention lasted for a continuous period of 6 weeks, during which the teaching content, class hours, and teaching progress were kept consistent between the two groups to ensure the comparability of the experimental results.

6. Group 1 and Group 2 do the Post-test

Within 1 week after the end of the experiment, both groups take a synchronous post-test on learning quality under the same conditions, using the same questionnaire and process as the pre-test to ensure data comparability. After collecting the questionnaires, valid ones are screened out, coded and entered into the database.

7. Compare Scores from Post-test

Descriptive statistics (calculation of mean, standard deviation, maximum value, minimum value) are conducted on the pre-test and post-test data of the two groups to intuitively present the changes in students' learning quality. Inferential statistics (independent samples t-test, paired samples t-test) are used to compare the differences: (1) Paired samples t-test is used to compare the pre-test and post-test scores of the experimental group and the control group respectively, to verify whether the learning quality of each group has significantly improved; (2) Independent samples t-test is used to compare the post-test scores of the two groups, to verify whether the improvement effect of the experimental group is significantly better than that of the control group. If the post-test score of the experimental group is significantly higher than its pre-test score ($p < 0.05$) and the post-test score of the control group ($p < 0.05$), the effectiveness of the ILM is verified.

Population / Sample Group

The population: All second-year primary education majors, totaling 404 students.

The Sample Group: 40 students were selected as experimental samples from all second-year students majoring in Primary Education at X Vocational College. These 40 students consist of 20 students majoring in Primary Education who have applied the intelligent learning model (the experimental group) and 20 students majoring in Primary Education who have not applied the intelligent learning model (the control group).

Research Instruments

Expert Evaluation of learning Quality Test Questionnaire: To ensure the scientific validity, representativeness, and effectiveness of the questionnaire content, this study employs the Index of Content Validity (IOC) method for expert review of the questionnaire items. A total of five experts were invited to participate in the evaluation of the questionnaire content validity, who must meet the following two criteria: (1) Professional background requirements: Possess a master's or doctoral degree in related fields such as primary education, vocational education, educational technology; (2) Industry experience requirements: Engaged in primary education teaching, curriculum design, or educational evaluation in vocational colleges or higher education institutions for over five years, familiar with the theory and practice in the fields of intelligent learning, vocational ability cultivation, and educational assessment.

This study adopted the Item Objective Congruence (IOC) index to evaluate the content validity and the consistency between each questionnaire item and research objectives. The specific process is as follows. First, the draft questionnaire and detailed scoring guidelines were distributed to experts. Then experts rated each item independently according to its relevance to the research objectives.

Data Collection

The data collection in this phase primarily revolves around the learning quality test questionnaire, aiming to obtain information on the changes in students' learning quality before and after the experiment. The specific steps are as follows:

1. Data Collection: Learning quality test questionnaires were distributed respectively to 20 students majoring in Primary Education who had participated in the teaching experiment (the experimental group) and 20 students majoring in Primary Education who had not participated in the teaching experiment (the control group). The questionnaires were filled out uniformly on-site and collected immediately to ensure the authenticity and completeness of the data.

2. Questionnaire Collection and Sorting: After all questionnaires were collected, the researchers numbered, categorized, and conducted a preliminary inspection of the questionnaires. Invalid questionnaires (such as those with incomplete responses or obviously random answers) were excluded to ensure the quality of the data finally used for analysis.

3. Data Entry and Storage: Data from valid questionnaires were entered into statistical analysis software to establish a database. Meanwhile, data backups were made to ensure the security and traceability of the data.

Data Analysis

1. Descriptive Statistics: Descriptive statistical analysis is conducted on the pre-test and post-test data using statistical software to calculate various indicators such as the mean (Mean), standard deviation (Standard Deviation), maximum value, minimum value, etc., to intuitively present the overall level and distribution of students' learning quality. By comparing the descriptive statistical results before and after the test, a preliminary judgment can be made on whether there has been an improvement in learning quality.

2. Independent Samples t-test: To test whether there is a significant difference in the average learning quality scores between the experimental group and the control group after the implementation of the intelligent learning model, this study adopts the Independent Samples t-test for difference analysis. The formula of the Independent Samples t-test is as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1-1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2}\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}}$$

$\bar{X}_1$: Mean score of the experimental group (students who applied the intelligent learning model)

$\bar{X}_2$: Mean score of the control group (students who did not apply the intelligent learning model)

n_1 : Sample size of the experimental group (20 students)

n_2 : Sample size of the control group (20 students)

S_1^2 : Sample variance of the scores of the experimental group

S_2^2 : Sample variance of the scores of the control group

Upon completion of the statistical analysis, a systematic interpretation of the results will be conducted. Combined with the teaching practice scenarios of the Primary Education major and the theoretical framework in the field of intelligent learning, an in-depth exploration will be made into the mechanism of action and practical value of the intelligent learning model in the process of improving learning quality. Meanwhile, the potential limitations of this study will be objectively pointed out, and targeted improvement directions and future research suggestions will be proposed accordingly.

Chapter 4
Result of Study

This study adopted different research methods at various phases, and the corresponding data analysis approaches varied across each phase. The following presents a detailed explanation of the data analysis based on the three research phases.

Phase 1: Investigating the Learning Status of Primary Education Majors in Vocational Colleges in Yunnan Province.

In Phase 1, the analysis results were presented after the completion of two steps, which are specified as follows:

1. Analysis Results after the "Expert Evaluation Questionnaire" Step

A review panel consisting of 5 experts in the field of education was convened. The IOC (Item-Objective Congruence) method was employed to conduct a professional evaluation of the questionnaire content, ensuring the scientific rigor of the questionnaire in terms of content relevance, expression accuracy, and measurement validity. The evaluation results are detailed in Appendix D1. The results indicated that the IOC scores of all items in the questionnaire exceeded 0.5, demonstrating that the questionnaire possesses good validity.

2. Analysis Results after the "Questionnaire Data Analysis" Step

2.1 Basic Information

A simple random sampling was conducted among all primary education majors at Yunnan X Vocational College, with a total of 309 students selected as participants. A total of 309 questionnaires were distributed, and 300 valid questionnaires were retrieved, resulting in an effective recovery rate of 98.36%. The sample structure is consistent with the demographic characteristics of primary education majors in vocational colleges, and the data exhibits strong representativeness.

As shown in Table 4.1, the sample exhibits strong representativeness: in terms of gender, female students account for 52.75% and male students 47.25%, reflecting a relatively balanced gender distribution; regarding professional direction, Primary School Chinese and Primary School Mathematics majors account for 55.02% and 44.98% respectively, consistent with the professional setting characteristics of primary education programs in vocational colleges; for academic year, freshmen, sophomores, and juniors account for 33.01%, 33.98%, and 33.01% respectively, showing an evenly distributed grade structure. Overall, the sample structure aligns with the population characteristics of primary education majors in vocational colleges, ensuring the reliability of subsequent research conclusions.

Table 4.1 Sample basic information (N=309)

Category		Number of Students	Percentage
Gender	Male	146	47.25%
	Female	163	52.75%
Professional Direction	Primary School Chinese	170	55.02%
	Primary School Mathematics	139	44.98%
Academic Year	Freshman	102	33.01%
	Sophomore	105	33.98%
	Junior	102	33.01%

Validity Analysis of the Questionnaire

To ensure the scientific rigor and validity of the survey data, and to lay a foundation for subsequent statistical analyses (such as factor analysis and correlation analysis), this study conducted validity tests on the core items of the questionnaire (34 Likert scale items), focusing specifically on the KMO (Kaiser-Meyer-Olkin) Measure of Sampling Adequacy and Bartlett's Sphericity Test to examine whether the data is suitable for factor analysis and further statistical processing. The questionnaire used in this survey included 36 items designed with a Likert scale (excluding basic information and open-ended questions), and these items were distributed across 7 core dimensions: learning objectives, curriculum settings, learning content, learning resources, teaching implementation, learning methods, and learning evaluation. To determine whether these 36 items are suitable for factor analysis, this study adopted SPSS 26.0 statistical software for quantitative analysis of the questionnaire data, combined quantitative analysis and content analysis methods, presented the statistical results in the form of percentages, and implemented the KMO test and Bartlett's Sphericity Test.

Specifically, the KMO test is used to evaluate the partial correlation between variables, with a value range of 0 to 1. The closer the KMO value is to 1, the stronger the partial correlation between variables, and the more suitable it is for factor analysis; Bartlett's Sphericity Test is used to test whether the correlation matrix between variables is an identity matrix, that is, to judge whether there is a significant correlation between variables, providing reliable support for the subsequent conduct of factor analysis. The test results showed that the KMO Measure of Sampling Adequacy was 0.842. According to the established standards of KMO interpretation criteria, this value is higher than 0.8, indicating that there are a large number of common factors among the items, the sampling adequacy is sufficient, and thus the prerequisite for conducting factor analysis is met. In addition, the approximate chi-square value obtained from Bartlett's Sphericity Test was 2589.76, with 496 degrees of freedom (df) and a significance level (Sig.) of 0.000 ($p<0.001$). This result indicates that there is a significant correlation between the items of each scale, thereby rejecting the null hypothesis in Bartlett's Sphericity Test (the correlation matrix between variables is an identity matrix, i.e., the variables are independent of each other). Therefore, the data shows a good foundation of construct validity and is considered suitable for factor analysis and subsequent statistical analyses. Through principal component analysis combined with the maximum variance rotation method, a total of 7 common factors were extracted, which completely correspond to the 7 core dimensions preset in the questionnaire, with no additional factors or missing dimensions; the cumulative variance contribution rate of the 7 common factors was 66.89%, which is higher than the 60% standard, indicating that the extracted common factors can effectively explain most of the data variation; the factor loadings of each item range from 0.538 to 0.862, all higher than the critical value of 0.5, and there is no excessive cross-loading (loading difference < 0.2), indicating good construct validity.

2.2 Existing problems

Through a systematic literature analysis, this study comprehensively sorted out the problems existing in the talent training of primary education programs in vocational colleges. Corresponding to these problems, a questionnaire survey was designed, and the specific results are presented as follows.

Table 4.2 Learning Objectives

Question No.	Question Content	Options	Number of Respondents	Percentage
1	Do you have any confusion about understanding the professional competencies of primary school teachers when studying courses related to the primary education major?	No Confusion at All	55	18.33%
		Little Confusion	20	6.67%
		Moderate Confusion	18	6.00%
		Much Confusion	95	31.67%
		Greatly Confused	112	37.33%
2	Do you have a sound career plan for primary school teachers and set clear learning goals based on professional competencies accordingly?	No Plan at All	101	33.67%
		Little Planning	54	18.00%
		Moderate Planning	60	20.00%

Table 4.2 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
		Considerable Planning	37	12.33%
		Comprehensive Planning	48	16.00%
3	Can you actively integrate the standards of relevant national teaching competetions and teacher qualification examinations into your learning goals during the learning process?	Never	50	16.67%
		Rarely	89	29.66%
		Occasionally	100	33.33%
		Frequently	45	15.00%
		Always	16	5.33%
4	Have you received professional career planning advice from teachers regarding your learning goals to fully prepare for employment?	No Advice at All	40	13.33%
		Little Advice	30	10.00%
		Moderate Advice	96	32.00%
		Considerable Advice	78	26.00%
		Extensive Advice	56	18.67%
5	Do you believe that the school's talent training objectives are clear and highly aligned with the core requirements of primary school teacher positions?	Strongly Disagree	51	17.00%
		Disagree	55	18.33%
		Neutral	67	22.33%
		Agree	50	16.67%
		Strongly Agree	77	25.67%

2.2.1 Problems with Learning Objectives

A total of 69.00% (31.67% + 37.33%) of students reported having "much" or "greatly" confused about understanding the professional competencies of primary school teachers. This indicates that current students lack clear guidance in recognizing the professional competencies required for primary school teachers, have not established a sound system of professional competencies necessary for the position, and face significant obstacles in understanding and grasping core professional competencies during their academic studies.

Approximately 51.67% (33.67% + 18.00%) of students stated that they have "no" or "little" sound career plans for primary school teachers and clear learning goals based on professional competencies. This reflects students' lack of planning for their future careers, the absence of clear career orientation in their learning goals, failure to effectively link personal learning processes with future career development, and a strong sense of blindness in their studies.

As many as 79.66% (16.67% + 29.66% + 33.33%) of students reported that they "never," "rarely," or "occasionally" actively integrate the standards of relevant national teaching competitions and teacher qualification examinations into their learning goals. This demonstrates a serious lack of connection between students' learning goals and industry standards as well as competition requirements, a deficiency in learning awareness oriented toward professional access standards and industry competition demands, and insufficient pertinence in their studies.

A total of 23.33% (13.33% + 10.00%) of students indicated that they have received "no" or "little" professional career planning advice from teachers. This highlights the insufficient supply of career planning guidance for students in current schools, the lack of targeted guidance from teachers on students' career development, and the failure to provide adequate professional support for students' employment preparation.

Around 35.33% (17.00% + 18.33%) of students stated that they "strongly disagree" or "disagree" that the school's talent training objectives are clear and highly aligned with the core requirements of primary school teacher positions. This reflects that the communication and implementation of the school's talent training objectives are not in place, the matching degree between training objectives and the actual needs of primary school teacher positions needs to be improved, and students have not fully perceived the relevance between professional learning and future positions.

Table 4.3 Curriculum Design

Question No.	Question Content	Options	Number of Respondents	Percentage
6	Do you think the scheduling and frequency of various courses you have studied are reasonable and in line with students' learning rhythms and examination needs?	Strongly Disagree	33	11.00%
		Disagree	85	28.33%
		Neutral	41	13.67%
		Agree	77	25.67%
		Strongly Agree	64	21.33%
7	Do you think the school has integrated the talent training program based on professional competencies into the curriculum system? Strongly Disagree	Strongly Disagree	41	13.67%
		Disagree	121	40.33%
		Neutral	104	34.67%
		Agree	20	6.67%
		Strongly Agree	14	4.67%
8	What do you think are the main problems of the current curriculum system? (Multiple choices allowed)	Excessively academic and theoretical	209	69.67%
		Outdated content with slow updates	176	58.67%

Table 4.3 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
		Difficulty in connecting with the actual needs of primary school teacher positions	159	53.00%
		Overlapping content among some courses	145	48.33%
		Others	45	15.00%
9	Do you think the curriculum design and teaching arrangement are in line with the cognitive characteristics of students majoring in primary education?	Strongly Disagree	30	10.00%
		Disagree	86	28.67%
		Neutral	115	38.33%
		Agree	40	13.33%
		Strongly Agree	29	9.67%
10	Do you think the proportion of theoretical courses and practical courses is balanced currently, and practical courses can meet the needs of cultivating professional skills for primary school teachers?	Strongly Disagree	30	10.00%
		Disagree	77	25.67%
		Neutral	123	41.00%
		Agree	40	13.33%
		Strongly Agree	30	10.00%

2.2.2 Problems with Curriculum Design

A total of 39.33% (11.00% + 28.33%) of students disagreed or strongly disagreed that the scheduling and frequency of courses are reasonable. This indicates that the current planning of course timing and frequency fails to fully align with students' learning rhythms and examination needs, lacking sufficient rationality and to a certain extent affecting students' learning experience and outcomes.

Approximately 54.00% (13.67% + 40.33%) of students disagreed or strongly disagreed that the school has integrated the professional competency-based talent training program into the curriculum system. This reflects a low degree of integration between the current curriculum system and professional competency cultivation objectives, as the talent training program has not been effectively implemented in specific curriculum design, resulting in insufficient career orientation of the curriculum system.

As many as 69.67% of students reported that the curriculum system is excessively academic and theoretical, 58.67% believed the content is outdated with slow updates, 53.00% pointed out difficulties in connecting with the actual needs of primary school teacher positions, and 48.33% noted overlapping content among some courses. These results demonstrate multiple structural flaws in the current curriculum system, with prominent issues such as the disconnection between theory and practice, outdated content, poor alignment with job requirements, and redundant course content, making it difficult to meet the actual needs of primary school teacher positions.

A total of 38.67% (10.00% + 28.67%) of students disagreed or strongly disagreed that the curriculum design and teaching arrangement are in line with the cognitive characteristics of primary education majors. This indicates that the current curriculum design fails to fully consider the cognitive rules and learning characteristics of students in this major, and the teaching arrangement lacks sufficient pertinence, which affects students' acceptance of course content.

Up to 76.67% (10.00% + 25.67% + 41.00%) of students reported that they strongly disagreed, disagreed, or remained neutral regarding the balance between theoretical and practical courses and whether practical courses can meet the needs of professional skill cultivation. This reflects an insufficient proportion of practical courses, as the pertinence and effectiveness of practical teaching have not fully met students' needs for professional skill improvement, and the imbalance between theoretical and practical teaching is relatively prominent.

Table 4.4 Learning Contents

Question No.	Question Content	Options	Number of Respondents	Percentage
11	What are the main problems you encounter when studying public basic courses in class? (Multiple choices allowed)	Tedious course content with low practicality	207	69.00%
		Insufficient connection between courses and the cultivation of core professional competencies	164	54.67%
		Unreasonable allocation of learning time, affecting professional studies	118	39.33%

Table 4.4 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
		Single teaching method with lack of interaction	103	34.33%
		Others	37	12.33%
12	Do you think the content of professional core courses (e.g., Educational Psychology, Primary School Pedagogy, Subject Teaching Methodology, etc.) offered by the school can meet the requirements of the unified teacher qualification examination and the professional competencies of primary school teachers?	Fully Satisfactory	30	10.00%
		Mostly Satisfactory	67	22.33%
		Moderately Satisfactory	112	37.33%
		Mostly Unsatisfactory	76	25.33%
		Fully Unsatisfactory	15	5.00%
13	What are the main difficulties you encounter when studying professional core courses at school? (Multiple choices allowed)	Abstract theoretical knowledge that is difficult to understand	184	61.33%

Table 4.4 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
		Disconnection between course content and the actual teaching practice of primary school teachers	128	42.67%
		Lack of supporting practical cases	106	35.33%
		Poor connection of knowledge points among different courses	94	31.33%
		Others	17	5.67%
14	Do you think the arrangement of current practical teaching courses (e.g., graduation internship, teaching observation, skill	Fully Capable	103	34.33%
		Mostly Capable	87	29.00%
		Moderately Capable	50	16.67%

Table 4.4 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
	training, etc.) can effectively improve students' professional literacy?	Mostly Incapable	40	13.33%
		Fully Incapable	20	6.67%
15	What are the main problems you encounter when participating in practical teaching courses? (Multiple choices allowed)	Insufficient practical opportunities and inadequate duration	212	70.67%
		Disconnection between training content and real teaching scenarios	67	22.33%
		Insufficient targeted guidance from instructors	106	35.33%
		Lack of effective training feedback and reflection	156	52.00%
		Others	20	6.67%

2.2.3 Problems with Learning Content

As many as 69.00% of the students reported that the content of public basic courses is tedious and lacks practicality, while 54.67% argued that these courses are inadequately connected to the cultivation of core professional competencies. This indicates that current public basic courses suffer from insufficient practicality and disconnection from professional training objectives. They fail to effectively facilitate the improvement of students' professional competencies, and the value of the courses has not been fully realized.

A total of 67.66% (25.33% + 5.00% + 37.33%) of the students stated that the content of professional core courses is mostly unsatisfactory, fully unsatisfactory, or only moderately satisfactory in meeting the requirements of the unified teacher qualification examination and professional competency needs. This reflects a low level of alignment between the content of current professional core courses and both the demands of the teacher qualification examination and the actual professional requirements of primary school teachers. The courses lack sufficient pertinence and thus struggle to support students' professional access and career development.

Among the respondents, 61.33% believed that the theoretical knowledge in professional core courses is abstract and difficult to understand, 42.67% pointed out a disconnection between course content and the realities of primary school teaching, and 35.33% mentioned a lack of supporting practical cases. These findings demonstrate that current professional core courses have a weak integration of theory and practice, with excessively abstract teaching content and a shortage of real-world application scenarios and case support, which creates great difficulties for students in understanding and applying what they have learned.

Approximately 36.67% (13.33% + 6.67% + 16.67%) of the students indicated that practical teaching courses are mostly incapable, fully incapable, or only moderately capable of effectively improving their professional literacy. This reveals that the design and implementation of current practical teaching courses are ineffective; they have limited effects on enhancing students' professional literacy and fail to fully achieve the educational goals of practical teaching.

Up to 70.67% of the students reported insufficient practical opportunities and inadequate duration in practical teaching courses, and 52.00% mentioned a lack of effective training feedback and reflection mechanisms. This illustrates that current practical teaching faces dual problems of insufficient resource supply and missing feedback mechanisms, which make it difficult to support the continuous refinement and improvement of students' professional skills.

Table 4.5 Learning Resources

Question No.	Question Content	Options	Number of Respondents	Percentage
16	Do you think teachers often use modern information technology to assist teaching so as to improve students' learning efficiency?	No Use at All	29	9.67%
		Rarely Use	75	25.00%
		Occasionally Use	81	27.00%
		Frequently Use	61	20.33%
		Always Use	54	18.00%
17	Do you think teachers can appropriately and fully utilize on-campus, off-campus, online and offline teaching resources to stimulate students' interest and motivation?	Fully Capable	39	13.00%
		Mostly Capable	65	21.67%
		Moderately Capable	89	29.67%
		Mostly Incapable	66	22.00%
		Fully Incapable	41	13.67%

Table 4.5 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
18	Can you actively search for various online and offline course resources related to primary education to study and improve your professional competencies?	Fully Capable	30	10.00%
		Mostly Capable	40	13.33%
		Moderately Capable	29	9.67%
		Mostly Incapable	125	41.67%
		Fully Incapable	76	25.55%
19	What is your level of understanding of digital resources such as the National Smart Education Platform for Primary and Secondary Schools, MOOCs and AI-assisted learning?	Very Familiar	15	5.00%
		Mostly Familiar	108	36.00%
		Moderately Familiar	55	18.33%
		Mostly Unfamiliar	90	30.00%
		Completely Unfamiliar	32	10.67%
20	What are the main difficulties you encounter when using digital resource libraries? (Multiple choices allowed)	Inconvenient resource search and difficult screening	163	54.33%
		Uneven quality of resources	151	50.33%

Table 4.5 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
		Lack of teacher guidance and inability to fully utilize resources	157	52.33%
		Network or equipment limitations preventing smooth usage	50	16.67%
		Others ________	4	1.33%

2.2.4 Problems with Learning Resources

A total of 34.67% (9.67% + 25.00%) of students reported that teachers never or rarely use modern information technology to support teaching. This indicates that teachers are currently insufficient in integrating modern information technology into teaching, failing to give full play to technology's role in enhancing learning efficiency, and the modernization level of teaching methods needs to be improved.

Approximately 35.67% (22.00% + 13.67%) of students believed that teachers are mostly incapable or fully incapable of properly and fully utilizing various teaching resources. This reflects the low efficiency of integration and utilization of current teaching resources; teachers have not effectively coordinated on-campus, off-campus, online, and offline resources, making it difficult to fully stimulate students' learning interest and motivation.

As many as 67.22% (41.67% + 25.55%) of students stated that they are mostly incapable or fully incapable of actively searching for various professional course resources to improve their professional competencies. This demonstrates that students currently have weak awareness of autonomous learning, lack the initiative and enthusiasm to use diverse resources for self-improvement, and their autonomous learning ability needs to be cultivated.

A total of 40.67% (30.00% + 10.67%) of students were mostly unfamiliar or completely unfamiliar with digital resources. This indicates that the popularization and promotion of current digital learning resources are inadequate; students have a low level of awareness of high-quality digital resources such as the National Smart Education Platform for Primary and Secondary Schools and MOOCs, and the accessibility of resources has not been effectively converted into usage effectiveness.

Among the respondents, 54.33% reported difficulties in searching and screening digital resources, 50.33% noted the uneven quality of resources, and 52.33% mentioned a lack of teacher guidance. These results illustrate that current digital resource libraries have problems such as irregular management and insufficient quality control. Meanwhile, the absence of teacher support in guiding resource usage has seriously affected students' effective utilization of digital resources.

Table 4.6 Teaching Implementation

Question No.	Question Content	Options	Number of Respondents	Percentage
21	Do you think teachers adopt diversified teaching methods and often use innovative approaches such as inquiry-based, situational, and project-based learning to stimulate students' learning interest?	Every Time	50	16.67%
		Most of the Time	62	20.67%
		Occasionally	97	32.33%
		Seldom	56	18.67%
		Never	35	11.67%
22	Do you think teachers' instructional design is student-centered, with a focus on students' learning outcomes and the enhancement of their professional competencies?	Strongly Disagree	32	10.67%
		Disagree	85	28.33%
		Neutral	61	20.33%
		Agree	76	25.33%
		Strongly Agree	46	15.33%
23	What are the main problems with interactive practical sessions in class? (Multiple choices allowed)	Single and unattractive interactive forms	163	54.33%
		Unreasonable division of labor in group collaboration leading to low efficiency	156	52.00%

Table 4.6 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
		Inadequate and delayed use of student learning data by teachers in adjusting teaching pace	189	63.00%
		Insufficient hands-on practice time for adequate skill training	201	67.00%
		Others ________	20	6.67%
24	What are the main problems in current classroom learning? (Multiple choices allowed)	Inadequate connection between theoretical explanation and practical training	198	66.00%
		Superficial implementation of scenario simulation and skill demonstration	157	52.33%

Table 4.6 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
		Excessive teacher-centered instruction and insufficient active student participation	176	58.66%
		Lack of smart teaching tools, which affects learning outcomes	187	62.33%
		Others	12	4.00%
		________		
25	What are the main problems you encounter in post-class consolidation and self-improvement? (Multiple choices allowed)	Unreasonable homework difficulty (either too hard or too easy)	171	57.00%
		Lack of peer evaluation and targeted teacher feedback	182	60.67%
		Inconvenient access to digital extended learning resources	165	55.00%

Table 4.6 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
		Inability to effectively identify personal weaknesses through learning reflection	200	66.67%
		Others	14	4.67%
		________		

2.2.5 Problems with Teaching Implementation

A total of 62.67% (18.67% + 11.67% + 32.33%) of students reported that teachers seldom, never, or occasionally adopt diversified and innovative teaching methods. This indicates that current teaching methods remain relatively traditional, with insufficient application of innovative instructional approaches such as inquiry-based, situational, and project-based learning, making it difficult to effectively stimulate students' learning interest and initiative.

Approximately 39.00% (10.67% + 28.33%) of students strongly disagreed or disagreed that teachers' instructional design is student-centered and focuses on learning outcomes and the enhancement of professional competencies. This reflects a teacher-centered tendency in current instructional design, which neglects students' learning needs and professional competency development goals, resulting in insufficient pertinence and effectiveness of teaching.

Among the respondents, 67.00% argued that interactive practical sessions in class lack sufficient hands-on practice time, 63.00% pointed out that teachers fail to utilize student learning data in a timely manner, and 54.33% noted the monotony of interactive forms. These findings demonstrate that current in-class interactive practical sessions suffer from multiple drawbacks, including unreasonable design, delayed feedback, and monotonous forms. Such issues hinder the guarantee of students' hands-on practice outcomes and learning experience, and the value of interactive teaching has not been fully realized.

As many as 66.00% of students stated that there is an inadequate connection between theoretical explanation and practical training in classroom learning, 62.33% mentioned the insufficient use of smart teaching tools, and 58.66% indicated excessive teacher dominance. This reveals core problems in current classroom teaching, such as the disconnection between theory and practice, insufficient application of educational technology, and the absence of student subjectivity, which seriously impede the improvement of learning outcomes.

Up to 66.67% of students reported that they are unable to effectively identify their own weaknesses through learning reflection after class, and 60.67% argued that there is a lack of peer evaluation and targeted teacher feedback. This illustrates that the post-class consolidation and improvement stage lacks effective feedback and reflection mechanisms, along with insufficient guidance and support from teachers and peers. As a result, it is difficult to help students timely detect and address their learning deficiencies, which restricts the sustainable improvement of their academic performance.

Table 4.7 Learning Approaches

Question No.	Question Content	Options	Number of Respondents	Percentage
26	Can you independently plan personalized learning (e.g., using digital course resources, AI-assisted tools, and online information retrieval) based on your own professional competency deficiencies?	Fully Capable	37	12.33%
		Mostly Capable	45	15.00%
		Moderately Capable	64	21.33%
		Mostly Incapable	131	43.67%
		Fully Incapable	23	7.67%
27	What are the main problems you encounter during independent learning? (Multiple choices allowed)	Lack of self-awareness and unclear identification of personal deficiencies	177	59.00%
		Difficulties in selecting digital learning resources	184	61.33%
		Insufficient ability and perseverance for independent learning planning	232	77.33%

Table 4.7 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
		Inability to use AI-assisted tools or poor effectiveness of such tools	145	48.33%
		Others	14	4.67%
28	When encountering problems you do not understand during independent learning, can you take the initiative to seek help from teachers or classmates?	Fully Capable	52	17.33%
		Mostly Capable	60	20.00%
		Moderately Capable	64	21.33%
		Mostly Incapable	105	35.00%
		Fully Incapable	19	6.33%
29	Do you think teachers can evaluate your learning outcomes and provide corresponding learning suggestions both in class and after class?	Fully Capable	47	15.67%
		Mostly Capable	72	24.00%
		Moderately Capable	103	34.33%
		Mostly Incapable	75	25.00%
		Fully Incapable	3	1.00%
30	What is your acceptance level of the "Smart Classroom + Practical Training" teaching model?	Very Acceptable	65	21.67%
		Mostly Acceptable	109	36.33%
		Neutral	80	26.67%
		Mostly Unacceptable	30	10.00%

Table 4.7 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
		Very Unacceptable	16	5.33%

2.2.6 Problems with Learning Approaches

A total of 51.34% (43.67% + 7.67%) of students reported that they are mostly incapable or fully incapable of independently planning personalized learning based on their own professional competency deficiencies. This indicates that current students have weak personalized learning planning abilities, lack the awareness and scientific methods for self-improvement targeting their own shortcomings, and show insufficient autonomy and pertinence in learning.

As many as 77.33% of students stated that they lack planning capabilities and perseverance during independent learning, 61.33% mentioned difficulties in selecting digital resources, and 59.00% pointed out a lack of self-awareness. These findings demonstrate that current students have multiple deficiencies in independent learning abilities, with prominent problems such as vague self-awareness, insufficient planning skills, and difficulties in resource screening, which seriously affect the effectiveness and sustainability of independent learning.

Approximately 41.33% (35.00% + 6.33%) of students reported that they are mostly incapable or fully incapable of taking the initiative to seek help when encountering problems in independent learning. This reflects that students currently have weak awareness of active help-seeking, and there is a lack of effective learning mutual-aid mechanisms. Difficulties encountered during independent learning cannot be solved in a timely manner, leading to the prevalence of learning obstacles.

A total of 60.33% (25.00% + 1.00% + 34.33%) of students indicated that teachers are mostly incapable, fully incapable, or only moderately capable of evaluating learning outcomes and providing learning suggestions. This reveals insufficient supply of learning evaluation and guidance from teachers, who have failed to provide students with timely and effective learning feedback and targeted suggestions, making it difficult to guide students toward targeted improvement.

Up to 42.00% (10.00% + 5.33% + 26.67%) of students reported that they mostly disapprove, strongly disapprove, or hold a neutral attitude toward the "Smart Classroom + Practical Training" model. This illustrates that the promotion and implementation effect of this teaching model needs to be improved. There may be problems such as mismatches between model design and student needs, and inefficient implementation processes, which prevent the model from gaining full recognition from students.

Table 4.8 Learning Evaluation

Question No.	Question Content	Options	Number of Respondents	Percentage
31	Do you think teachers can currently evaluate students' learning outcomes by assessing both the mastery of professional knowledge and the achievement of professional competencies?	Every Time	25	8.33%
		Most of the Time	51	17.00%
		Occasionally	56	18.67%
		Seldom	165	54.33%
		Never	5	1.67%
32	Do you think current course evaluation can focus not only on students' examination scores but also on learning processes (e.g.,	Every Time	25	8.33%
		Most of the Time	65	21.67%
		Occasionally	54	18.00%
		Seldom	101	33.67%
		Never	55	18.33%

Table 4.8 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
	classroom participation, practical performance, self-study frequency, etc.)?			
33	What do you think are the main problems with current learning evaluation? (Multiple choices allowed)	Single evaluation subject, limited to teachers only	76	25.33%
		Inconsistent evaluation criteria for learning outcomes	176	58.67%
		Evaluation results fail to fully reflect students' professional competencies	198	66.00%
		Cumbersome evaluation process	101	33.66%
		Others ________	34	11.33%
34	What do you think are the main problems with professional competency-based	Overly abstract criteria that are difficult to understand and	190	63.33%

Table 4.8 (Continued)

Question No.	Question Content	Options	Number of Respondents	Percentage
	evaluation criteria? (Multiple choices allowed)	apply for comparison		
		Incomplete evaluation indicators that do not cover core professional competencies	197	65.67%
		Evaluation results cannot effectively reflect learning outcomes	156	52.00%
		Insufficient guiding role of evaluation for subsequent learning	183	61.00%
		Others ________	13	4.33%

2.2.7 Problems with Learning Evaluation

A total of 56.00% (54.33% + 1.67%) of students reported that teachers seldom or never evaluate both the mastery of professional knowledge and the achievement of professional competencies simultaneously. This indicates that the current learning evaluation system is one-sided, overemphasizing the assessment of professional knowledge while lacking sufficient coverage of professional competency evaluation, thus failing to fully reflect students' comprehensive literacy.

Approximately 52.00% (33.67% + 18.33%) of students stated that course evaluation seldom or never attaches importance to the learning process, focusing merely on examination scores. This reflects that the current evaluation mechanism relies excessively on summative assessment, with a lack of formative assessment. It is difficult to comprehensively track and reflect students' learning processes and growth trajectories, resulting in insufficient scientificity of the evaluation.

As many as 66.00% of students argued that evaluation results cannot fully reflect professional competencies, and 58.67% pointed out inconsistent evaluation criteria. These findings demonstrate that the current learning evaluation is plagued by core problems of non-unified criteria and incomplete results. The insufficient scientificity and effectiveness of the evaluation make it impossible to provide targeted guidance for students' professional competency improvement.

Among the respondents, 65.67% believed that the indicators of professional competency-based evaluation are incomplete, 63.33% noted that the criteria are overly abstract, and 61.00% mentioned that the evaluation has a weak guiding role for subsequent learning. This illustrates that the current professional competency evaluation system has multiple flaws, such as imperfect indicators, unspecific criteria, and weak guidance. It cannot effectively guide students to improve their professional competencies in a targeted manner, and the educational value of the evaluation has not been fully realized.

Table 4.9 Open-ended Questions

Question No.	Question Content	Options	Number of Respondents	Percentage
35	Besides the aspects mentioned above, what other problems or confusions do you encounter during your studies in the Primary Education major at higher vocational colleges?	None	127	42.33%
36	In response to these problems, what specific improvement suggestions or expectations do you have?	None	69	23.00%

2.2.8 Problems with Open-ended Questions

only 42.33% of the students filled in other problems or confusions in Question 35, with more than half (57.67%) providing no additional content; in Question 36, merely 23% of the students put forward specific improvement suggestions or expectations, while over three-quarters (77%) did not supplement any information. These results indicate that the 7 structured dimensions in the questionnaire, including learning objectives, curriculum design, learning content, learning resources, teaching implementation, learning approaches, and learning evaluation, have basically covered the core confusions of students in their professional learning.

After collation, the filled-in responses to Question 35 can be roughly divided into two categories: first, insufficient courses to meet the needs of interdisciplinary teaching; second, personalized difficulties in practical sessions, such as "unbalanced allocation of internship schools, with some schools lacking specific internship plans and mechanisms" and "insufficient training equipment (e.g., simulated classrooms and teaching aids), making it difficult to carry out immersive teaching practice".

The filled-in responses to Question 36 can be roughly divided into two categories: first, suggestions for curriculum and practice optimization, such as "hope to add courses like 'Case Analysis of Real Primary School Classes' and invite teachers from off-campus practice bases to deliver lectures" and "suggest establishing a dual-mentor tutoring mechanism between colleges and internship units"; second, suggestions for resource and technical support, such as "hope the college compiles high-quality digital resources (e.g., MOOC course lists and AI teaching tool tutorials) and organizes special training sessions" and "suggest opening more on-campus simulated classrooms and allowing students to book them independently for practice".

Phase 2: To design a career competency-oriented intelligent learning model for primary education major in vocational colleges in Yunnan province

Combined with the research findings from the literature review and questionnaire survey, as well as the countermeasures and solutions proposed in existing literature, this study constructs a career competency-oriented intelligent learning model for primary education major in vocational colleges in Yunnan province. Through the collaborative design of six core dimensions, this intelligent learning model effectively addresses the key issues in talent cultivation for the Primary Education major in vocational colleges:

Learning Objective Dimension: Guided by career competency, it clarifies the positioning of training generalist teachers to meet the primary education needs in Yunnan and rural areas of Southwest China, solving the problems of students' vague career cognition and lack of career-oriented learning goals.

Learning Content Dimension: It integrates four types of courses, namely public basic courses, professional core courses, practical teaching courses, and quality development courses, and aligns them with the unified teacher qualification examination and core job requirements, resolving the issues of over-theorization, outdated content, and disconnection from practice in the curriculum.

Learning Resource Dimension: It integrates on-campus curriculum resources, off-campus collaborative resources, and digital resource libraries, addressing the problems of insufficient resource supply and inconvenient utilization.

Learning Process Dimension: It optimizes the three-stage design of pre-class, in-class, and post-class learning, forming a closed loop of learning situation diagnosis, real-time interaction, and personalized consolidation, and solving the problems of insufficient teaching pertinence and poor connection between teaching links.

Learning Approach Dimension: It constructs two learning modes—independent learning and classroom learning, settling the issues of insufficient classroom learning time, inadequate after-class learning duration, lack of teacher-student interaction, and insufficient peer collaborative learning.

Learning Evaluation Dimension: It adopts a multi-subject, career competency-oriented evaluation method, addressing the problems of a single evaluation subject and the absence of evaluation criteria based on career competency dimensions.

To enhance practical operability, the model designs specific teacher-student activities for three teaching phases respectively:

Pre-class Phase: Teachers release pre-assessment questions and preview resources through the intelligent platform, conduct learning situation analysis and adjust teaching plans, while students complete knowledge preview and independent learning.

In-class Phase: Teachers adopt the "Smart Classroom + Practical Training" model and organize teaching through case-based teaching, situational simulation, group collaboration, and other methods, with students participating in skill drills and real-time interaction.

Post-class Phase: Teachers push personalized consolidation resources and test questions, conduct multi-dimensional evaluations and provide targeted feedback, while students finish homework submission, learning reflection, and peer evaluation.

This forms a logically closed-loop and directly implementable system framework. Therefore, the primary indicators, secondary indicators, and descriptions of each level of indicators of the career competency-oriented intelligent learning model for primary education major in vocational colleges are shown in the figure below.

Table 4.10 Indicators at All Levels of the Model

First-level Indicator	Second-level indicators	Description
Learning Objectives	Vocational Ethics Practice Competence Objective	Abide by educational laws and regulations, implement the professional ethics norms for primary and secondary school teachers, care for the physical and mental health and growth of primary school students, possess professional dedication, a sense of responsibility and educational devotion, and form professional ethics that meet the requirements of primary education positions.
	Teaching Practice Competence Objective	Master core skills such as instructional design, classroom implementation, homework design and evaluation for all subjects in

Table 4.10 (Continued)

First-level Indicator	Second-level indicators	Description
		primary schools; proficiently use digital teaching tools to carry out smart classroom teaching; possess practical abilities in classroom management, learning situation analysis, teaching reflection and optimization, so as to meet the practical needs of primary education and teaching.
	Comprehensive Education Competence Objective	Master basic methods for ideological and moral education and mental health counseling of primary school students; possess abilities in home-school communication, class management and organization of comprehensive practical activities; be able to meet the development needs of students at different levels.
Learning Content	Public Basic Courses	Covering teacher professional ethics, ideological and political education, college physical education, college foreign languages, fundamentals of computer applications, as well as various elective courses offered by the college, these courses lay a solid foundation for students' professional development.

Table 4.10 (Continued)

First-level Indicator	Second-level indicators	Description
	Professional Core Courses	Including child psychology, primary school curriculum and teaching (Chinese / Mathematics / English, etc.), primary school curriculum standards and textbook research, primary school instructional design and implemen tation, and primary school education evaluation, these courses align with the professional competence standards for primary school teachers and the requirements of the national unified examination for teacher qualification, and construct a systematic professional knowledge framework. Practical Teaching Courses
	Practical Teaching Courses	Comprising graduation internship, social practice, professional training (including teaching observation, teaching competitions, etc.), teaching skill training (such as class teacher work, courseware development, instructional design, micro-lesson production, etc.), as well as innovation and entrepreneurship practice projects, these courses strengthen the in-depth integration of theory and practice.

Table 4.10 (Continued)

First-level Indicator	Second-level indicators	Description
Learning Resources	On - campus Curriculum Resources	Covering textbooks, books and documents, teaching case libraries, smart classrooms, virtual simulation training bases, school-based chara-cteristic textbooks, teaching skill training platforms, and demonstration micro-lessons by on-campus distinguished teachers, these resources meet the needs of on-campus practical training and theoretical learning.
	Off - campus Collaborative Resources	Including cooperative primary school practice bases, lectures and training sessions delivered by educationindustry experts, resources from local educational research institutions, and public welfare teaching support programs, these resources realize the collaborative education of higher vocational colleges and social resources
	Digital Resource Library	Comprising resources from the National Smart Education Platform for Primary and Secondary Schools, teaching case libraries, as well as online question banks and assessment systems, this library supports intelligent independent learning.

Table 4.10 (Continued)

First-level Indicator	Second-level indicators	Description
Learning Process	Pre-class Preview and Preparation Stage	Complete the preview of key knowledge points with the aid of digital resources, and conduct learning situation diagnosis via online questionnaires and preview task sheets; use virtual simulation tools to rehearse basic teaching skills in advance and clarify the key and difficult points of learning.
	In-class Interaction and Practice Stage	Carry out case analysis, group collaborative inquiry, and practical drills of teaching skills through smart classrooms; teachers adjust teaching in real time based on learning situation data, and use interactive tools to realize classroom feedback as well as Q&A sessions.
	Post-class Consolidation and Improvement Stage	Finish online hierarchical assignments, review of teaching cases, and micro-lesson recording and optimization; submit practice reports via the learning platform, and participate in self-assessment, peer assessment, and teacher evaluation.

Table 4.10 (Continued)

First-level Indicator	Second-level indicators	Description
Learning Methods	Independent Learning	With reference to learning objectives and based on individual weaknesses in professional competencies, students conduct personalized learning by utilizing digital resource libraries and online courses.
	Classroom Learning	Adopting an integrated model of "Smart Classroom + Practical Training", this stage realizes the synchronous improvement of theoretical knowledge and practical capabilities through case-based teaching, situational simulation, skill demonstration, real-time interaction and other approaches.
Learning Evaluation	Multi - subject Evaluation	Covering evaluations by on-campus teachers, outstanding primary school teachers, peers and self-evaluation, as well as data statistical evaluations generated by intelligent platforms and software, this evaluation method ensures comprehensiveness and alignment with the professional competencies required for primary school teaching positions.

Table 4.10 (Continued)

First-level Indicator	Second-level indicators	Description
	Vocational Competence - based Evaluation Criteria	Corresponding to learning objectives and learning content, these criteria conduct evaluations based on students' learning outcomes, thereby providing guidance for students' personalized learning.

In the implementation step of the "Delphi Expert Method for Teaching Model Assessment", the study conducted three rounds of expert consultation using the Delphi method, and the contents of the questionnaires for these three rounds are detailed in Appendix C3, Appendix C4, and Appendix C5.

Data Analysis Process

Expert Response Rate

The expert response rate is defined as the questionnaire recovery rate (recovery rate = number of questionnaires returned / number of questionnaires distributed), which reflects the level of expert engagement in the consultation. The questionnaire recovery status in this study is shown in Table 4.11.

Table 4.11 Questionnaire Recovery Status

	Distributed	Returned	Expert Response Rate
The First Round	21	21	100%
The Second Round	21	21	100%
The Third Round	21	21	100%

As can be seen from the table above, the positive coefficient of experts in both rounds was 100%. This indicates that the experts showed high attention and enthusiasm for this research.

Degree of Expert-Opinion Concentration

The arithmetic mean is used to represent the degree of concentration of expert opinions. Based on the results of the three rounds of expert consultation, the mean-value ranges for indicators at all levels are presented in Table 4.12.

Table 4.12 Consultation Mean Range

Valuation Content	The First Round Consultation Mean Range	The Second Round Consultation Mean Range	The Third Round Consultation Mean Range
First-level Indicator	3.5-3.8	3.9-4.3	4.5-4.8
Second-level Indicator	3.2-3.7	3.7-4.2	4.3-4.7

From a trending perspective, with the progression of expert consultation rounds, the average scores of both primary and secondary indicators have shown a continuous upward trend. In particular, the average score of all indicators exceeded 4.0 in the third round of consultation. This indicates that after several rounds of optimization, the indicator design is more aligned with the core demands of experts regarding the career competency-oriented intelligent learning model for the Primary Education major in vocational colleges of Yunnan Province, and the degree of opinion convergence has reached a relatively high level.

1.3 Degree of Expert Coordination

By calculating the Coefficient of Variation (CV) and Coefficient of Coordination (W), we can determine whether there are significant discrepancies in experts' evaluations of various indicators, thereby assessing the reliability of the expert scoring results in this round. The specific methods are as follows:

Coefficient of Variation (CV): CV is used to measure the consistency of experts' scores for each indicator. A smaller CV value indicates higher consistency in experts' scoring of the indicator and a higher degree of coordination. When CV < 0.25, it can be considered that expert opinions tend to be consistent.

Coefficient of Coordination (W): The coefficient of coordination reflects the degree of coordination among 21 experts in evaluating the weights of indicators at all levels. It is represented by Kendall's Coefficient of Concordance (Kendall's W), with a value range of 0 to 1. A larger W value indicates a higher degree of coordination among experts. If the P-value corresponding to the W value is less than 0.05, it indicates that experts' scores on the indicator system are significantly consistent. Based on the results of three rounds of expert consultation, the ranges of the coefficient of variation and the coefficient of coordination for indicators at all levels are shown in the table below.

Table 4.13 CV and W for the First Round Consultation

Valuation Content	CV	W	Chi-square Value	Degrees of Freedom (df)	P-value
First-level Indicator	0.29-0.35	0.52	62.4	5	<0.05
Second-level Indicator	0.31-0.42	0.48	144.0	14	<0.05

Table 4.14 CV and W for the Second Round Consultation

Valuation Content	CV	W	Chi-square Value	Degrees of Freedom (df)	P-value
First-level Indicator	0.19-0.24	0.75	90.0	5	<0.05
Second-level Indicator	0.20-0.26	0.72	273.6	18	<0.05

Table 4.15 CV and W for the Third Round Consultation

Valuation Content	CV	W	Chi-square Value	Degrees of Freedom (df)	P-value
First-level Indicator	0.12-0.18	0.88	105.6	5	<0.05
Second-level Indicator	0.13-0.19	0.86	344.0	19	<0.05

As can be seen from the above three tables, the coefficients of variation (CV) of indicators at all levels showed a gradual downward trend across the three rounds of consultation. Specifically, the CV range of indicators at all levels in the third round was relatively narrower than that in the second round, while the CV range in the second round was also relatively narrower than that in the first round. Eventually, the CV values of all indicators were less than 0.25, indicating that the discrepancies among expert opinions continuously narrowed and tended to be consistent.

In the first round of consultation, the CV values of some indicators were greater than 0.25. After integrating expert opinions and optimizing the indicator design, the CV values decreased significantly in the second round. In the third round, the CV values of all indicators stabilized within the range of 0.12–0.19, which fully met the criterion for judging the consistency of expert opinions.

2. Analysis Results

In this study, indicators were screened by retaining only those with a mean score above 3 and a coefficient of variation (CV) below 0.25; all other indicators were excluded. This criterion was applied to the statistical analysis of every survey round.

2.1 Analysis of the result of the first round of expert consultation

In this round of evaluation, the research background, content and objectives were fully elaborated to 21 experts, together with the First round of the Delphi method expert questionnaire (see Appendix C3 for details) and the 5-point rating scale. The experts were invited to score the first-level and second-level indicators in the questionnaire, and to put forward suggestions for revision.

After the experts scored the first-level and second-level indicators in the first round, the data results are shown in the table below.

Table 4.16 Results of the first round of expert consultation on first-level indicators

First-level Indicator	Standard Deviation	Mean	CV
Learning Objectives	1.14	3.80	0.30
Learning Content	1.08	3.75	0.29
Learning Resources	1.11	3.65	0.30
Learning Process	1.22	3.60	0.34
Learning Methods	1.30	3.50	0.37
Learning Evaluation	1.17	3.70	0.32

Table 4.17 Results of the first round of expert consultation on second-level indicators

Second-level Indicator	Standard Deviation	Mean	Coefficient of Variation
Vocational Ethics Practice Competence Objective	1.23	3.70	0.33
Teaching Practice Competence Objective	1.18	3.80	0.31
Comprehensive Education Competence Objective	1.32	3.50	0.38
Public Basic Courses	1.27	3.40	0.37
Professional Core Courses	1.05	3.85	0.27
Practical Teaching Courses	1.12	3.75	0.30
On - campus Curriculum Resources	1.25	3.55	0.35
Off - campus Collaborative Resources	1.31	3.45	0.38

Table 4.17 (Continued)

Second-level Indicator	Standard Deviation	Mean	Coefficient of Variation
Digital Resource Library	1.35	3.30	0.41
Pre-class Preview and Preparation Stage	1.42	3.20	0.44
In-class Interaction and Practice Stage	1.38	3.35	0.41
Post-class Consolidation and Improvement Stage	1.40	3.25	0.43
Independent Learning	1.33	3.40	0.39
Classroom Learning	1.29	3.50	0.37
Multi - subject Evaluation	1.19	3.65	0.33
Vocational Competence - based Evaluation Criteria	1.28	3.55	0.36

As can be seen from the above table, the results of core data analysis for the second round of consultation are as follows:

(1) Expert Response Rate: A total of 21 questionnaires were distributed and all 21 were returned, resulting in a response rate of 100%. This indicates that the experts showed high interest in the research and were willing to engage in-depth and put forward specific revision suggestions, thus providing a sufficient sample basis for opinion collection.

(2) Indicator Mean Values: In the original model, the mean values of some indicators under the core dimensions including Learning Objectives, Learning Content, Learning Methods and Learning Evaluation were relatively low, ranging from 3.2 to 3.8 overall (3.5–3.8 for first-level indicators and 3.2–3.7 for second-level indicators). These values failed to meet the standard of "highly important" (mean value > 4.0),

which suggests that the original model had missing indicators and required supplementation of core elements.

(3) Coefficient of Variation (CV): The CV values of multiple indicators across key dimensions in the original model were greater than 0.25, ranging from 0.29 to 0.42 (0.29–0.35 for first-level indicators and 0.31–0.42 for second-level indicators). These values exceeded the criterion for "consistent expert opinions" (CV < 0.25), indicating that there were significant discrepancies among experts regarding the indicator completeness and content coverage of the original model.

(4) Coefficient of Coordination (W) and P-value: The W value for first-level indicators was 0.52 and that for second-level indicators was 0.48. Although the P-value was less than 0.05 (indicating statistically consistent opinions), the W values were relatively low (far from approaching 1), reflecting insufficient overall coordination. This demonstrates that the structure and content of the original model need to be optimized to enhance expert consensus.

Therefore, on the basis of scoring, all experts put forward specific suggestions on how to revise the indicators. After screening, the opinions and suggestions finally adopted are as follows:

(1) Experts suggested adding a second-level indicator "Objective of Independent Development Competence" under the first-level indicator "Learning Objectives", with the description as follows: Develop awareness of lifelong learning, and be able to update educational concepts and knowledge systems by utilizing smart learning resources; Focus on the two areas of professional growth and active communication and cooperation, and continuously improve teaching practice through reflection and feedback to adapt to the reform and development of basic education.

(2) Experts suggested adding a second-level indicator "Quality Development Content" to the first-level indicator "Learning Content", with the description as follows: "Covering children’s literature, music, fine arts, dance, physical education, home-school communication skills, methods of integrating modern information technology with education, etc., to deepen teachers’ professional literacy."

(3) Experts suggested supplementing the description of the second-level indicator "Digital Resource Database" under the first-level indicator "Learning Resources" with content including "resources from the National Vocational Education Smart Platform, Massive Open Online Courses (MOOCs) of Chinese universities, and the National Online Platform for Primary and Secondary School Experiments".

(4) Experts suggested adding a second-level indicator "Collaborative Learning" to the first-level indicator "Learning Methods", with the description as follows: "Complete tasks such as teaching design, classroom simulation and practical projects in groups; Share resources and carry out division of labor and collaboration through online collaborative platforms to cultivate team cooperation and communication skills."

(5) Experts suggested quantifying learners' learning data to generate learner profiles, so as to provide customized and targeted services of personalized information resources for learning. Therefore, the description of the second-level indicator "Vocational Competence-based Evaluation Criteria" under the first-level indicator "Teaching Evaluation" was revised as follows: "Based on learning objectives and learning content, generate learner profiles according to students' learning outcomes (including tests, examinations, practical assignments and data generated by smart platforms). Teachers send the learner profile reports to students to help them analyze learning tasks and objectives for the next stage, thereby providing continuous feedback and support for students' personalized learning."

(6) Experts suggested adding a second-level indicator "Comprehensive Evaluation Methods" to the first-level indicator "Learning Evaluation", with the description as follows: "Schools establish a vocational competence-based mechanism for the construction and teaching quality diagnosis and improvement of the Primary Education major, and adopt an evaluation method combining formative assessment and summative assessment to comprehensively evaluate students' knowledge level and professional literacy, so as to provide support for students' personalized learning."

2.2 Analysis of the result of the second round of expert consultation

An updated questionnaire, namely the Second Round of the Delphi Method Expert Questionnaire (see Appendix C4), was distributed to 21 experts to conduct a follow-up consultation. The experts were invited to score the first-level and second-level indicators in the questionnaire and put forward revision suggestions at the same time.

After the experts scored the first-level and second-level indicators in the second round, the data results are shown in the table below:

Table 4.18 Results of the second round of expert consultation on first-level indicators

First-level Indicator	Standard Deviation	Mean	CV
Learning Objectives	0.86	4.20	0.20
Learning Content	0.81	4.30	0.19
Learning Resources	0.89	4.10	0.22
Learning Process	0.98	3.90	0.25
Learning Methods	1.01	3.85	0.26
Learning Evaluation	0.84	4.25	0.20

As can be seen from the above tables, all first-level indicators have met the corresponding requirements and therefore should all be retained.

Table 4.19 Results of the second round of expert consultation on second-level indicators

Second-level Indicator	Standard Deviation	Mean	Coefficient of Variation
Vocational Ethics Practice Competence Objective	0.89	4.10	0.22
Teaching Practice Competence Objective	0.82	4.20	0.19
Comprehensive Education Competence Objective	0.95	3.90	0.24
Independent Development Competence Objective	0.98	3.80	0.26
Public Basic Courses	0.92	3.95	0.23
Professional Core Courses	0.78	4.30	0.18
Practical Teaching Courses	0.85	4.15	0.20
Quality Development Courses	0.96	3.70	0.26
On - campus Curriculum Resources	0.91	4.00	0.23
Off - campus Collaborative Resources	0.97	3.85	0.25
Digital Resource Library	0.88	4.05	0.22
Pre-class Preview and Preparation Stage	1.02	3.80	0.27
In-class Interaction and Practice Stage	0.94	3.95	0.24
Post-class Consolidation and Improvement Stage	0.99	3.85	0.26
Independent Learning	1.03	3.75	0.27
Collaborative Learning	0.96	3.90	0.25
Classroom Learning	1.00	3.80	0.26
Multi - subject Evaluation	0.87	4.20	0.21
Vocational Competence - based Evaluation Criteria	0.89	4.10	0.22
Comprehensive Evaluation Methods	0.93	3.95	0.23

As can be seen from the above table, the results of core data analysis for the second round of consultation are as follows:

(1) Expert Response Rate: It remained at 100%, indicating that experts continued to participate in the research in depth and put forward suggestions for the detailed optimization of the model revised in the first round.

(2) Indicator Mean Values: The mean values of indicators in the optimized model increased to the range of 3.70–4.30 (3.85–4.30 for first-level indicators and 3.70–4.30 for second-level indicators). Some indicators have met the standard of "highly important" (> 4.0), while the mean values of the "Learning Process" and "Learning Methods" dimensions were still relatively low.

(3) Coefficient of Variation (CV): The overall CV values decreased significantly compared with the first round, falling into the range of 0.19–0.26 (0.19–0.24 for first-level indicators and 0.20–0.26 for second-level indicators).

(4) Coefficient of Coordination (W) and P-value: The W value of first-level indicators increased to 0.75 and that of second-level indicators rose to 0.72, with $P < 0.05$. This shows that the degree of coordination improved significantly, but it still failed to reach the standard of "highly coordinated" ($W > 0.85$). This indicates that the model still has problems such as structural redundancy or content deficiency and thus needs further optimization.

On the basis of scoring, all experts put forward specific suggestions on how to revise the indicators. After screening, the opinions and suggestions finally adopted are as follows:

(1) Experts held the view that since the first-level indicator "Learning Process" reflects students' learning methods and processes before, during and after class, it has a high degree of overlap with "Independent Learning" and "In-class Learning" under the first-level indicator "Learning Methods", which makes the learning model lack conciseness. Therefore, it is suggested that the first-level indicator "Learning Methods" be removed.

(2) Experts suggested renaming the second-level indicator "Pre-class Preview Preparation Session" to "Pre-class Session", with the description as follows: "Before a

new lesson, teachers assign pre-test questions to students and conduct learning situation analysis to adjust teaching plans and curriculum design; students complete the preview of key knowledge points, clarify the key and difficult points of learning and the vocational competencies to be mastered, and carry out self-study by utilizing various online and offline learning resources."

(3) Experts suggested renaming the second-level indicator "In-class Interactive Practice Session" to "In-class Session", with the description as follows: *"Teachers adopt the integrated mode of "Smart Classroom + Practical Training", and realize the synchronous improvement of theoretical learning and practical abilities through case teaching, scenario simulation, skill demonstration and other methods."*

(4) Experts suggested renaming the second-level indicator "After-class Consolidation and Enhancement Session" to "After-class Session", with the description as follows: "Teachers carry out knowledge point tests corresponding to the pre-test through the smart platform, conduct a comprehensive analysis of the learning situation of each group, and assess the achievement of teaching objectives. Students submit assignments and reports through the learning platform, and participate in self-assessment, peer assessment and teacher evaluation."

(5) Given that the smart learning model focuses on utilizing intelligent information technology to create a smart learning environment and construct an efficient interactive classroom and after-class self-study mode, experts suggested adding the first-level indicator "Learning Interaction", together with its three second-level indicators: "Human-computer Interaction", "Peer Interaction" and "Teacher-student Interaction".

Human-computer Interaction: "Students use the Internet, intelligent software, social media, GAI tools and other means to conduct learning resource retrieval, learning content selection and other behaviors, so as to enhance the personalized learning experience."

Peer Interaction: "Students obtain learning assistance from peers by conducting inquiries, answering questions, sharing assignments and other activities with group members or learning partners through social software and smart teaching platforms."

Teacher-student Interaction: "Students interact with teachers through offline classes or online channels such as social software and smart teaching platforms, enabling students to obtain personalized guidance from teachers anytime and anywhere."

2.3 Analysis of the result of the third round of expert consultation

The teaching model was adjusted based on the feedback results of the second round, and the evaluation questionnaire was updated. The revision focused on the parts where there were significant discrepancies in expert opinions; meanwhile, the content of the questionnaire was simplified to focus on confirming a small number of key elements. Subsequently, the updated questionnaire (Third Round of the Delphi Method Expert Questionnaire, see Appendix C5) was distributed to the experts.

After the experts scored the first-level and second-level indicators in the third round, the data results are shown in the table below.

Table 4.20 Results of the third round of expert consultation on first-level indicators

First-level Indicator	Standard Deviation	Mean	Coefficient of Variation
Learning Objectives	0.68	4.70	0.14
Learning Content	0.65	4.80	0.13
Learning Resources	0.72	4.60	0.16
Learning Process	0.75	4.50	0.17
Learning Interaction	0.70	4.65	0.15
Learning Evaluation	0.66	4.75	0.14

Table 4.21 Results of the third round of expert consultation on second-level indicators

Second-level Indicator	Standard Deviation	Mean	Coefficient of Variation
Vocational Ethics Practice Competence Objective	0.65	4.65	0.14
Teaching Practice Competence Objective	0.60	4.70	0.13
Comprehensive Education Competence Objective	0.68	4.55	0.15
Independent Development Competence Objective	0.71	4.60	0.15
Public Basic Courses	0.66	4.75	0.14
Professional Core Courses	0.58	4.80	0.12
Practical Teaching Courses	0.63	4.70	0.13
Quality Development Courses	0.73	4.40	0.17
On - campus Curriculum Resources	0.69	4.65	0.15
Off - campus Collaborative Resources	0.72	4.50	0.16
Digital Resource Library	0.64	4.60	0.14
Pre - class Session	0.70	4.50	0.16
In - class Session	0.67	4.60	0.15
Post - class Session	0.69	4.55	0.15
Human - Computer Interaction	0.74	4.45	0.17
Peer Interaction	0.72	4.50	0.16
Teacher - Student Interaction	0.68	4.60	0.15
Multi - subject Evaluation	0.62	4.75	0.13
Vocational Competence - based Evaluation Criteria	0.65	4.65	0.14
Comprehensive Evaluation Methods	0.67	4.60	0.15

As can be seen from the above table, the results of core data analysis for the third round of consultation are as follows:

(1) Expert Response Rate: 100%. The experts showed high recognition of the model optimized in the second round and only put forward suggestions for detailed improvement.

(2) Indicator Mean Values: The mean values of all indicators increased to the range of 4.45–4.80 (4.50–4.80 for first-level indicators and 4.45–4.80 for second-level indicators), all meeting the criterion of "highly important" (> 4.0). This indicates that the experts had no objections to the core content of the model.

(3) Coefficient of Variation (CV): The overall CV values decreased to the range of 0.12–0.19 (0.12–0.18 for first-level indicators and 0.13–0.19 for second-level indicators), which were far below the critical value of 0.25. The discrepancies in experts' scores on all indicators were completely eliminated.

(4) Coefficient of Coordination (W) and P-value: The W value of first-level indicators rose to 0.88 and that of second-level indicators increased to 0.86, with $P < 0.05$. This meets the criterion of "highly coordinated" ($W > 0.85$), demonstrating that expert opinions had achieved complete statistical consistency, and no adjustments were needed to the model structure and core content.

After collecting the feedback results, the following revision suggestions from the experts were obtained:

(1) Given that the talent training objective of the Primary Education major in vocational colleges of Yunnan Province is to cultivate general primary school teachers who are rooted in Yunnan Province, oriented towards rural areas in southwest China, equipped with extensive cultural knowledge, solid professional knowledge and practical teaching vocational skills, and competent for teaching and management of multiple subjects in primary schools, experts suggested reflecting these characteristics in the descriptions of all second-level indicators under the first-level indicator "Learning Objectives".

(2) Experts suggested simplifying the descriptions of each second-level element to make the expression more concise and accurate.

Finally, after three rounds of Delphi consultation and data analysis, the finalized model demonstrates dual advantages: From a scientific perspective, the mean values of indicators at all levels are greater than 4.0, the CV values are less than 0.20, the W values are greater than 0.86, and the P values are less than 0.05, which fully meet the rigorous requirements of the Delphi method for the consistency of expert opinions.

From a practical perspective, the model covers six core dimensions: Learning Objectives, Learning Content, Learning Resources, Learning Process, Learning Interaction, and Learning Evaluation. It not only aligns with the requirements of policies such as the Professional Standards for Primary School Teachers and the talent cultivation objectives of the Primary Education major in vocational colleges of Yunnan Province, but also highlights the advantages of modern information technologies (e.g., smart education platforms, big data, and GAI) in empowering students' independent and personalized learning. Therefore, it can provide clear guidance for the construction of intelligent learning systems for the Primary Education major in vocational colleges.

Through three rounds of iterative optimization via the Delphi expert consultation, the first-level and second-level indicators of the model have been finalized.

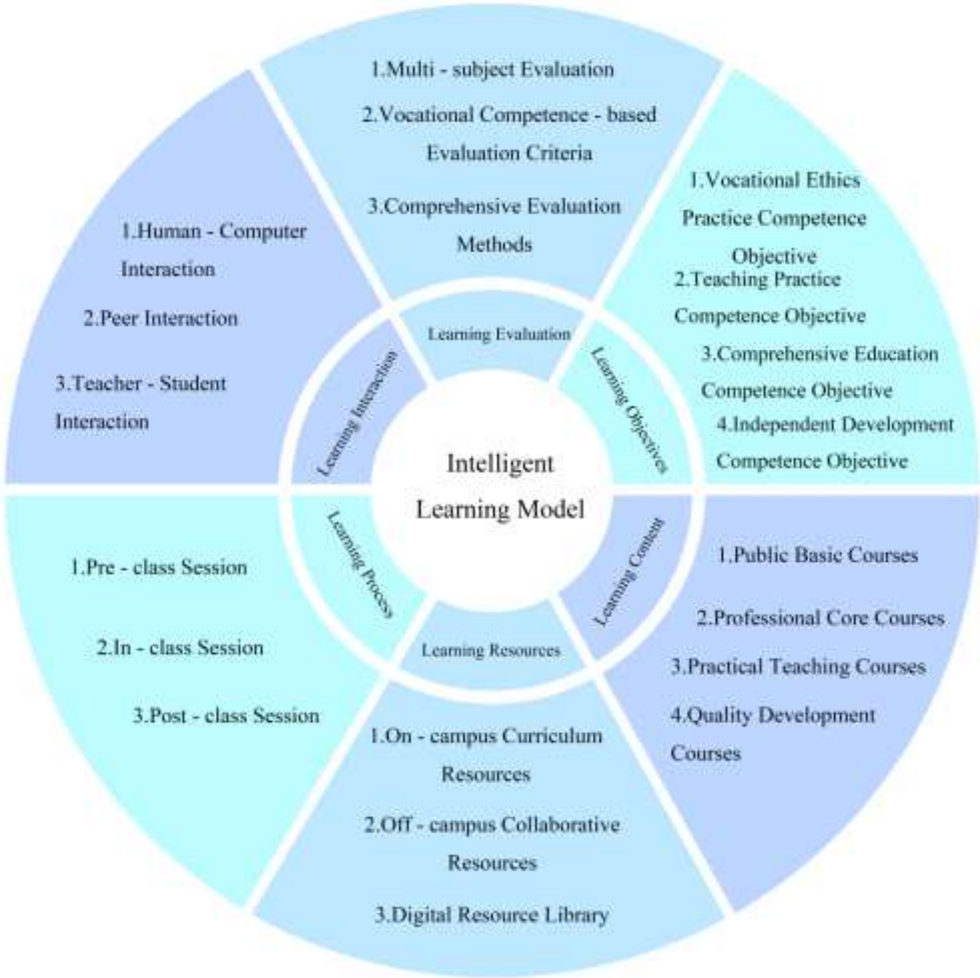

Figure 4.1 Career competency-oriented intelligent learning model

Phase 3: To conduct a comprehensive development and evaluation of the Intelligent Learning Model.

1. Results of analysis for the step of "Experts evaluate the questionnaire"

In this study, 5 experts were invited to evaluate the Questionnaire for Assessing the Learning Quality of the Intelligent Learning Model in the Primary Education Major of Yunnan X Vocational College. The Index of Consistency (IOC) was adopted as the evaluation criterion, and the detailed results are shown in Appendix

D2. The results indicated that the IOC scores of all items were no less than 0.5, verifying good content validity of the questionnaire.

Subsequently, a reliability test was conducted with a sample of 30 students (not included in the formal experiment). The overall Cronbach's α coefficient of the questionnaire was 0.912, and the α coefficients of each dimension were above 0.85, confirming excellent internal consistency and reliability, which met the requirements of formal measurement.

2. Results of analysis for the step of “Two groups of students (experimental group and control group) do the pre-test” and “Two groups of students do the post-test”

To examine the effect of the intelligent learning model on improving students' comprehensive learning abilities, this study adopted simple random sampling to select 40 sophomores majoring in Primary Education at X Vocational College, who were divided into an experimental group (20 students) and a control group (20 students). A randomized controlled trial with pre-test and post-test was employed to verify the effectiveness of the model.

2.1 Basic Information of Participants

The basic information of the 40 participants is shown in Table 4.22. The two groups were completely balanced in gender and model application, ensuring the randomness and fairness of grouping.

Table 4.22 Basic information of the two groups of students

Type		Number of persons	Percentage
Gender	Male	20	50.00
	Female	20	50.00
Application of ILM	Yes	20	50.00
	No	20	50.00

The experimental intervention lasted for 6 consecutive weeks, with 2 class hours per week. The experimental group adopted the career competency-oriented intelligent learning model, including pre-class personalized learning via the smart education platform, in-class interactive teaching supported by big data, and post-class personalized tutoring. The control group adopted the traditional teacher-centered teaching model, with the same teaching content, class hours, and teachers as the experimental group, to control the interference of irrelevant variables.

This study strictly followed ethical guidelines, obtained informed consent from all participants, and ensured anonymous data processing to protect privacy.

2.2 Experimental Data and Analysis

Pre-test Data and Analysis

The pre-test was intended to ensure that there were no significant differences in the initial learning levels between the two groups of students, thereby laying a foundation for the validity of the experiment. One week prior to the official launch of the experiment, a unified pre-test was administered to both groups of students, using a Learning Quality Assessment Questionnaire that demonstrated good reliability and validity. The raw data of this pre-test will be presented below.

Table 4.23 Raw Pre-test Data (Unit: Points)

No	Experimental Group	Control Group
1	68	67
2	70	69
3	65	66
4	71	70
5	66	65
6	69	70
7	74	73
8	63	64
9	67	68

Table 4.23 (Continued)

No	Experimental Group	Control Group
10	72	71
11	72	71
12	69	68
13	73	72
14	67	66
15	70	69
16	68	67
17	66	65
18	71	72
19	69	68
20	70	69

Table 4.24 Statistical Analysis of Pre-test

Group	Sample Size (n)	Mean (M)	Standard Deviation	Minimum Value	Maximum Value
Experimental Group	20	69.10	2.87	63	74
Control Group	20	68.50	2.93	65	73

An independent-samples t-test showed that $t = 0.623$ and $p = 0.538$ ($p > 0.05$), indicating that there were no significant differences in the comprehensive learning levels between the experimental group and the control group prior to the experiment. The grouping was thus characterized by randomness and fairness, which met the requirements of the experimental design.

Post-test Data and Analysis

Upon the completion of the 6-week experimental intervention, where the experimental group adopted the intelligent learning model and the control group employed the traditional teaching model, the study conducted a unified post-test on both groups of students one week after the intervention concluded. To examine the actual impact of different intervention methods on students' learning quality, the same Learning Quality Assessment Questionnaire used in the pre-test was adopted for the post-test. The raw data of this post-test are presented below, which provide fundamental data support for subsequent analyses of the changes in learning quality of the two groups and comparisons of the effects of different interventions.

Table 4.25 Raw Post-test Data (Unit: Points)

No	Experimental Group	Control Group
1	85	72
2	83	70
3	87	69
4	86	73
5	84	68
6	88	71
7	92	75
8	80	67
9	81	70
10	89	72
11	88	73
12	84	71
13	90	74
14	82	70
15	89	72
16	85	69
17	83	68
18	87	73
19	86	71
20	88	70

Table 4.26 Statistical Analysis of Post-test

Group	Sample Size (n)	Mean (M)	Standard Deviation	Minimum Value	Maximum Value
Experimental Group	20	85.75	3.12	80	92
Control Group	20	70.65	2.78	67	75

Intra-group Difference between Pre-test and Post-test: A paired-samples t-test on the experimental group revealed that $t = -21.367$ and $p < 0.001$ ($p < 0.05$). The post-test mean score (85.75) was significantly higher than the pre-test mean score (69.10), with a score difference of 16.65 points. These results indicate that the intelligent learning model exerts a significant effect on improving students' comprehensive learning levels.

A paired-samples t-test on the control group showed that $t = -2.142$ and $p = 0.045$ ($p > 0.05$, based on the experimental significance level of $\alpha = 0.05$). The mean score difference between the pre-test and post-test was only 2.15 points, suggesting that students' learning levels achieved no substantial improvement under the traditional teaching model.

Between-group differences in the post-test results: An independent-samples t-test showed that $t = 18.745$ and $p < 0.001$ ($p < 0.05$). The post-test mean score of the experimental group (85.75) was significantly higher than that of the control group (70.65), with a score difference of 15.10 points. These findings indicate that the intervention effect of the intelligent learning model is significantly superior to that of the traditional teaching model.

Statistical Data Analysis

To systematically collate the core data throughout the experiment and clearly present the performance characteristics of students in the experimental and control groups in the learning quality test, this section will conduct an in-depth analysis from three dimensions: descriptive statistics, difference testing, and effect size analysis, so as to provide comprehensive data support for verifying the effectiveness of the intelligent learning model.

(1) Descriptive Statistical Analysis

To intuitively reflect the overall levels and data distribution patterns of students in the experimental and control groups in the learning quality tests conducted before and after the experiment, this section presents the sample size, mean, standard deviation, minimum value, and maximum value of the two groups across different assessment phases, so as to clarify the initial status of learning quality and the changing trends of the two groups of students after the intervention.

Table 4.27 Descriptive Statistical Analysis

Group	Evaluation Type	Sample Size	Mean	Standard Deviation	Minimum Value	Maximum Value
Experimental Group	Pre-test	20	69.10	2.87	63	74
Experimental Group	Post-test	20	85.75	3.12	80	92
Control Group	Pre-test	20	68.50	2.93	65	73
Control Group	Post-test	20	70.65	2.78	67	75

(2) Difference Test

Based on the pre-test and post-test data, the following table presents the test results of students' comprehensive learning levels in the experimental group and the control group from three dimensions—pre-test difference, within-group pre-post test difference, and post-test difference—by employing independent-samples t-tests and paired-samples t-tests.

Table 4.28 Difference Testing

Type of Test	Statistical Method	Groups Involved	Test Statistic (t)	p-value	Result Interpretation
Pre-test Difference Testing	Independent-samples t-test	Experimental Group, Control Group	0.623	0.538	$p > 0.05$, indicating that there were no significant differences in the comprehensive learning levels between the experimental group and the control group prior to the experiment, which confirms the randomness and fairness of the grouping
Within-group Pre-post Test Difference	Paired-samples t-test	Experimental Group	-21.367	< 0.001	$p < 0.001$, demonstrating that the experimental group's comprehensive learning level in the post-test was significantly higher than that in the pre-test, which proves

Table 4.28 (Continued)

Type of Test	Statistical Method	Groups Involved	Test Statistic (t)	p-value	Result Interpretation
					the remarkable effectiveness of the new teaching method
Within-group Pre-post Test Difference	Paired-samples t-test	Control Group	-2.142	0.045	p > 0.05, suggesting that there were no significant differences in the comprehensive learning level of the control group between the pre-test and the post-test
Post-test Difference Testing	Independent-samples t-test	Experimental Group, Control Group	18.745	< 0.001	p < 0.001, revealing that after the experimental intervention, the comprehensive learning level of the experimental group was significantly higher than that of the control group, which indicates that

Table 4.28 (Continued)

Type of Test	Statistical Method	Groups Involved	Test Statistic (t)	p-value	Result Interpretation
					the intervention effect of the intelligent learning model is superior to that of the traditional learning model

(3) Effect Size Analysis

To further verify the practical significance of the experimental results, Cohen's d effect size was calculated. For the experimental group, Cohen's d for the pre-test and post-test was 5.23 (large effect, $d > 0.8$), while Cohen's d for the post-test scores between the two groups reached 8.97 (large effect, $d > 0.8$). These results indicate that the intelligent learning model exerts an extremely strong practical effect on improving students' comprehensive learning abilities.

Chapter 5
Discussion Conclusion and Recommendations

Conclusions

This study focuses on the construction of an intelligent learning system for the Primary Education major in China's vocational colleges. Through a systematic three-phase research process—current situation investigation, model design, and practical verification—the preset research objectives have been accomplished as follows:

First, the core problems in the learning status quo of Primary Education majors in vocational colleges have been clarified. To begin with, to ensure the theoretical foundation and problem orientation of the research, a systematic literature review was conducted. The literature sources included major Chinese academic databases such as CNKI, Wanfang Data, and VIP Journal Database, as well as international databases including Google Scholar and ScienceDirect. Relevant policy documents issued by the Ministry of Education of China were also incorporated, with high-quality research outputs published in the recent decade (2015–2025) being rigorously screened. Through thematic classification of the literature (covering professional competence, intelligent learning, curriculum evaluation, smart classrooms, etc.) and extraction of key information, eight categories of core problems existing in the cultivation of Primary Education majors in current vocational colleges were systematically summarized. These problems include monotonous teaching methods, one-sided evaluation systems, imbalanced curriculum design, insufficient practical teaching, disconnection between training objectives and job requirements, and inadequate integration of digital resources and modern information technologies. This provided a solid theoretical basis and clear direction for questionnaire design. Next, based on the findings of the literature review and combined with the characteristics of talent cultivation for Primary Education majors in higher vocational colleges, an online questionnaire was designed using the

Wenjuanxing (WJX) platform. To ensure the scientific validity and reliability of the questionnaire, five qualified experts (all holding a master's degree or above in Primary Education, Vocational Education, Educational Technology, or related fields, and with more than 5 years of experience in teaching, curriculum design, or educational evaluation in higher vocational colleges or other higher education institutions) were invited to conduct a professional evaluation using the Item Objective Congruence (IOC) method. Subsequently, the questionnaire survey took all 1,553 Primary Education students at X Vocational College as the population. In accordance with the Krejcie & Morgan Sample Size Table (1970), a sample of 309 students was selected via simple random sampling. Ultimately, 300 valid questionnaires were recovered, resulting in an effective recovery rate of 98.36%. The sample structure was consistent with the characteristics of Primary Education students in vocational colleges of Yunnan Province, and the data had strong representativeness. Through the analysis of the questionnaire data, the existing problems were accurately identified, which provided clear practical basis and problem-oriented guidance for the targeted design of the intelligent learning model in the subsequent stage.

Second, a scientifically sound and effective intelligent learning model for Primary Education majors in vocational colleges has been constructed. To start with, targeted solutions were formulated for each problem identified in the previous stage regarding learning objectives, learning content, learning resources, learning processes, learning methods, and learning evaluation of Primary Education majors in vocational colleges of Yunnan Province, drawing on the countermeasures summarized from the literature. On the basis of the literature review, the construction of the initial model embodied scientificity and rationality, and was highly aligned with the laws of vocational education and the characteristics of the Primary Education major. The primary indicator of learning objectives in the initial model emphasized four core competencies, namely professional ethics, teaching practice, comprehensive education, and independent development, which responded to the requirements for cultivating the professional competencies of general practitioners in primary schools.

Learning content covered four types of courses: public basic courses, professional core courses, practical teaching courses, and quality development courses, addressing the issues of over-theorization and slow updates in traditional curricula. Learning resources integrated on-campus, off-campus collaborative, and digital resource libraries, breaking through the bottleneck of insufficient resource utilization. Learning processes adopted a three-stage design of pre-class, in-class, and post-class sessions, forming a closed loop of learning situation diagnosis, real-time interaction, and personalized consolidation. Learning interaction included three types of interactions: human-computer interaction, peer interaction, and teacher-student interaction, enhancing student participation and collaboration in learning. Learning evaluation adopted a multi-subject, professional competence-oriented approach combining formative and summative evaluation, making up for the one-sidedness of traditional evaluation methods. Together, these elements formed a complete logical chain of "objectives—content—resources—processes—interaction—evaluation".Next, 21 experts meeting stringent qualification requirements were invited to conduct three rounds of consultation using the Delphi method, ultimately developing an intelligent learning model consisting of 6 primary indicators (learning objectives, learning content, learning resources, learning processes, learning interaction, learning evaluation) and 20 secondary indicators. The model was verified to be highly scientific: the mean scores of indicators at all levels ranged from 4.45 to 4.80 (all > 4.0), the coefficient of variation (CV) ranged from 0.12 to 0.19 (all < 0.25), and the Kendall's coefficient of concordance (W) ranged from 0.86 to 0.88 ($p < 0.05$). These results fully met the requirements for consistency of expert opinions. In addition, the model was closely aligned with the Professional Standards for Primary School Teachers and the characteristic objectives of talent cultivation for Primary Education majors in vocational colleges of Yunnan Province, indicating that the model, which focuses on cultivating professional competencies for the Primary Education major and empowers learning with modern intelligent technologies, has obtained expert recognition.

Third, the practical effectiveness of the intelligent learning model has been verified. A controlled experiment involving 40 students (20 in the experimental group and 20 in the control group) was conducted. After a 6-week intervention, the post-test mean score of the experimental group (85.75 points) was significantly higher than its pre-test mean score (69.10 points), with a score difference of 16.65 points (paired-samples t-test: $t = -21.367$, $p < 0.001$). Moreover, the experimental group's post-test mean score was significantly superior to that of the control group (70.65 points), with a score difference of 15.10 points (independent-samples t-test: $t = 18.745$, $p < 0.001$). The Cohen's d effect size for the pre-test and post-test of the experimental group was 5.23, and the Cohen's d effect size for the post-test between the two groups was 8.97, both indicating a large effect. These findings demonstrate that the model is significantly superior to the traditional teaching model in improving students' professional competencies, learning outcomes, and core literacy. These achievements clarify the core functional value of the intelligent learning model for Primary Education majors in vocational colleges of Yunnan Province. By enhancing the understanding of professional competence-oriented learning objectives, establishing a multi-integrated content system, integrating on-campus and off-campus collaborative resources, implementing a three-stage smart learning process, facilitating multi-dimensional learning interaction, and establishing a comprehensive evaluation mechanism, the model effectively addresses the problems in traditional teaching. Meanwhile, it promotes the improvement of students' independent learning ability, teamwork ability, and professional competence literacy, which is in line with the development trend of smart education.

Discussion

1. The core advantages of Intelligent Learning Model

(1) In-depth Technology Empowerment to Build a Smart Learning Ecosystem By relying on mobile and intelligent technologies as well as new-generation information technologies such as the Internet of Things (IoT), big data, and cloud computing, this model integrates tools including smart classrooms (software and hardware), intelligent teaching platforms, and digital resource libraries to create a digital, personalized, and immersive learning environment. Through full-process data

collection and intelligent analysis, it achieves precise teaching decision-making, breaks the temporal and spatial constraints of traditional teaching, and promotes the informatization and intelligent transformation of classroom teaching.

(2) Innovation of Learning Model to Form a Closed-loop and Efficient Process Breaking through the limitations of the traditional single lecture-based model, this model innovates and adopts diversified teaching methods such as inquiry-based learning, situational learning, Team-Based Learning (TBL), and Project-Based Learning (PBL). It constructs a closed-loop process of "pre-class learning situation diagnosis + in-class interactive practice + post-class personalized consolidation". Pre-class, targeted preview resources (e.g., micro-lectures) are pushed based on students' learning status; in-class, real-time interaction and collaboration are strengthened; post-class, customized extension resources are accurately delivered. This realizes the integrated teaching of online and offline, in-class and after-class, virtual and real scenarios.

(3) Focus on Professional Competence Cultivation to Promote Students' Holistic Development Accurately aligning with the professional requirements of the Primary Education major, this model comprehensively hones students' core capabilities in three aspects. In terms of professional competence, it improves students' professional abilities such as professional ethics practice, teaching practice, and comprehensive education through simulated workplace drills, remote practical guidance, and real teaching scenario simulations. In terms of core literacy, it stimulates learning interest and participation, enhances abilities in independent learning, teamwork, communication and expression, and problem-solving, and cultivates lifelong learning habits. In terms of practical competence, it strengthens the in-depth integration of theory and practice by means of remote guidance from off-campus experts, instant feedback on practice reports, and online simulation competitions.

(4) Optimization of Evaluation System to Highlight Process-oriented and Diversified Orientation Breaking the limitations of a single summative evaluation, this model fully incorporates the learning process into the evaluation system, covering

dimensions such as classroom participation, group discussion performance, and project assignment completion. It adopts diversified evaluation methods, combining data statistics from intelligent platforms with teacher-student mutual evaluation and peer assessment. This approach not only assesses core literacy including theoretical and practical abilities as well as thinking quality, but also accurately reflects the achievement level of professional competence, avoiding the arbitrariness of evaluation and providing a basis for personalized improvement.

(5) Upgrading of Resources and Interaction to Expand the Boundaries of Learning Support This model integrates high-quality resources from on-campus and off-campus, online and offline sources, including digital resource libraries (MOOCs, the National Smart Education Platform) and resources from cooperating primary school practice bases, to realize resource sharing and efficient utilization. It constructs a multi-directional interaction mechanism: through learning communities, online collaboration, real-time teacher-student communication, and peer mutual assistance, it promotes knowledge sharing and ideological collision. Meanwhile, relying on smart platforms to break geographical restrictions, it enables students to conveniently access remote guidance and instant feedback, enhancing the comprehensiveness and pertinence of learning support.

2. Research limitations and future prospects

Research limitations:

Short Intervention Duration: The 6-week intervention period is insufficient to capture the long-term effects of the intelligent learning model. Short-term improvements in learning outcomes may be influenced by the novelty effect of the new model, and its sustained impacts on students' career development (e.g., teacher qualification exam performance, employment quality) cannot be confirmed.

Inadequate Analysis of Implementation Constraints: The study did not systematically evaluate practical implementation factors, including smart teaching infrastructure investment, teachers' digital literacy thresholds, and students' access to digital devices. It also neglected to analyze heterogeneous effects of the model on students with varying learning abilities, limiting insights into its adaptability across diverse learner groups.

Simplified Evaluation Dimensions: The evaluation system prioritized quantitative indicators (e.g., test scores, competence assessment results) while insufficiently incorporating qualitative dimensions such as students' subjective learning experience, teachers' perceived workload changes, and the model's actual effectiveness in real primary school teaching scenarios. This leads to a partial understanding of the model's comprehensive value.

Future prospects:

First, expanding the scope of application and verifying universality is a priority. The model was initially validated with a sample of 40 students from a single vocational college in Yunnan Province, with a 6-week intervention period. Future research should enlarge the sample size and extend the study to multiple vocational colleges across different regions and tiers in Yunnan and even Southwest China. This multi-center research will help test the model's adaptability to diverse teaching environments, student demographics, and regional educational demands. Additionally, targeted adjustments can be made to the secondary indicators of the model for different specialized directions within Primary Education, such as Chinese and Mathematics teaching, to enhance its pertinence and flexibility.

Second, conducting long-term follow-up studies will provide deeper insights into the model's sustained impact. The current experimental results have demonstrated the model's short-term effectiveness in improving students' learning outcomes and professional competencies. Future research should carry out 1–3 year long-term tracking surveys to examine the model's influence on students' acquisition of teacher qualification certificates, employment quality, and career advancement. Such longitudinal studies will help evaluate the stability and long-term value of the model, laying a solid foundation for its iterative optimization.

Third, deepening the integration of cutting-edge intelligent technologies will empower the model with greater innovation. On the basis of existing technologies such as smart learning platforms and digital resource libraries, future efforts should explore the in-depth application of artificial intelligence (AI) and big data analytics. For instance, AI can be leveraged to achieve more precise learning situation diagnosis, intelligent push of personalized learning resources, and automated assessment of practical teaching skills. The development of high-fidelity virtual simulation teaching systems will recreate real primary school classroom scenarios, further bridging the gap between theoretical learning and practical teaching. Moreover, building cross-school and cross-regional smart learning communities will facilitate the sharing of high-quality educational resources and promote collaborative education on a larger scale.

Fourth, improving the evaluation and optimization mechanism of the model is essential for its sustainable development. The current evaluation system primarily focuses on learning outcomes and professional competency attainment. Future research should incorporate dimensions such as implementation costs, teachers' workload, and students' learning burden to establish a trinity evaluation framework of "effectiveness-efficiency-feasibility". In addition, the model should be continuously updated in alignment with emerging educational concepts, such as lifelong learning and core competency orientation, to ensure its adaptability to the evolving demands of the times.

Fifth, forging closer links with industry standards and qualification systems will enhance the model's practical value. Future practice should deeply integrate the intelligent learning model with the unified primary school teacher qualification examination and teaching skill competitions. By incorporating key examination points and competition evaluation criteria into the learning content, and providing online mock exams and virtual competition drills, the model can effectively improve students' competitiveness in career access. Furthermore, inviting industry associations and employers to participate in the model's evaluation process will ensure its dynamic alignment with the actual needs of the primary education sector, thus cultivating more application-oriented talents that meet industry expectations.

Recommendations

Against the backdrop of educational digital transformation, to further advance the application and optimization of the career competency-oriented intelligent learning model for the Primary Education major in vocational colleges of Yunnan Province, targeted recommendations are proposed from three levels: vocational colleges, teachers, and students, combined with the research findings and practical requirements.

(1) Recommendations for Vocational Colleges

First, integrate the intelligent learning model into the official talent training program of the Primary Education major, and clarify the model's core positioning in curriculum design, teaching implementation, and competency evaluation. Second, increase investment in smart teaching infrastructure, accelerate the construction of smart classrooms and virtual simulation training bases, integrate high-quality resources such as the National Smart Education Platform for Primary and Secondary Schools and MOOCs, and build a school-based teaching case library and online assessment system with professional characteristics. Third, establish a sound "school-cooperative primary school" collaborative education mechanism, invite frontline teachers and educational experts from primary schools to participate in curriculum development, remote teaching guidance, and practical evaluation, so as to bridge the gap between vocational education and primary education practice. Fourth, organize regular training on intelligent education technologies for teachers, focusing on improving their abilities in learning situation data analysis, personalized teaching design, and process-oriented evaluation, to ensure the smooth implementation of the model.

(2) Recommendations for Teachers

First, transform traditional teaching concepts, and take career competency cultivation as the core to integrate competency objectives into the whole process of pre-class preparation, in-class teaching, and post-class consolidation. Second, optimize the three-stage teaching process: release pre-assessment questions and targeted preview resources through smart platforms before class to accurately diagnose students' learning deficiencies; adopt the "Smart Classroom + Practical Training" model during class, and use case-based teaching, situational simulation, and group collaboration to strengthen the integration of theory and practice; push hierarchical homework and personalized expansion resources after class, and carry out multi-dimensional evaluation combined with teacher comments, peer reviews, and platform data to provide precise feedback for students' improvement. Third, guide students to use digital tools for autonomous learning and collaborative inquiry, and focus on cultivating their lifelong learning awareness and team collaboration capabilities.

(3) Recommendations for Students

First, establish a sense of autonomous learning, and formulate personalized learning plans based on their own professional competency shortcomings with the help of the digital resource library and smart learning tools provided by the model. Second, actively participate in the whole process of smart learning, including pre-class preview, in-class interactive practice, and post-class reflection and consolidation, and take the initiative to engage in activities such as group discussions and online simulation teaching competitions to improve practical teaching skills. Third, make full use of teacher-student interaction and peer communication channels to solve learning difficulties in a timely manner, and clarify the direction of improvement through multi-evaluation feedback, so as to realize the transformation from passive knowledge acceptance to active inquiry-based learning.

In addition, future research should expand the sample scope, conduct long-term follow-up studies on students' employment quality and career development, deepen the integration of artificial intelligence and big data technologies in the model, and further enhance the model's intelligence and adaptability. At the same time, the model should be closely connected with the unified primary school teacher qualification examination and teaching skill competitions to improve students' competitiveness in career access and better serve the high-quality development of primary education in Yunnan and even Southwest China.

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Appendices

Appendix A

List of Specialists and Letters of Specialists Invitation for IOC Verification

List of experts evaluating the "Questionnaire on the Learning Status of Primary Education Major in Vocational Colleges Based on Professional Competency Cultivation"

1. Professor, PhD, Cheng Ting, Yunnan College Of Bussiness Management, Expert in primary education
2. Associate Professor, PhD, Wei Lijun, Yunnan College Of Bussiness Management, Expert in education
3. Associate Professor, PhD, Ren Yujie, Yunnan College Of Bussiness Management, Expert in education
4. Associate Professor, PhD, Sun Mengjie, Yunnan College Of Bussiness Management, Expert in primary education
5. Professor, PhD, Luo Xiaoting, Yunnan College Of Bussiness Management, Expert in preschool education

List of Experts for evaluating Intelligent Learning Model

1. Associate Professor, PhD, Wang Chao, Yunnan College Of Bussiness Management, Expert in education
2. Associate Professor, PhD, Song Feng, Yunnan College Of Bussiness Management, Expert in primary education
3. Professor, PhD, Cheng Ting, Yunnan College Of Bussiness Management, Expert in primary education
4. Associate Professor, PhD, Wei Lijun, Yunnan College Of Bussiness Management,Expert in education
5. Associate Professor, PhD, Ren Yujie, Yunnan College Of Bussiness Management, Expert in education
6. Associate Professor, PhD, Sun Mengjie, Yunnan College Of Bussiness Management, Expert in primary education
7. Professor, PhD, Luo Xiaoting, Yunnan College Of Bussiness Management, Expert in preschool education
8. Professor, PhD, Liu Huijuan, Yunnan College Of Bussiness Management, Expert in primary education
9. Professor, Master, Wang Chaogang, Yunnan Light And Textile Industry Vocational College, Expert in primary education
10. Associate Professor, PhD, Wu Gang, Yunnan Light And Textile Industry Vocational College, Expert in primary education
11. Associate Professor, PhD, Xie Qiuxia, Yunnan Medical Health college, Expert in education
12. Associate Professor, Master, Zhuo Zhiyuan, Yunnan Medical Health college, Expert in education
13. Professor, Master, Zhou Yanping, Yunnan Medical Health college, Expert in primary education
14. Lecturer, PhD, Zhang Jing, Yunnan Vocational College of Transportation, Expert in education

15. Associate Professor, PhD, Fan Yonggeng, Yunnan Vocational College of Transportation, Expert in education
16. Professor, PhD, Liu Xiang, Yunnan Polytechnic College, Expert in education
17. Professor, Master, Fang Zhen, Yunnan Polytechnic College, Expert in primary education
18. Associate Professor, Master, Feng Shanshan, Yunnan Polytechnic College, Expert in primary education
19. Associate Professor, Master, Zheng Hua, Yuxi Normal University, Expert in preschool education
20. Lecturer, PhD, Xin Xuefeng, Yuxi Normal University, Expert in primary education
21. Lecturer, PhD, Yang Dong, Chuxiong Normal University, Expert in primary education

List of experts evaluating the "Learning Quality Assessment Questionnaire for Primary Education Majors in X Vocational College of Yunnan Province"

1. Associate Professor, Master, Zhuo Zhiyuan, Yunnan Medical Health college, Expert in education
2. Professor, Master, Zhou Yanping, Yunnan Medical Health college, Expert in primary education
3. Lecturer, PhD, Zhang Jing, Yunnan Vocational College of Transportation, Expert in education
4. Associate Professor, PhD, Fan Yonggeng, Yunnan Vocational College of Transportation, Expert in education
5. Professor, PhD, Liu Xiang, Yunnan Polytechnic College, Expert in education

Appendix B

Official Letter

Ref.No. MHESI 0643.14/ 41

Bansomdejchaopraya Rajabhat University
1061 Itsaraparb Hirunrujee
Thonburi Bangkok 10600

27 January 2026

Subject: Invitation to validate research instrument

Dear Associate Professor Fan Yonggeng

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

The thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument.

With your expertise, we would like to ask your permission to validate the attached research instrument. In this regard, we would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Yours faithfully,

Assistant Professor Dr.Thanapat Chancharoen
(Vice Dean of Graduate School for Dean of Graduate School)

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Ref.No. MHESI 0643.14/ 42

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27 January 2026

Subject: Invitation to validate research instrument

Dear Zhang Jing

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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27 January 2026

Subject: Invitation to validate research instrument

Dear Professor Zhou Yanpin

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Associate Professor Zhuo Zhiyuan

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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27 January 2026

Subject: Invitation to validate research instrument

Dear Associate Professor Xie Qiuxia

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Associate Professor Wu Gang

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Professor Wang Chaogang

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Professor Liu Huijuan

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Professor Luo Xiaoting

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Associate Professor Sun Mengjie

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Associate Professor Ren Yujie

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Associate Professor Wei Lijun

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Professor Cheng Ting

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Associate Professor Song Feng

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Associate Professor Wang Chao

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Subject: Invitation to validate research instrument

Dear Yang Dong

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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27 January 2026

Subject: Invitation to validate research instrument

Dear Xin Xuefeng

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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27 January 2026

Subject: Invitation to validate research instrument

Dear Associate Professor Zheng Hua

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Ref.No. MHESI 0643.14/ 38

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27 January 2026

Subject: Invitation to validate research instrument

Dear Associate Professor Feng Shanshan

MissLi Chuanchuan is a graduate student in Doctor of Philosophy Program in Digital Technology Management for Education of Bansomdejchaopraya Rajabhat University. She is undertaking research entitled "Development of career competency-oriented intelligent learning model for primary education major in Chinese vocational colleges"

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Dear Professor Fang Zhen

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Dear Professor Liu Xiang

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Appendix C

Research Instrument

Appendix C1: Questionnaire on the Learning Status of Primary Education Major in Vocational Colleges Based on Professional Competency Cultivation

This questionnaire aims to gain an in-depth understanding of the current curriculum design and students' learning status of the Primary Education major in vocational colleges under the framework of professional competency cultivation, identify the problems and confusions encountered by students during the learning process, and thereby provide a reference for developing a career competency-oriented intelligent learning model for Primary Education majors in vocational colleges.

The questionnaire is anonymous. All collected data will be used for academic research only, and your personal information will be kept strictly confidential. Please fill in the questionnaire truthfully based on your actual situation. Your genuine feedback is crucial for optimizing the learning system. Thank you for your support and cooperation!

I. Basic Information (Please mark "√" before your choice)

1. Gender: ☐ Male ☐ Female

2. Grade: ☐ Freshman ☐ Sophomore ☐ Junior

3. Major : ☐ Primary Chinese Education ☐ Primary Mathematics Education

Instructions for Filling Out: For single-choice questions, please mark "√" in the box before the option. For multiple-choice questions, please tick "√" in the boxes before the applicable options. If a question includes an "Others" option and you have additional content to supplement, please fill in your opinions or suggestions in the blank line.

II. Learning Objective Dimension

1. Do you have any confusion about understanding the professional competencies required for primary school teachers when learning courses related to the Primary Education major?

☐ None at all ☐ Seldom ☐ Moderate ☐ Quite a lot ☐ Extremely a lot

2. Do you have a comprehensive career plan for becoming a primary school teacher, and have you set clear learning objectives based on professional competency requirements?

☐ None at all ☐ Seldom ☐ Moderate ☐ Quite a lot ☐ Extremely a lot

3. Can you proactively incorporate national teaching competition standards and teacher qualification examination requirements into your own learning objectives during the learning process?

☐ None at all ☐ Seldom ☐ Moderate ☐ Quite a lot ☐ Extremely a lot

4. Have you received professional career planning advice from teachers regarding your learning objectives, so as to fully prepare for future employment?

☐ None at all ☐ Seldom ☐ Moderate ☐ Quite a lot ☐ Extremely a lot

5. Do you think the college's talent cultivation objectives are clear and highly aligned with the core competency requirements of primary school teaching positions?

☐ None at all ☐ Seldom ☐ Moderate ☐ Quite a lot ☐ Extremely a lot

III. Curriculum Design Dimension

6. Do you think the schedule and frequency of various courses offered are reasonable, and in line with students' learning rhythm and examination requirements?

☐ None at all ☐ Seldom ☐ Moderate ☐ Quite a lot ☐ Extremely a lot

7. Do you think the college has integrated the professional competency-oriented talent training program into the curriculum system?

☐ None at all ☐ Seldom ☐ Moderate ☐ Quite a lot ☐ Extremely a lot

8. What do you think are the main problems with the current curriculum system? (Multiple choices allowed)

☐ Excessively academic and theoretical

☐ Outdated content with slow updates

☐ Difficult to connect with the practical needs of primary school teaching positions

☐ Overlapping content among certain courses

☐ Others _________

9. Do you think the curriculum design and teaching arrangements are in line with the cognitive characteristics of Primary Education majors?

☐ None at all ☐ Seldom ☐ Moderate ☐ Quite a lot ☐ Extremely a lot

10. Do you think the proportion of theoretical courses and practical courses is balanced at present, and can the practical courses meet the needs of cultivating professional skills for primary school teachers?

☐ None at all ☐ Seldom ☐ Moderate ☐ Quite a lot ☐ Extremely a lot

IV. Learning Content Dimension

11. What are the main problems you encounter when learning public basic courses in class? (Multiple choices allowed)

☐ Boring content with low practicality

☐ Poor connection with the cultivation of core professional competencies

☐ Unreasonable time allocation that affects professional learning

☐ Single teaching method lacking interaction

☐ Others ________

12. Do you think the content of professional core courses (e.g., Educational Psychology, Primary School Pedagogy, Subject Teaching Methodology, etc.) offered by the college can meet the requirements of the unified teacher qualification examination and the professional competencies of primary school teachers?

☐ Fully meet ☐ Basically meet ☐ Moderate ☐ Barely meet ☐ Fully not meet

13. What are the main difficulties you encounter when learning professional core courses at college? (Multiple choices allowed)

☐ Abstract theoretical knowledge that is difficult to understand

☐ Disconnection between course content and the reality of primary school teaching

☐ Lack of practical case support

☐ Poor connection of knowledge points between different courses

☐ Others ________

14. Do you think the current arrangement of practical teaching courses (e.g., graduation internship, teaching observation, skill training, etc.) can effectively improve students' professional literacy?

☐ Fully capable ☐ Basically capable ☐ Moderate ☐ Barely capable ☐ Fully incapable

15. What are the main problems you encounter when participating in practical teaching courses? (Multiple choices allowed)

☐ Insufficient practical opportunities and duration

☐ Disconnection between training content and real teaching scenarios

☐ Lack of targeted guidance from instructors

☐ Lack of effective training feedback and reflection

☐ Others ________

V. Learning Resource Dimension

16. Do you think teachers often use modern information technology to assist teaching, so as to improve students' learning efficiency?

☐ None at all ☐ Seldom ☐ Moderate ☐ Quite a lot ☐ Extremely a lot

17. Do you think teachers can appropriately and fully utilize on-campus, off-campus, online and offline teaching resources to stimulate students' learning interest and motivation?

☐ Fully capable ☐ Basically capable ☐ Moderate ☐ Barely capable ☐ Fully incapable

18. Can you proactively search for various online and offline course resources related to Primary Education to study and improve your professional competencies in daily study?

☐ Fully capable ☐ Basically capable ☐ Moderate ☐ Barely capable ☐ Fully incapable

19. How well do you understand digital resources such as the National Smart Education Platform for Primary and Secondary Schools, MOOCs, and AI-assisted learning tools?

☐ Very well ☐ Relatively well ☐ Moderately ☐ Relatively poorly ☐ Not at all

20. What are the main difficulties you encounter when using digital resource libraries? (Multiple choices allowed)

☐ Inconvenient resource search and difficult screening

☐ Uneven quality of resources

☐ Lack of teacher guidance for full utilization

☐ Network or equipment restrictions that hinder smooth use

☐ Others ________

VI. Teaching Implementation Dimension

21. Do you think teachers adopt diversified teaching methods and often use innovative approaches such as inquiry-based, situational, and project-based learning to enhance students' learning interest?

☐ Every time ☐ Most of the time ☐ Occasionally ☐ Seldom ☐ Never

22. Do you think teachers' instructional design is student-centered, focusing on students' learning outcomes and the improvement of their professional competencies?

☐ None at all ☐ Seldom ☐ Moderate ☐ Quite a lot ☐ Extremely a lot

23. What are the main problems with interactive practice sessions in class? (Multiple choices allowed)

☐ Single form of interaction lacking attractiveness

☐ Unreasonable division of labor in group collaboration leading to low efficiency

☐ Teachers' delayed adjustment of teaching due to inadequate use of learning data

☐ Insufficient hands-on practice time for full skill mastery

☐ Others ________

24. What are the main problems in current classroom learning? (Multiple choices allowed)

☐ Poor connection between theoretical explanation and practical training

☐ Superficial implementation of situational simulation and skill demonstration

☐ Excessive teacher-centered teaching with insufficient student participation

☐ Lack of smart teaching tools that affect learning effectiveness

☐ Others ________

25. What are the main problems you encounter in the after-class consolidation and improvement stage? (Multiple choices allowed)

☐ Unreasonable homework difficulty (too hard or too easy)

☐ Lack of peer evaluation and targeted teacher feedback

☐ Inconvenient access to digital extended learning resources

☐ Inability to effectively identify personal deficiencies through reflection

☐ Others ________

VII. Learning Methods Dimension

26. Can you independently plan personalized learning (e.g., using digital course resources, AI-assisted tools, and online research) based on your own professional competency weaknesses?

☐ Fully capable ☐ Basically capable ☐ Moderate ☐ Barely capable ☐ Fully incapable

27. What are the main problems you encounter during independent learning? (Multiple choices allowed)

☐ Lack of self-awareness about personal weaknesses

☐ Difficulty in selecting appropriate digital learning resources

☐ Lack of independent learning planning ability and perseverance

☐ Inability to use AI-assisted tools effectively or achieve good results

☐ Others ________

28. When encountering problems you do not understand during independent learning, will you proactively seek help from teachers or classmates?

☐ Fully capable ☐ Basically capable ☐ Moderate ☐ Barely capable ☐ Fully incapable

29. Do you think teachers can evaluate your learning outcomes in class and after class, and provide corresponding learning suggestions?

☐ Fully capable ☐ Basically capable ☐ Moderate ☐ Barely capable ☐ Fully incapable

30. What is your acceptance level of the "Smart Classroom + Practical Training" teaching model?

☐ Very acceptable ☐ Relatively acceptable ☐ Moderate ☐ Relatively unacceptable ☐ Completely unacceptable

VIII. Learning Evaluation Dimension

31. Do you think teachers can currently evaluate students' learning outcomes by assessing both the mastery of professional knowledge and the achievement of professional competencies?

☐ Every time ☐ Most of the time ☐ Occasionally ☐ Seldom ☐ Never

32. Do you think current course evaluation can focus not only on students' examination scores but also on learning processes (e.g., classroom participation, practical performance, self-study frequency, etc.)?

☐ Every time ☐ Most of the time ☐ Occasionally ☐ Seldom ☐ Never

33. What do you think are the main problems with current learning evaluation? (Multiple choices allowed)

☐ Single evaluation subject, limited to teachers only

☐ Inconsistent evaluation criteria for learning outcomes

☐ Evaluation results fail to fully reflect students' professional competencies

☐ Cumbersome evaluation process

☐ Others ________

34. What do you think are the main problems with professional competency-based evaluation criteria? (Multiple choices allowed)

☐ Overly abstract criteria that are difficult to understand and apply for comparison

☐ Incomplete evaluation indicators that do not cover core professional competencies

☐ Evaluation results cannot effectively reflect learning outcomes

☐ Insufficient guiding role of evaluation for subsequent learning

☐ Others ________

IX. Open-Ended Questions

35. Besides the aspects mentioned above, what other problems or confusions do you encounter during your studies in the Primary Education major at higher vocational colleges?

36. In response to these problems, what specific improvement suggestions or expectations do you have?

Thank you for taking the precious time to participate in this questionnaire. Your opinions are crucial to my research and will provide highly valuable references for this study.

Appendix C2: Table of experts' evaluation of "Questionnaire on the Learning Status of Primary Education Major in Vocational Colleges Based on Professional Competency Cultivation"

To gain a comprehensive understanding of the learning status of Primary Education majors at X Vocational College in Yunnan Province, I have designed a questionnaire. All the questions in the table below are derived from this instrument. I sincerely hope that, through your professional evaluation and guidance, this questionnaire will be made more scientific and rigorous.

Part 1: General information of the experts

1.Your gender:

☐ Male ☐ Female

2.Your professional title:

☐ No Title ☐ Teaching Assistant ☐ Lecturer ☐ Associate Professor

☐ Professor

Part 2: Table of experts' evaluation of "Questionnaire on the Learning Status of Primary Education Major in Vocational Colleges Based on Professional Competency Cultivation"

Filling Instructions: Each item in this questionnaire is rated on a 3-point scale: -1 = Disagree, 0 = Neutral, 1 = Agree. Please mark "√" in the box (☐) corresponding to the score that you think the item deserves.

I. Learning Objective Dimension	For experts		
	-1	0	1
1. Do you have any confusion about understanding the professional competencies required for primary school teachers when learning courses related to the Primary Education major?			
2. Do you have a comprehensive career plan for becoming a primary school teacher, and have you set clear learning objectives based on professional competency requirements?			
3. Can you proactively incorporate national teaching competition standards and teacher qualification examination requirements into your own learning objectives during the learning process?			
4. Have you received professional career planning advice from teachers regarding your learning objectives, so as to fully prepare for future employment?			
5. Do you think the college's talent cultivation objectives are clear and highly aligned with the core competency requirements of primary school teaching positions?			

II. Curriculum Design Dimension	For experts		
	-1	0	+1
6. Do you think the schedule and frequency of various courses offered are reasonable, and in line with students' learning rhythm and examination requirements?			
7. Do you think the college has integrated the professional competency-oriented talent training program into the curriculum system?			

II. Curriculum Design Dimension	For experts		
	-1	0	+1
8. What do you think are the main problems with the current curriculum system? (Multiple choices allowed)			
9. Do you think the curriculum design and teaching arrangements are in line with the cognitive characteristics of Primary Education majors?			
10. Do you think the proportion of theoretical courses and practical courses is balanced at present, and can the practical courses meet the needs of cultivating professional skills for primary school teachers?			

III. Learning Content Dimension	For experts		
	-1	0	+1
11. What are the main problems you encounter when learning public basic courses in class? (Multiple choices allowed)			
12. Do you think the content of professional core courses (e.g., Educational Psychology, Primary School Pedagogy, Subject Teaching Methodology, etc.) offered by the college can meet the requirements of the unified teacher qualification examination and the professional competencies of primary school teachers?			
13. What are the main difficulties you encounter when learning professional core courses at college? (Multiple choices allowed)			
14. Do you think the current arrangement of practical teaching courses (e.g., graduation internship, teaching observation, skill training, etc.) can effectively improve students’ professional literacy?			

III. Learning Content Dimension	For experts		
	-1	0	+1
15. What are the main problems you encounter when participating in practical teaching courses? (Multiple choices allowed)			

IV. Learning Resource Dimension	For experts		
	-1	0	+1
16. Do you think teachers often use modern information technology to assist teaching, so as to improve students' learning efficiency?			
17. Do you think teachers can appropriately and fully utilize on-campus, off-campus, online and offline teaching resources to stimulate students' learning interest and motivation?			
18. Can you proactively search for various online and offline course resources related to Primary Education to study and improve your professional competencies in daily study?			
19. How well do you understand digital resources such as the National Smart Education Platform for Primary and Secondary Schools, MOOCs, and AI-assisted learning tools?			
20. What are the main difficulties you encounter when using digital resource libraries? (Multiple choices allowed)			

V.Teaching Implementation Dimension	For experts		
	-1	0	+1
21. Do you think teachers adopt diversified teaching methods and often use innovative approaches such as inquiry-based, situational, and project-based learning to enhance students' learning interest?			
22. Do you think teachers' instructional design is student-centered, focusing on students' learning outcomes and the improvement of their professional competencies?			
23. What are the main problems with interactive practice sessions in class? (Multiple choices allowed)			
24. What are the main problems in current classroom learning? (Multiple choices allowed)			
25. What are the main problems you encounter in the after-class consolidation and improvement stage? (Multiple choices allowed)			

VI. Learning Methods Dimension	For experts		
	-1	0	+1
26. Can you independently plan personalized learning (e.g., using digital course resources, AI-assisted tools, and online research) based on your own professional competency weaknesses?			
27. What are the main problems you encounter during independent learning? (Multiple choices allowed)			
28. When encountering problems you do not understand during independent learning, will you proactively seek help from teachers or classmates?			
29. Do you think teachers can evaluate your learning outcomes in class and after class, and provide corresponding learning suggestions?			

VI. Learning Methods Dimension	For experts		
	-1	0	+1
30. What is your acceptance level of the "Smart Classroom + Practical Training" teaching model?			

VII. Learning Evaluation Dimension	For experts		
	-1	0	+1
31. Do you think teachers can currently evaluate students' learning outcomes by assessing both the mastery of professional knowledge and the achievement of professional competencies?			
32. Do you think current course evaluation can focus not only on students' examination scores but also on learning processes (e.g., classroom participation, practical performance, self-study frequency, etc.)?			
33. What do you think are the main problems with current learning evaluation? (Multiple choices allowed)			
34. What do you think are the main problems with professional competency-based evaluation criteria? (Multiple choices allowed)			

Appendix C3: First round of the Delphi method expert questionnaire

To cultivate the professional competencies of students majoring in Primary Education at higher vocational colleges and develop an intelligent learning model tailored to their learning requirements, this Delphi consultation is hereby initiated. We earnestly anticipate your valuable suggestions and in-depth insights. We hereby commit that the findings of this consultation will be strictly restricted to the realm of academic research, so as to guarantee the compliance and professionalism of data utilization. We sincerely appreciate your participation in this expert consultation.

Part 1: General information of the experts

Instructions: Please write a mark ✓ in ☐ corresponding to the actual situation about yourself.

1.Your gender:

☐ Male ☐ Female

2.Your professional title:

☐ No Title

☐ Teaching Assistant

☐ Lecturer

☐ Associate Professor

☐ Professor

3.you have been engaged in teaching in the field of Primary Education:

☐ 3 years or less

☐ 4-10 years

☐ 11-20 years

☐ More than 20 years

Part 2: Expert consultation on the elements of intelligent learning model.

Please rate the indicators at each level listed below and provide revision suggestions. The scoring range for this consultation is 1 to 5 points, with specific explanations as follows: 1 point represents "very unimportant", 2 points represent "unimportant", 3 points represent "average", 4 points represent "important", and 5 points represent "very important". Please mark a "√" in the box of the option that aligns with your opinion. In this round of consultation, we solicit your views on the primary indicators, secondary indicators and their corresponding descriptions, and request you to evaluate the appropriateness of these indicators. Should you deem any indicator inappropriate, please provide your revision recommendations; you may also propose indicators that you believe need to be added or deleted.

1. First-level indicators of the intelligent learning model

First-level indicators	1	2	3	4	5	Suggestion
Learning Objectives						
Learning Content						
Learning Resources						
Learning Process						
Learning Methods						
Learning Evaluation						

2. Second-level indicators of the intelligent learning model

Second-level indicators	Description	1	2	3	4	5	Suggestion
Vocational Ethics Practice Competence Objective	Abide by educational laws and regulations, implement the professional ethics norms for primary and secondary school teachers, care for the physical and mental health and growth of primary school students, possess professional dedication, a sense of responsibility and educational devotion, and form professional ethics that meet the requirements of primary education positions.						
Teaching Practice Competence Objective	Master core skills such as instructional design, classroom implementation, homework design and evaluation for all subjects in primary schools; proficiently use digital teaching tools to carry out smart classroom teaching; possess practical abilities in classroom management, learning situation analysis, teaching reflection and optimization, so as to meet the practical needs of primary education and teaching.						
Comprehensive Education Competence Objective	Master basic methods for ideological and moral education and mental health counseling of primary school students; possess abilities in home-school communication, class management and organization of comprehensive practical activities; be able to meet the development needs of students at different levels.						
Public Basic Courses	Covering teacher professional ethics, ideological and political education, college physical education, college foreign languages, fundamentals of computer applications, as well as various elective courses						

Second-level indicators	Description	1	2	3	4	5	Suggestion
	offered by the college, these courses lay a solid foundation for students' professional development.						
Professional Core Courses	Including child psychology, primary school curriculum and teaching (Chinese / Mathematics / English, etc.), primary school curriculum standards and textbook research, primary school instructional design and implementation, and primary school education evaluation, these courses align with the professional competence standards for primary school teachers and the requirements of the national unified examination for teacher qualification, and construct a systematic professional knowledge framework. Practical Teaching Courses						
Practical Teaching Courses	Comprising graduation internship, social practice, professional training (including teaching observation, teaching competitions, etc.), teaching skill training (such as class teacher work, courseware development, instructional design, micro-lesson production, etc.), as well as innovation and entrepreneurship practice projects, these courses strengthen the in-depth integration of theory and practice.						
On - campus Curriculum Resources	Covering textbooks, books and documents, teaching case libraries, smart classrooms, virtual simulation training bases, school-based characteristic textbooks, teaching skill training platforms, and demonstration micro-lessons by on-campus distinguished teachers, these resources meet the needs of on-campus practical training and theoretical learning.						

Second-level indicators	Description	1	2	3	4	5	Suggestion
Off - campus Collaborative Resources	Including cooperative primary school practice bases, lectures and training sessions delivered by education industry experts, resources from local educational research institutions, and public welfare teaching support programs, these resources realize the collaborative education of higher vocational colleges and social resources.						
Digital Resource Library	Comprising resources from the National Smart Education Platform for Primary and Secondary Schools, teaching case libraries, as well as online question banks and assessment systems, this library supports intelligent independent learning.						
Pre-class Preview and Preparation Stage	Complete the preview of key knowledge points with the aid of digital resources, and conduct learning situation diagnosis via online questionnaires and preview task sheets; use virtual simulation tools to rehearse basic teaching skills in advance and clarify the key and difficult points of learning.						
In-class Interaction and Practice Stage	Carry out case analysis, group collaborative inquiry, and practical drills of teaching skills through smart classrooms; teachers adjust teaching in real time based on learning situation data, and use interactive tools to realize classroom feedback as well as Q&A sessions.						
Post-class Consolidation and Improvement Stage	Finish online hierarchical assignments, review of teaching cases, and micro-lesson recording and optimization; submit practice reports via the learning platform, and participate in self-assessment, peer assessment, and teacher evaluation.						

Second-level indicators	Description	1	2	3	4	5	Suggestion
Independent Learning	With reference to learning objectives and based on individual weaknesses in professional competencies, students conduct personalized learning by utilizing digital resource libraries and online courses.						
Classroom Learning	Adopting an integrated model of "Smart Classroom + Practical Training", this stage realizes the synchronous improvement of theoretical knowledge and practical capabilities through case-based teaching, situational simulation, skill demonstration, real-time interaction and other approaches.						
Multi - subject Evaluation	Covering evaluations by on-campus teachers, outstanding primary school teachers, peers and self-evaluation, as well as data statistical evaluations generated by intelligent platforms and software, this evaluation method ensures comprehensiveness and alignment with the professional competencies required for primary school teaching positions.						
Vocational Competence - based Evaluation Criteria	Corresponding to learning objectives and learning content, these criteria conduct evaluations based on students' learning outcomes, thereby providing guidance for students' personalized learning.						

Appendix C4: Second round of the Delphi method expert questionnaire

To cultivate the professional competencies of students majoring in Primary Education at higher vocational colleges and develop an intelligent learning model tailored to their learning requirements, this Delphi consultation is hereby initiated. We earnestly anticipate your valuable suggestions and in-depth insights. We hereby commit that the findings of this consultation will be strictly restricted to the realm of academic research, so as to guarantee the compliance and professionalism of data utilization. We sincerely appreciate your participation in this expert consultation.

Part 1: General information of the experts

Instructions: Please write a mark ✓ in ☐ corresponding to the actual situation about yourself.

1.Your gender:

☐ Male

☐ Female

2.Your professional title:

☐ No Title

☐ Teaching Assistant

☐ Lecturer

☐ Associate Professor

☐ Professor

3.you have been engaged in teaching in the field of Primary Education:

☐ 3 years or less

☐ 4-10 years

☐ 11-20 years

☐ More than 20 years

Part 2: Expert consultation on the elements of intelligent learning model.

Please rate the indicators at each level listed below and provide revision suggestions. The scoring range for this consultation is 1 to 5 points, with specific explanations as follows: 1 point represents "very unimportant", 2 points represent "unimportant", 3 points represent "average", 4 points represent "important", and 5 points represent "very important". Please mark a "√" in the box of the option that aligns with your opinion. In this round of consultation, we solicit your views on the primary indicators, secondary indicators and their corresponding descriptions, and request you to evaluate the appropriateness of these indicators. Should you deem any indicator inappropriate, please provide your revision recommendations; you may also propose indicators that you believe need to be added or deleted.

1. First-level indicators of the intelligent learning model

First-level indicators	1	2	3	4	5	**Suggestion**
Learning Objectives						
Learning Content						
Learning Resources						
Learning Process						
Learning Methods						
Learning Evaluation						

2. Second-level indicators of the intelligent learning model

Second-level indicators	**Description**	1	2	3	4	5	**Suggestion**
Vocational Ethics Practice Competence Objective	Abide by educational laws and regulations, implement the professional ethics norms for primary and secondary school teachers, care for the physical and mental health and growth of						

Second-level indicators	Description	1	2	3	4	5	Suggestion
	primary school students, possess professional dedication, a sense of responsibility and educational devotion, and form professional ethics that meet the requirements of primary education positions.						
Teaching Practice Competence Objective	Master core skills such as instructional design, classroom implementation, homework design and evaluation for all subjects in primary schools; proficiently use digital teaching tools to carry out smart classroom teaching; possess practical abilities in classroom management, learning situation analysis, teaching reflection and optimization, so as to meet the practical needs of primary education and teaching.						
Comprehensive Education Competence Objective	Master basic methods for ideological and moral education and mental health counseling of primary school students; possess abilities in home-school communication, class management and organization of comprehensive practical activities; be able to meet the development needs of students at different levels.						
Independent Development Competence Objective	Cultivate a lifelong learning awareness, and be able to utilize intelligent learning resources to update educational philosophies and knowledge systems; focus on two dimensions including professional growth and active communication and cooperation, and continuously improve teaching practices through reflection and feedback to adapt to the reform and development of basic education.						
Public Basic Courses	Covering teacher professional ethics, ideological and political education, college physical education,						

Second-level indicators	Description	1	2	3	4	5	Suggestion
	college foreign languages, fundamentals of computer applications, as well as various elective courses offered by the college, these courses lay a solid foundation for students' professional development.						
Professional Core Courses	Including child psychology, primary school curriculum and teaching (Chinese / Mathematics / English, etc.), primary school curriculum standards and textbook research, primary school instructional design and implementation, and primary school education evaluation, these courses align with the professional competence standards for primary school teachers and the requirements of the national unified examination for teacher qualification, and construct a systematic professional knowledge framework. Practical Teaching Courses						
Practical Teaching Courses	Comprising graduation internship, social practice, professional training (including teaching observation, teaching competitions, etc.), teaching skill training (such as class teacher work, courseware development, instructional design, micro-lesson production, etc.), as well as innovation and entrepreneurship practice projects, these courses strengthen the in-depth integration of theory and practice.						
Quality Development Courses	Covering children's literature, music, fine arts, dance, physical education, home-school communication skills, and methods for integrating modern information technology into education, these courses further enhance teachers'						

Second-level indicators	Description	1	2	3	4	5	Suggestion
	professional literacy.						
On - campus Curriculum Resources	Covering textbooks, books and documents, teaching case libraries, smart classrooms, virtual simulation training bases, school-based characteristic textbooks, teaching skill training platforms, and demonstration micro-lessons by on-campus distinguished teachers, these resources meet the needs of on-campus practical training and theoretical learning.						
Off - campus Collaborative Resources	Including cooperative primary school practice bases, lectures and training sessions delivered by education industry experts, resources from local educational research institutions, and public welfare teaching support programs, these resources realize the collaborative education of higher vocational colleges and social resources.						
Digital Resource Library	Including resources from the National Smart Education Platform for Primary and Secondary Schools, the National Smart Education Platform for Vocational Education, China University MOOC, the National Online Platform for Primary and Secondary School Experiments, teaching case libraries, as well as online question banks and assessment systems, this library supports intelligent independent learning.						
Pre-class Preview and Preparation Stage	Complete the preview of key knowledge points with the aid of digital resources, and conduct learning situation diagnosis via online questionnaires and preview task sheets; use virtual simulation tools to rehearse basic teaching skills in advance and clarify the key and difficult points of						

Second-level indicators	Description	1	2	3	4	5	Suggestion
	learning.						
In-class Interaction and Practice Stage	Carry out case analysis, group collaborative inquiry, and practical drills of teaching skills through smart classrooms; teachers adjust teaching in real time based on learning situation data, and use interactive tools to realize classroom feedback as well as Q&A sessions.						
Post-class Consolidation and Improvement Stage	Finish online hierarchical assignments, review of teaching cases, and micro-lesson recording and optimization; submit practice reports via the learning platform, and participate in self-assessment, peer assessment, and teacher evaluation.						
Independent Learning	With reference to learning objectives and based on individual weaknesses in professional competencies, students conduct personalized learning by utilizing digital resource libraries and online courses.						
Collaborative Learning	Complete tasks such as instructional design, classroom simulation and practical projects in the form of groups; share resources and conduct division of labor and collaboration via online collaborative platforms, so as to cultivate team collaboration and communication capabilities.						
Classroom Learning	Adopting an integrated model of "Smart Classroom + Practical Training", this stage realizes the synchronous improvement of theoretical knowledge and practical capabilities through case-based teaching, situational simulation, skill demonstration, real-time interaction and other						

Second-level indicators	Description	1	2	3	4	5	Suggestion
	approaches.						
Multi - subject Evaluation	Covering evaluations by on-campus teachers, outstanding primary school teachers, peers and self-evaluation, as well as data statistical evaluations generated by intelligent platforms and software, this evaluation method ensures comprehensiveness and alignment with the professional competencies required for primary school teaching positions.						
Vocational Competence - based Evaluation Criteria	Corresponding to learning objectives and learning content, these criteria conduct evaluations based on students' learning outcomes, thereby providing guidance for students' personalized learning.						
Comprehensive Evaluation Methods	The college has established a professional development and teaching quality diagnosis and improvement mechanism for the Primary Education major based on professional competencies, and adopted an assessment method combining formative assessment and summative assessment to conduct a comprehensive evaluation of students' knowledge level and professional literacy.						

Appendix C5: Third round of the Delphi method expert questionnaire

To cultivate the professional competencies of students majoring in Primary Education at higher vocational colleges and develop an intelligent learning model tailored to their learning requirements, this Delphi consultation is hereby initiated. We earnestly anticipate your valuable suggestions and in-depth insights. We hereby commit that the findings of this consultation will be strictly restricted to the realm of academic research, so as to guarantee the compliance and professionalism of data utilization. We sincerely appreciate your participation in this expert consultation.

Part 1: General information of the experts

Instructions: Please write a mark ✓ in ☐ corresponding to the actual situation about yourself.

1.Your gender:

☐ Male

☐ Female

2.Your professional title:

☐ No Title

☐ Teaching Assistant

☐ Lecturer

☐ Associate Professor

☐ Professor

3.you have been engaged in teaching in the field of Primary Education:

☐ 3 years or less

☐ 4-10 years

☐ 11-20 years

☐ More than 20 years

Part 2: Expert consultation on the elements of intelligent learning model

Please rate the indicators at each level listed below and provide revision suggestions. The scoring range for this consultation is 1 to 5 points, with specific explanations as follows: 1 point represents "very unimportant", 2 points represent "unimportant", 3 points represent "average", 4 points represent "important", and 5 points represent "very important". Please mark a "√" in the box of the option that aligns with your opinion. In this round of consultation, we solicit your views on the primary indicators, secondary indicators and their corresponding descriptions, and request you to evaluate the appropriateness of these indicators. Should you deem any indicator inappropriate, please provide your revision recommendations; you may also propose indicators that you believe need to be added or deleted.

1. First-level indicators of the intelligent learning model

First-level indicators	1	2	3	4	5	Suggestion
Learning Objectives						
Learning Content						
Learning Resources						
Learning Process						
Learning Interaction						
Learning Evaluation						

2. Second-level indicators of the intelligent learning model

Second-level indicators	Description	1	2	3	4	5	Suggestion
Vocational Ethics Practice Competence Objective	Abide by educational laws and regulations, implement the professional ethics norms for primary and secondary school teachers, care for the physical and mental health and growth of primary school students, possess professional dedication, a sense of responsibility and educational devotion, and form professional ethics that meet the requirements of primary education positions.						
Teaching Practice Competence Objective	Master core skills such as instructional design, classroom implementation, homework design and evaluation for all subjects in primary schools; proficiently use digital teaching tools to carry out smart classroom teaching; possess practical abilities in classroom management, learning situation analysis, teaching reflection and optimization, so as to meet the practical needs of primary education and teaching.						
Comprehensive Education Competence Objective	Master basic methods for ideological and moral education and mental health counseling of primary school students; possess abilities in home-school communication, class management and organization of comprehensive practical activities; be able to meet the development needs of students at different levels.						
Independent Development Competence Objective	Cultivate a lifelong learning awareness, and be able to utilize intelligent learning resources to update educational philosophies and knowledge systems; focus on two dimensions including professional						

Second-level indicators	Description	1	2	3	4	5	Suggestion
	growth and active communication and cooperation, and continuously improve teaching practices through reflection and feedback to adapt to the reform and development of basic education.						
Public Basic Courses	Covering teacher professional ethics, ideological and political education, college physical education, college foreign languages, fundamentals of computer applications, as well as various elective courses offered by the college, these courses lay a solid foundation for students' professional development.						
Professional Core Courses	Including child psychology, primary school curriculum and teaching (Chinese / Mathematics / English, etc.), primary school curriculum standards and textbook research, primary school instructional design and implementation, and primary school education evaluation, these courses align with the professional competence standards for primary school teachers and the requirements of the national unified examination for teacher qualification, and construct a systematic professional knowledge framework. Practical Teaching Courses						
Practical Teaching Courses	Comprising graduation internship, social practice, professional training (including teaching observation, teaching competitions, etc.), teaching skill training (such as class teacher work, courseware development, instructional design, micro-lesson production, etc.), as well as innovation and entrepreneurship practice projects, these courses strengthen the in-depth integration						

Second-level indicators	Description	1	2	3	4	5	Suggestion
	of theory and practice.						
Quality Development Courses	Covering children's literature, music, fine arts, dance, physical education, home-school communication skills, and methods for integrating modern information technology into education, these courses further enhance teachers' professional literacy.						
On - campus Curriculum Resources	Covering textbooks, books and documents, teaching case libraries, smart classrooms, virtual simulation training bases, school-based characteristic textbooks, teaching skill training platforms, and demonstration micro-lessons by on-campus distinguished teachers, these resources meet the needs of on-campus practical training and theoretical learning.						
Off - campus Collaborative Resources	Including cooperative primary school practice bases, lectures and training sessions delivered by education industry experts, resources from local educational research institutions, and public welfare teaching support programs, these resources realize the collaborative education of higher vocational colleges and social resources.						
Digital Resource Library	Including resources from the National Smart Education Platform for Primary and Secondary Schools, the National Smart Education Platform for Vocational Education, China University MOOC, the National Online Platform for Primary and Secondary School Experiments, teaching case libraries, as well as online question banks and assessment systems,						

Second-level indicators	Description	1	2	3	4	5	Suggestion
	this library supports intelligent independent learning.						
Pre - class Session	Complete the preview of key knowledge points with the aid of digital resources, and conduct learning situation diagnosis via online questionnaires and preview task sheets; use virtual simulation tools to rehearse basic teaching skills in advance and clarify the key and difficult points of learning.						
In - class Session	Carry out case analysis, group collaborative inquiry, and practical drills of teaching skills through smart classrooms; teachers adjust teaching in real time based on learning situation data, and use interactive tools to realize classroom feedback as well as Q&A sessions.						
Post - class Session	Finish online hierarchical assignments, review of teaching cases, and micro-lesson recording and optimization; submit practice reports via the learning platform, and participate in self-assessment, peer assessment, and teacher evaluation.						
Human - Computer Interaction	Students retrieve learning resources and select learning content by utilizing the Internet, intelligent software, social media, and GAI tools, thereby enhancing their personalized learning experience.						
Peer Interaction	Through social software and smart teaching platforms, students obtain learning support from peers by asking questions, providing answers, and sharing assignments with group members or learning partners.						

Second-level indicators	Description	1	2	3	4	5	Suggestion
Teacher - Student Interaction	Students interact with teachers via offline classrooms, online social software, and smart teaching platforms, enabling them to receive personalized guidance from teachers anytime and anywhere						
Multi - subject Evaluation	Covering evaluations by on-campus teachers, outstanding primary school teachers, peers and self-evaluation, as well as data statistical evaluations generated by intelligent platforms and software, this evaluation method ensures comprehensiveness and alignment with the professional competencies required for primary school teaching positions.						
Vocational Competence - based Evaluation Criteria	Corresponding to learning objectives and learning content, these criteria conduct evaluations based on students' learning outcomes, thereby providing guidance for students' personalized learning.						
Comprehensive Evaluation Methods	The college has established a professional development and teaching quality diagnosis and improvement mechanism for the Primary Education major based on professional competencies, and adopted an assessment method combining formative assessment and summative assessment to conduct a comprehensive evaluation of students' knowledge level and professional literacy.						

Appendix C6: Lesson one for "Child Psychology"

Lesson Plan: Cognitive Development of Primary School Children

Student Groups Being Taught: Primary Education Major, Sophomore **Students Duration**: Four Class Periods

I. Career Competency-Oriented Learning Objectives

1.Professional Ethics Practice Competency Objective: Through learning the laws governing children's cognitive development, students will develop a correct view of teachers, a correct view of education, and corresponding behaviors, so as to understand, respect, and care for students.

2.Teaching Practice Competency Objective: Enable students to understand the concepts and classifications of sensation and perception, and master the general laws and main characteristics of the development of children's sensation and perception.

3.Comprehensive Education Competency Objective: Equip students with the ability to observe and analyze practical problems in school education, teaching, and teaching reform, and put forward feasible suggestions for improving the quality of education and teaching.

4.Independent Development Competency Objective: Enable students to consciously improve their scientific and humanistic literacy by applying the knowledge they have learned.

II. Learning Content

1.Overview of sensation and perception

2.Development of children's visual, auditory, and tactile senses

3.Development of children's spatial perception and temporal perception

III. Key and Difficult Learning Points

Understand the concepts and classifications of sensation and perception, and recognize the importance of visual and auditory development for children's learning and growth.

IV. Learning Resources (Distributed to Students Before and After Class for Independent and Personalized Learning)

1.On-Campus Resources: Child Psychology Teaching Case Library; Virtual Simulation Training Base (simulated primary school classroom scenarios); Demonstration Micro-lessons by On-Campus Master Teachers; Teaching Skills Training Platform.

2.Off-Campus Resources: Teaching practice cases of lower grades in cooperative primary schools; Special lecture videos by education industry experts on the development of children's sensation and perception.

3.Digital Resources: "Children's Cognitive Development" thematic resources on the National Smart Education Platform for Primary and Secondary Schools; Relevant chapters of Child Psychology on the Chinese University MOOC platform.

V. Learning Process and Learning Interaction

(I) Pre-Class Session (Teacher’s Learning Situation Diagnosis + Students’ Independent Preview)

1.Teacher’s Actions: Release pre-test questions through the intelligent teaching platform, such as "What visual problems do you think lower-grade primary school students are prone to when looking at the blackboard?" Collect answer data to conduct learning situation analysis and adjust the allocation of key and difficult points in classroom teaching.

2.Students’ Actions: Align with the learning objectives to self-check their deficiencies in mastering the knowledge of children's sensation and perception;

Use spare time to retrieve preview materials from on-campus and off-campus case libraries and digital resource libraries for personalized learning, clarify key and difficult learning points, and record preview questions.

3.Learning Interaction:

Human-computer interaction (Teachers release test questions and learning content through the intelligent platform; Students take tests and view relevant learning resources via the platform).

Peer interaction (Group discussions online and offline).

(II) In-Class Session (Intelligent Classroom + Students' Practical Training)

1.Class Introduction: The teacher starts the class with a question related to professional scenarios: "As future rural primary school teachers, if you find that students are often inattentive and cannot see the blackboard clearly in class, what characteristics of sensory and perceptual development may be related to this?" Trigger students' discussions combined with real cases in primary schools.

2.Class Objectives: Enable students to understand the concepts and classifications of sensation and perception, and master the general laws and main characteristics of the development of children's sensation and perception.

3.Class Interaction:

The teacher releases the pre-test results, focuses on the high-frequency error points of students, and conducts roaming guidance in the classroom.

Learning Interaction: Human-computer interaction (View test reports on the platform); Peer interaction (Group discussions); Teacher-student interaction (Q&A sessions).

The teacher explains the concepts, classifications, and developmental laws of children's sensation and perception by combining PPT with virtual simulation scenarios, and integrates cases such as "How rural primary schools use the natural environment to cultivate children's spatial perception" into the explanation.

Practical Training Session: Students are divided into groups to carry out the practical operation of "classroom activity design". Based on the laws of sensation and perception, design one classroom interaction activity suitable for lower-grade primary school students (e.g., visual attention training games) and simulate the demonstration on the virtual simulation training platform.

4.Learning Interaction: Human-computer interaction (Practical operation on the intelligent platform); Peer interaction (Teamwork in design); Teacher-student interaction (Skill guidance + case comments).

5.Class Summary: The teacher summarizes the learning content of this session, assigns homework to students, and asks them to review the content learned in this class.

(III) Post-Class Session (Teacher's Evaluation and Feedback + Students' Advanced Learning)

1.Teacher's Actions: Grade the post-test questions and practical training results through the intelligent platform, generate personalized learning reports (including knowledge point scores, career competency achievement levels, and deficiency analysis); Analyze the overall learning situation based on group learning data, verify the achievement of teaching objectives, and put forward suggestions for the next round of learning for each student based on their reports.

2.Students' Actions: Receive personal learning reports and reflect on deficiencies against the career competency objectives; Complete after-class homework and participate in self-evaluation and peer evaluation on the platform; According to the teacher's suggestions, use the digital resource library for supplementary learning to prepare for the next class "Cognitive Development of Children – Sessions 3 and 4".

3.After-Class Homework: What are the characteristics of the occurrence and development of children's visual, auditory, and tactile senses? How do these three major senses coordinate with each other? Please design a classroom game plan for lower-grade primary school teaching scenarios that utilizes the law of "coordinated development of vision and hearing".

VI. Learning Evaluation

1.Evaluation Subjects: On-campus teachers, peers, teachers from off-campus practice bases, and students themselves.

2.Evaluation Dimensions: On-campus teachers evaluate students based on classroom performance, homework, pre-test and post-test scores, intelligent platform data, and self-study situation; Peers evaluate the homework of group members; Students evaluate their own ability to retrieve resources and use modern information tools for self-study; Teachers from off-campus practice bases score students' case analysis and practical assignments.

3.Evaluation Methods: Formative assessment (pre-class preview, in-class practical operation, intelligent platform data, etc., accounting for 60%) + Summative assessment (quality of after-class homework, accounting for 40%). The evaluation results are aligned with career competency objectives, incorporated into learner profiles, and used to guide subsequent personalized learning.

Appendix C7: Lesson two for "Child Psychology"

Lesson Plan: The Emergence and Development of Children's Attention & the Qualities of Attention

Student Groups Being Taught: Primary Education Major, Sophomore Students
Duration: Four Class Periods

I. Career Competency-Oriented Learning Objectives

1.Professional Ethics Practice Competency Objective: Develop a correct view of students, a correct view of teachers and a correct view of education; understand, respect and care for students; and consciously improve one's own scientific and humanistic literacy.

2.Teaching Practice Competency Objective: Enable students to understand the concepts and classifications of sensation and perception; master the age characteristics and general trends of the development of children's attention and memory; and grasp the application logic of forgetting rules in primary school education.

3.Comprehensive Education Competency Objective: Equip students with the ability to observe and analyze practical problems in school education, teaching and teaching reform, and put forward feasible suggestions for improving the quality of education and teaching.

4.Independent Development Competency Objective: Enable students to consciously improve their scientific and humanistic literacy by applying the knowledge they have learned.

II. Learning Content

1.The development of children's attention and observation

2.The development of children's memory

III. Key and Difficult Learning Points

1.The emergence, development and qualities of children's attention

2.The concept and classification of memory, as well as the general trends and characteristics of memory development

IV. Learning Resources (Distributed to Students Before and After Class for Independent and Personalized Learning)

1.On-Campus Resources: On-campus training base; school-based teaching case library (cognitive teaching cases of rural primary schools in Yunnan); demonstration micro-lessons by on-campus master teachers.

2.Off-Campus Resources: Classroom recording videos from primary school practice bases; guidelines for optimizing rural primary school teaching issued by local teaching and research institutions.

3.Digital Resources: "Children's Cognitive Development" thematic resources on the National Smart Education Platform for Primary and Secondary Schools; relevant resources of Child Psychology on MOOC platforms; real questions of teacher qualification examinations in online question banks and assessment systems.

V. Learning Process and Learning Interaction

(I) Pre-Class Session (Teacher's Learning Situation Diagnosis + Students' Independent Preview)

1.Teacher's Actions: Release pre-test questions through the intelligent teaching platform, such as "What do you think are the main reasons for distraction in class among lower-grade students in rural primary schools?" and "What simple children's memory training methods do you know?". Collect answer data to generate a learning situation analysis report, locate students' knowledge blind spots, and determine how to explain the key and difficult points of teaching.

2.Students' Actions: Align with the learning objectives to self-check questions about the knowledge points of children's memory development; use spare time to retrieve preview materials from on-campus and off-campus case libraries and digital resource libraries for personalized learning, clarify key and difficult learning points, and record preview questions.

3.Learning Interaction:

Human-computer interaction (Teachers release test questions and learning content through the intelligent platform; Students take tests and view relevant learning resources via the platform).

Peer interaction (Group discussions online and offline).

(II) In-Class Session (Intelligent Classroom + Students' Practical Training)

1.Class Introduction: The teacher raises a question: "What scenarios of students' inattention and low memory efficiency have you seen in rural primary school classrooms?" Then, the teacher introduces the key points of this lesson by sharing cases of memory strategy application in literacy teaching for lower and middle grades in rural primary schools.

2.Class Objectives: Understand the concepts and classifications of attention, observation and memory, as well as the development laws of children's attention and memory.

3.Class Interaction:

The teacher releases the career competency-integrated learning objectives of this chapter (covering knowledge, ability and quality dimensions), clarifying the relationship between learning objectives and learning content. The teacher publishes the pre-test results and answers the common questions and preview deficiencies in independent learning.

Intelligent Classroom + Practical Training: The teacher explains core knowledge points combined with cases of rural primary schools in Yunnan, such as how rural primary schools design science classes by using observation rules. The teacher sends test questions to students through the intelligent platform to enliven the classroom atmosphere and conduct real-time comments.

Students are required to sort out knowledge points following the teacher’s train of thought, record application scenarios related to career competencies, and be given some time for group discussions.

4.Learning Interaction:

Human-computer interaction (Interaction between teachers and students on the intelligent teaching platform);Peer interaction (Group discussions);Teacher-student interaction (Q&A sessions).

(III) Post-Class Session (Teacher’s Evaluation and Feedback + Students’ Advanced Learning)

1.Teacher’s Actions: Grade post-test questions and practical training results through the intelligent platform, generate personalized learner profile reports combined with group peer review data, clarify each student’s knowledge weaknesses and career competency gaps, and provide targeted suggestions for the next round of learning for each student.

2.Students’ Actions: Receive personal learning reports and reflect on deficiencies against career competency objectives; complete after-class homework and participate in self-evaluation and peer evaluation on the platform; conduct supplementary learning by using the digital resource library according to the teacher’s suggestions to prepare for the next class "The Development of Children's Personality and Sociality".

3.After-Class Homework: Based on the knowledge learned in this class, design a teaching plan for classroom attention management for Grade Two students in rural primary schools in Yunnan (including activity objectives, implementation steps and low-cost prop preparation, adapted to rural teaching conditions).

VI. Learning Evaluation

1.Evaluation Subjects: On-campus teachers, peers, teachers from off-campus practice bases, and students themselves.

2.Evaluation Dimensions: On-campus teachers evaluate students based on classroom performance, homework, pre-test and post-test scores, intelligent platform data, and self-study situation; peers evaluate the homework of group members; students evaluate their own ability to retrieve resources and use modern information tools for self-study; teachers from off-campus practice bases score students' case analysis and practical assignments.

3.Evaluation Methods: Formative assessment (pre-class preview, in-class practical operation, intelligent platform data, etc., accounting for 60%) + Summative assessment (quality of after-class homework, accounting for 40%). The evaluation results are aligned with career competency objectives, incorporated into learner profiles, and used to guide subsequent personalized learning.

Appendix C8: Lesson three for "Modern Educational Technology"

Lesson Plan: Information-Based Teaching and Its Instructional Design

Student Groups Being Taught: Primary Education Major, Sophomore Students
Duration: Four Class Periods

I. Career Competency-Oriented Learning Objectives

1.Professional Ethics Practice Competency Objective: Initially acquire the theories, methods and skills of education and teaching in the information age, as well as the awareness and attitude of applying information technology to teaching and learning. Strengthen the sense of responsibility of empowering primary school education with modern educational technology.

2.Teaching Practice Competency Objective: Combined with the actual teaching situation of rural primary schools in Yunnan (such as limited resources and special learning needs of students), complete a full set of information-based instructional design plans through group collaboration, and possess the practical ability to integrate information technology into primary school subject teaching.

3.Comprehensive Education Competency Objective: Understand the definition, characteristics and basic principles of information-based instructional design; clarify the adaptation logic of information-based resources in rural primary school teaching.

4.Independent Development Competency Objective: Independently use intelligent learning resources to update educational concepts and knowledge systems, and cultivate the ability to support teaching with modern information technology.

II. Learning Content

Be able to accurately describe the characteristics of information-based teaching and information-based instructional design; understand the basic principles of information-based instructional design.

III. Key and Difficult Learning Points

1.Be able to understand the steps of instructional design that integrate the teacher's leading role with the student's dominant role.

2.Be able to understand the tools and methods of information-based teaching evaluation.

IV. Learning Resources (Distributed to Students Before and After Class for Independent and Personalized Learning)

1.On-Campus Resources: Modern Educational Technology Thematic Case Library; Virtual Simulation Training Base (simulated information-based classroom scenarios in rural primary schools); Demonstration Micro-lessons by On-Campus Master Teachers; Teaching Skills Training Platform (Information-Based Instructional Design Template Library).

2.Off-Campus Resources: Information Technology Application Guidelines from Off-Campus Practice Bases; Excerpts of lectures on rural education informatization delivered by education experts.

3.Digital Resources: "Information-Based Instructional Design" thematic courses on the National Smart Education Platform for Vocational Education; Relevant chapters of Modern Educational Technology on the National Smart Education Platform for Primary and Secondary Schools and Chinese University MOOC; Practical operation tutorials for Chaoxing Learning Pass and Rain Classroom.

V. Learning Process and Learning Interaction

(I) Pre-Class Session (Teacher’s Learning Situation Diagnosis + Students’ Independent Preview)

1.Teacher’s Actions: Release pre-test questions through the intelligent teaching platform and design targeted questions to assess students’ basic understanding of information-based teaching and instructional design, so as to provide a basis for adjusting subsequent teaching content.

2.Students' Actions: Answer questions on the intelligent teaching platform to identify their own weaknesses in applying information-based tools to instructional design; conduct learning on relevant content by using on-campus and off-campus resource libraries as well as digital resources.

3.Learning Interaction:

Human-computer interaction (Teachers release test questions and learning content through the intelligent platform; Students take tests and view relevant learning resources via the platform).Peer interaction (Group discussions online and offline).

(II) In-Class Session (Intelligent Classroom + Students' Practical Training)

1.Class Introduction: The teacher introduces the theme of this lesson—Information-Based Teaching and Its Instructional Design, briefly expounds the concept and significance of information-based teaching, and arouses students' interest.

2.Class Objectives: Guide students to accurately describe the characteristics of information-based teaching and information-based instructional design; help them understand the basic principles of information-based instructional design.

3.Class Interaction:

The teacher releases the pre-test results, focuses on high-frequency error points, conducts roaming guidance in the classroom and sorts out common learning needs.

The teacher explains the connotation, principles of information-based instructional design and the complete steps of the teaching model that integrates the teacher's leading role with the student's dominant role, by combining PPT with virtual simulation classroom scenarios.Ask students to assess their own learning styles by using Fleming, N.'s VARK (Visual, Aural, Read/Write, Kinesthetic)

Questionnaire.

3.Learning Interaction:

Human-computer interaction (Answering questions on the intelligent platform);

Teacher-student interaction (Skill guidance + case comments).

(III) Post-Class Session (Teacher’s Evaluation and Feedback + Students’ Advanced Learning)

1.Teacher’s Actions: The teacher sorts out the core knowledge points, releases the chapter test questions and assigns after-class homework through the Rain Classroom intelligent platform. Meanwhile, combined with the data from the intelligent platform and group peer review results, generate personalized learner profile reports, clarify each student’s knowledge weaknesses and career competency gaps, and provide targeted suggestions for the next round of learning for each student.

2.Students’ Actions: Receive personal learning reports and reflect on deficiencies against career competency objectives; complete after-class homework and participate in self-evaluation and peer evaluation on the platform; conduct supplementary learning by using the digital resource library according to the teacher’s suggestions.

3.After-Class Homework: Search for 2 cases of teaching objective analysis and formulation online, analyze their shortcomings, and revise and improve them.

VI. Learning Evaluation

1.Evaluation Subjects: On-campus teachers, peers, teachers from off-campus practice bases, and students themselves.

2.Evaluation Dimensions: On-campus teachers conduct evaluations based on students’ classroom performance, homework, pre-test and post-test scores, data from intelligent platforms, and self-study performance; peers evaluate the

homework of group members; students assess their own competence in resource retrieval and self-learning by using modern information tools; teachers from off-campus practice bases score students' case analysis and practical assignments. 3.Evaluation Methods: Formative assessment (including pre-class preview, in-class practical operation, data from intelligent platforms, etc., accounting for 60%) combined with summative assessment (quality of after-class homework, accounting for 40%). The evaluation results are aligned with career competency objectives, incorporated into learner profiles, and used to guide subsequent personalized learning.

Appendix C9: Lesson four for “Modern Educational Technology”

Lesson Plan: Design, Development and Evaluation of Multimedia Courseware

Student Groups Being Taught: Primary Education Major, Sophomore Students
Duration: Four Class Periods

I. Career Competency-Oriented Learning Objectives

1.Professional Ethics Practice Competency Objective: Cultivate a rigorous and meticulous attitude towards courseware development, and improve the professional literacy of using high-quality courseware to facilitate efficient learning for students in rural primary schools.

2.Teaching Practice Competency Objective: Master the design and development process of multimedia courseware, and develop relevant multimedia courseware based on instructional design.

3.Comprehensive Education Competency Objective: Understand the definition, characteristics and basic principles of information-based instructional design; develop the ability to integrate information-based resources into rural primary school teaching.

4.Independent Development Competency Objective: Be able to apply the learned knowledge to distinguish the advantages and disadvantages of multimedia courseware.

II. Learning Content

Understand the concept, characteristics and types of multimedia courseware, as well as the core concepts and basic principles of multimedia courseware design; grasp the whole process of PPT courseware development.

III. Key and Difficult Learning Points

Practice the use of PPT interface tools

IV. Learning Resources (Distributed to Students Before and After Class for Independent and Personalized Learning)

1.On-Campus Resources: On-campus Excellent Multimedia Courseware Case Library; Demonstration Micro-lessons by On-Campus Master Teachers; Teaching Skills Training Platform.

2.Off-Campus Resources: Courseware samples from off-campus practice bases; Guidelines for rural teachers on courseware development issued by local teaching and research institutions.

3.Digital Resources: "PPT Courseware Development" thematic course on the National Smart Education Platform for Vocational Education; Relevant resource libraries on the National Smart Education Platform for Primary and Secondary Schools; Courseware development chapters of Modern Educational Technology on Chinese University MOOC, etc.

V. Learning Process and Learning Interaction

(I) Pre-Class Session (Teacher’s Learning Situation Diagnosis + Students’ Independent Preview)

1.Teacher’s Actions: Release pre-test questions through the intelligent teaching platform (covering the knowledge points of information-based instructional design from the previous session and the key points of multimedia courseware in this session). Generate a learning situation analysis report to accurately locate students’ cognitive blind spots and adjust the focus of classroom teaching.

2.Students’ Actions: Self-assess their deficiencies in PPT operation and courseware design; preview core knowledge points by using the resources provided by teachers or digital resource libraries.

3.Learning Interaction: Human-computer interaction (Teachers release test questions and learning content through the intelligent platform; Students take tests and view relevant learning resources via the platform).Peer interaction (Group discussions online and offline).

(II) In-Class Session (Intelligent Classroom + Students' Practical Training)

1.Class Introduction: The teacher introduces the importance and application value of multimedia courseware to stimulate students' learning interest.

2.Class Objectives: Clarify the teaching objectives and expected outcomes of this session, so that students can clearly understand the learning focus and goals.

3.Class Interaction:Organize groups to summarize "the most confusing courseware development problems encountered in preview", list several types of common problems, and the teacher conducts roaming guidance and provides answers.

Teacher Demonstration: Taking the Chinese lesson Bo Ya Plays the Zither for primary schools as an example, the teacher demonstrates the whole process of PPT courseware development.

Student Practical Training: Students use the templates on the training platform to write courseware scripts and hands-on develop at least 5 core pages of PPT. The teacher provides real-time guidance on operational problems.

Learning Interaction:Human-computer interaction (Students operate on the training platform);Peer interaction (Group collaboration);Teacher-student interaction (Skill guidance and case comments).

4.Class Summary: The teacher summarizes the key content of this session and encourages students to continue learning and improve their multimedia courseware development skills.

(III) Post-Class Session (Teacher's Evaluation and Feedback + Students' Advanced Learning)

1.Teacher's Actions: The teacher sorts out the core knowledge points, releases the chapter test questions and assigns after-class homework through the Rain Classroom intelligent platform. Meanwhile, combined with the data from the intelligent platform and group peer review results, generate personalized learner profile reports, clarify each student's knowledge weaknesses and career competency gaps, and provide targeted suggestions for the next round of learning for each student.

2.Students' Actions: Receive personal learning reports and reflect on deficiencies against career competency objectives; complete after-class homework and participate in self-evaluation and peer evaluation on the platform; conduct supplementary learning by using the digital resource library according to the teacher's suggestions.

3.After-Class Homework: Based on the instructional design assignment from Chapter 5, design and develop a relevant PPT courseware.

4.Learning Interaction:

Human-computer interaction (Teachers and students interact via Rain Classroom)

VI. Learning Evaluation

1.Evaluation Subjects: On-campus teachers, peers, teachers from off-campus practice bases, and students themselves.

2.Evaluation Dimensions: On-campus teachers conduct evaluations based on students' classroom performance, homework, intelligent platform data and self-study performance; peers evaluate the homework of group members; students assess their own competence in resource retrieval and self-learning by using modern information tools; teachers from off-campus practice bases score

students' case analysis and practical assignments. 3.Evaluation Methods: Formative assessment (including pre-class preview, in-class practical operation, intelligent platform data, etc., accounting for 60%) combined with summative assessment (quality of after-class homework, accounting for 40%). The evaluation results are aligned with career competency objectives, incorporated into learner profiles, and directly guide the learning focus of the next module—"Micro-lesson Development".

Appendix C10: Lesson five for "Moral Development and Moral Education of Primary School Students"

Lesson Title: Laws and Characteristics of Primary School Students' Moral Development

Student Groups Being Taught: Sophomores Majoring in Primary Education

Duration: Four Class Periods

I. Vocational Competency-Oriented Learning Objectives

1.Professional Ethics Practice Competence: Consolidate and improve personal moral qualities; initially develop a sense of mission and responsibility as a primary school teacher engaged in moral education; foster affection for primary school students and professional ethics for primary school education.

2.Teaching Practice Competence: Analyze the special influencing factors of students' moral development in combination with the reality of a large number of left-behind children in rural primary schools in Yunnan; design targeted moral education activity plans through group collaboration.

3.Comprehensive Education Competence: Master the key factors affecting primary school students' moral development; conduct effective teaching according to the characteristics of students' moral development at different stages.

4.Independent Development Competence: Proactively learn the "moral education module" knowledge points required for the national teacher qualification examination; independently cultivate core competencies adaptable to moral education work in rural primary schools using resource libraries and the Internet.

II. Learning Content

1.Understand the virtues and values advocated in China.

2.Recognize the basic characteristics of primary school students' moral development and the corresponding moral education requirements.

III. Key and Difficult Points

1.Key Points: Analyze the internal structure of morality and explain the various factors influencing moral development.

2.Difficult Points: Recognize the basic characteristics of primary school students' moral development and the corresponding moral education requirements.

IV. Learning Resources (Sent to students before and after class for independent and personalized learning)

1.On-campus Resources: Primary school moral education case library, demonstration micro-courses by on-campus famous teachers, teaching skills training platform (moral education plan template library).

2.Off-campus Resources: Moral education cases from public welfare teaching support projects, characteristic moral education activity cases of primary schools in Southwest China.

3.Digital Resources: "Primary School Moral Education" special resources on the National Smart Education Platform for Primary and Secondary Schools, relevant videos on China University MOOC, and the National Online Case Library for Primary and Secondary School Moral Education.

V. Learning Process and Interaction

(I) Pre-class Stage (Teacher's Learning Situation Diagnosis + Students' Independent Preview)

1.Teacher's Actions: Release pre-test questions through the smart teaching platform, such as "What do you think is the most important thing to pay attention to in the moral development of left-behind children in rural areas?" and "What simple primary school moral education methods do you know?"; collect answer data to generate a learning situation analysis report.

2.Students' Actions: Align with learning objectives to identify personal shortcomings in moral education theories and practices; preview core knowledge points using digital resource libraries (e.g., MOOC courses, rural moral education cases).

Learning Interaction: Human-computer interaction (searching and self-studying online materials), teacher-student interaction (teacher releases exercises on Rain Classroom, students complete them).

(II) In-class Stage (Smart Classroom + Students' Practical Training)

1.Class Introduction: The teacher plays videos of Grade 1 "Morality and Life" and Grade 5 "Morality and Society" classes, and asks students to answer: What are the differences between the two?

2.Class Objectives: Understand the relationships between morality and virtue, and between virtue and moral education; clarify the functions of moral education and the significance of primary school moral education; analyze the reasons why contemporary society attaches importance to school moral education.

3.Class Interaction:The teacher plays a short video of moral education activities in cooperative rural primary schools and raises the question: "Faced with the emotional sensitivity of many left-behind children in the class, as a head teacher of a rural primary school in Yunnan, how would you teach moral education courses effectively?"

Learning Interaction: Teacher-student interaction (question and response), peer interaction (brief discussions).

Explain the connotation and characteristics of morality, and clarify the functions of moral education and the significance of primary school moral education through PPT and relevant videos.

Practical Training: Students design 1 moral education activity plan (including objectives, processes, and evaluation methods) using templates on the training platform; the teacher provides real-time guidance on the plans.

Learning Interaction: Human-computer interaction (virtual platform operation, case retrieval), peer interaction (group collaborative design), teacher-student interaction (skill guidance + case comments).

4.Class Summary: The teacher summarizes the basic content of morality, virtue, and moral education, and puts forward the functions of moral education in primary school.

(III) Post-class Stage (Teacher's Evaluation and Feedback + Students' Advanced Learning)

1.Teacher's Actions: Release and grade post-test questions through the smart platform; generate personalized learner profile reports based on assignments and smart platform data; analyze the learning situation of each group; assess the achievement of teaching objectives; provide learning suggestions for each student for the next stage.

2.Students' Actions: Receive personal learning reports and reflect on shortcomings against vocational competency objectives; complete post-class assignments and participate in self-evaluation and peer evaluation on the platform; supplement learning using digital resource libraries according to teacher's suggestions.

3.Post-class Assignment: Select 1 moral education case of a rural primary school in Yunnan, and analyze its successful experiences and areas for optimization based on the moral development theories learned in this lesson.

VI. Learning Evaluation

1.Evaluation Subjects: On-campus teachers, peers, teachers from off-campus practice bases, and students themselves.

2.Evaluation Dimensions:

On-campus teachers evaluate based on classroom performance,

assignments, smart platform data, and students' self-study;Peers evaluate group members' assignments;Students self-evaluate their resource retrieval ability and competence in independent learning using modern information tools;Teachers from off-campus practice bases score students' case analysis and practical assignments. 3.Evaluation Methods: Process assessment (pre-class preview, in-class practical training, smart platform data, etc., accounting for 60%) + summative assessment (quality of post-class assignments, accounting for 40%). Evaluation results are aligned with vocational competency objectives, incorporated into learner profiles, and directly guide the learning focus of the next lesson "Main Content of Primary School Students' Moral Development".

Appendix C11: Lesson six for "Moral Development and Moral Education of Primary School Students"

Lesson Title: Main Content of Primary School Students' Moral Development

Student Groups Being Taught: Sophomores Majoring in Primary Education

Duration: Four Class Periods

I. Vocational Competency-Oriented Learning Objectives

1.Professional Ethics Practice Competence: Deepen the educational philosophy of "putting education first and moral education at the forefront"; consolidate and improve personal moral qualities; initially develop a sense of mission and responsibility as a primary school teacher engaged in moral education.

2.Teaching Practice Competence: Learn to judge the basic characteristics of moral development of primary school students in different grades and understand their corresponding moral education requirements; design targeted moral education activities based on village-level resources (e.g., ethnic customs, village committee activities).

3.Comprehensive Education Competence: Master the grade-stage characteristics of primary school students' moral cognition, emotion, and behavior development; understand the practical value of foreign moral development theories.

4.Independent Development Competence: Consolidate the core knowledge points of the "moral education module" in the national teacher qualification examination; cultivate core competencies adaptable to moral education work in rural primary schools in Yunnan.

II. Learning Content

1.Connotation, characteristics, and internal structure of morality.

2.Basic factors influencing the moral development of primary school students.

3.Core foreign moral development theories (theories by Piaget, Kohlberg, Erikson, etc.) and their basic propositions.

III. Key and Difficult Points

1.Key Points: Understand several major foreign moral development theories and their basic propositions.

2.Difficult Points: Conduct effective teaching according to the characteristics of students' moral development at different stages.

IV. Learning Resources

1.On-campus Resources: Primary school moral education case library, virtual simulation training base, demonstration micro-courses by on-campus famous teachers (courses on rural moral education activity design), teaching skills training platform (moral education plan template library).

2.Off-campus Resources: Moral education cases from public welfare teaching support projects, characteristic moral education activity cases of primary schools in Southwest China.

3.Digital Resources: "Primary School Moral Education" special resources on the National Smart Education Platform for Primary and Secondary Schools, relevant videos on China University MOOC, and the National Online Case Library for Primary and Secondary School Moral Education.

V. Learning Process and Interaction

(I) Pre-class Stage (Teacher's Learning Situation Diagnosis + Students' Independent Preview)

1.Teacher's Actions: Release pre-test questions through the smart teaching platform, such as "What do you think is the biggest difference in moral development between Grade 3 and Grade 6 students in rural Yunnan?" and "What methods do you know for cultivating virtues in lower-grade rural students?"; collect answer data to generate a learning situation analysis report.

2.Students' Actions: Align with learning objectives to identify personal shortcomings in moral education theories and practices; preview core knowledge points using on-campus resources, teaching practice base resources, and digital resource libraries.

Learning Interaction: Human-computer interaction (searching and self-studying online materials), teacher-student interaction (teacher releases exercises, students complete them).

(II) In-class Stage (Smart Classroom + Students' Practical Training)

1.Class Introduction: The teacher asks students to read the "Problem Situation" on page 31 of the textbook and think about it.

2.Class Objectives: The teacher guides students to understand several major foreign moral development theories and their basic propositions.

3.Class Interaction:

Smart Classroom: Through PPT combined with virtual simulated grade-specific classroom scenarios in rural areas, the teacher explains the connotation of China's core virtues and values, focusing on analyzing the grade differences in moral cognition, emotion, and behavior development of rural primary school students (e.g., behavioral habits for lower-grade students, value identification for upper-grade students).

Theory Application: Combined with rural cases in Yunnan, interpret the application of Piaget's and Kohlberg's theories in grade-specific moral education in rural primary schools.

Practical Training: Students design 1 moral education activity plan (including objectives, processes, and evaluation methods) using templates on the training platform; the teacher provides real-time guidance on the plans.

Learning Interaction: Human-computer interaction (virtual platform operation, case retrieval), peer interaction (group collaborative design), teacher-student interaction (skill guidance + case comments).

(III) Post-class Stage (Teacher's Evaluation and Feedback + Students' Advanced Learning)

1.Teacher's Actions: Release and grade post-test questions through the smart platform; generate personalized learner profile reports based on assignments and smart platform data; analyze the learning situation of each group; assess the achievement of teaching objectives; provide learning suggestions for each student for the next stage.

2.Students' Actions: Receive personal learning reports and reflect on shortcomings against vocational competency objectives; complete post-class assignments and participate in self-evaluation and peer evaluation on the platform; supplement learning using digital resource libraries according to the teacher's suggestions.

Learning Interaction: Human-computer interaction (answering questions on the platform), peer interaction (mutual evaluation of achievements), teacher-student interaction (questioning and commenting).

3.Post-class Assignment: Complete the first and second assignments in the extended learning section (Item 4) on page 55 of the textbook.

VI. Learning Evaluation

1.Evaluation Subjects: On-campus teachers, peers, teachers from off-campus practice bases, and students themselves.

2.Evaluation Dimensions:

On-campus teachers evaluate based on classroom performance, answer quality, smart platform data, and students' self-study;Peers evaluate group members' assignments;Students self-evaluate their resource retrieval ability and competence in independent learning using modern information tools; Teachers from off-campus practice bases score students' case analysis and practical assignments.

3.Evaluation Methods: Process assessment (pre-class preview, in-class practical training, smart platform data, etc., accounting for 60%) + summative assessment (quality of post-class assignments, accounting for 40%). Evaluation results are aligned with vocational competency objectives, incorporated into learner profiles, and guide subsequent personalized learning.

Appendix C12: Learning Quality Assessment Questionnaire for Primary Education Majors at X Vocational College of Yunnan Province

To evaluate the application effect of the intelligent learning model for the Primary Education major in X Vocational College, accurately track changes in learning quality, and provide data support for professional teaching optimization and model refinement, we have designed this questionnaire. Your truthful feedback is crucial to this research. There are no right or wrong answers to the questions. All collected data will be used for academic research only, and your personal information will be kept strictly confidential.

I. Basic Information

1.Gender: ☐ Male ☐ Female

2.Have you participated in learning activities under the intelligent learning model (e.g., learning via Chaoxing Study Online, Rain Classroom, or engaging in virtual simulation training in smart classrooms)?

☐ Yes ☐ No

The following scale covers different dimensions of the intelligent learning model for the Primary Education major at X Vocational College. Please rate each item using the Likert scale below based on your actual learning experience. The scale adopts a 5-point rating system, ranging from "Fully Agree" (highest score) to Fully Disagree" (lowest score). Please mark "✓" in the box corresponding to your chosen rating for each item. Only one rating may be selected per item; do not select multiple options or leave any item blank.

II. Career Competency-Oriented Learning Objectives

1. Do you have a clear understanding of the core professional competencies required for primary school teachers of Primary Education majors as specified by the Ministry of Education of China?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

2. Do you think the teaching model for the Primary Education major in higher vocational colleges aligns with the training objectives for core professional competencies of primary school teachers?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

3. Do you think teachers in higher vocational colleges can align teaching content with professional competencies and clearly inform students of effective learning approaches?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

4. Do you think the learning model in higher vocational colleges has effectively improved your career adaptability to meet the requirements of primary school teaching positions?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

III. Learning Content

1. Can you clearly identify which parts of the public basic courses you are currently studying are relevant to the cultivation of your professional competencies?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

2. Can you clearly understand how the content of the professional core courses you are currently studying cultivates your professional competencies?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

3. Do you think the content of practical teaching courses for the Primary Education major provides effective guidance based on the professional competencies required for primary school teachers?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

4. Do you think the content of the quality development courses you are currently studying can further enhance your professional competencies?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

IV. Learning Resources

1. Beyond in-class learning, do you take the initiative to access on-campus course resources (e.g., books and documents, online teaching case libraries, school-based textbooks) for supplementary learning?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

2. Beyond in-class learning, do you take the initiative to access off-campus course resources (e.g., resources from off-campus practice bases, lectures and training sessions by education industry experts) for supplementary learning?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

3. Beyond in-class learning, do you take the initiative to access digital resource libraries online (e.g., resources from the National Smart Education Platform for Primary and Secondary Schools, the National Smart Education Platform for Vocational Education, and China University MOOCs) for supplementary learning?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

V. Learning Process

1. Before class, do teachers use smart platforms to assign pre-assessment questions and clearly inform students of the key and difficult learning points as well as the professional competencies to be mastered?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

2. During class, do teachers focus on cultivating students' professional competencies as the core objective, adopt the integrated "Smart Classroom + Practical Training" model to deliver new learning content, and thereby improve students' professional abilities?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

3. After class, can teachers use smart platforms to assign knowledge tests on new courses to assess the achievement of teaching objectives?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

VI. Learning Interaction

1. In the learning process, do you excel at using human-computer interaction tools (e.g., smart platforms, authorized online courses, AI applications) to enhance your personalized learning experience?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

2. Do you frequently interact and communicate with group members or learning partners via social software and smart platforms to obtain peer support for learning?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

3. Do teachers encourage students to seek consultations through offline classes or smart teaching platforms and support students' personalized learning needs?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

VII. Learning Evaluation

1. Have you received evaluations of your learning outcomes (based on professional competency cultivation) from teachers, experts from off-campus practice bases, and peers?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

2. Can teachers generate learner profiles (reflecting your learning preferences, knowledge level, and competency development needs) based on your relevant learning data to guide your subsequent learning?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

3. Do you think the current learning evaluation methods can comprehensively assess students' knowledge level and professional literacy?

☐ Fully Agree ☐ Mostly Agree ☐ Neutral ☐ Mostly Disagree ☐ Fully Disagree

Thank you for taking the precious time to participate in this questionnaire survey! Your opinions are crucial to my research and will provide highly valuable references for this study. I solemnly promise to strictly keep your personal information confidential and ensure the security of your privacy.

Appendix C13: Table of experts' evaluation of “Learning Quality Assessment Questionnaire for Primary Education Majors in X Vocational College of Yunnan Province”

To evaluate the application effect of the intelligent learning model for the Primary Education major in X Vocational College, accurately track changes in learning quality, and provide data support for the optimization of professional teaching and the refinement of the model, I have specially designed a learning quality assessment questionnaires. All the questions in the table below are derived from this instrument. I sincerely hope that, through your professional evaluation and guidance, this questionnaire will be made more scientific and rigorous.

Part 1: General information of the experts

1.Your gender:

☐ Male ☐ Female

2.Your professional title:

☐ No Title ☐ Teaching Assistant ☐ Lecturer ☐ Associate Professor

☐ Professor

Part 2: Table of experts' evaluation of “Learning Quality Assessment Questionnaire for Primary Education Majors in X Vocational College of Yunnan Province”

Filling Instructions: Each item in this questionnaire is rated on a 3-point scale: -1 = Disagree, 0 = Neutral, 1 = Agree. Please mark "√" in the box (☐) corresponding to the score that you think the item deserves.

I.Career Competency-Oriented Learning Objectives	For experts		
	-1	0	1
1. Do you have a clear understanding of the core professional competencies required for primary school teachers of Primary Education majors as specified by the Ministry of Education of China?			
2. Do you think the teaching model for the Primary Education major in higher vocational colleges aligns with the training objectives for core professional competencies of primary school teachers?			
3. Do you think teachers in higher vocational colleges can align teaching content with professional competencies and clearly inform students of effective learning approaches?			
4. Do you think the learning model in higher vocational colleges has effectively improved your career adaptability to meet the requirements of primary school teaching positions?			

II. Learning Content	For experts		
	-1	0	+1
1. Can you clearly identify which parts of the public basic courses you are currently studying are relevant to the cultivation of your professional competencies?			
2. Can you clearly understand how the content of the professional core courses you are currently studying cultivates your professional competencies?			
3. Do you think the content of practical teaching courses for the Primary Education major provides effective guidance based on the professional competencies required for primary school teachers?			

II. Learning Content	For experts		
	-1	0	+1
4. Do you think the content of the quality development courses you are currently studying can further enhance your professional competencies?			

III. Learning Resources	For experts		
	-1	0	+1
1. Beyond in-class learning, do you take the initiative to access on-campus course resources (e.g., books and documents, online teaching case libraries, school-based textbooks) for supplementary learning?			
2. Beyond in-class learning, do you take the initiative to access off-campus course resources (e.g., resources from off-campus practice bases, lectures and training sessions by education industry experts) for supplementary learning?			
3.Beyond in-class learning, do you take the initiative to access digital resource libraries online (e.g., resources from the National Smart Education Platform for Primary and Secondary Schools, the National Smart Education Platform for Vocational Education, and China University MOOCs) for supplementary learning?			

IV. Learning Process	For experts		
	-1	0	+1
1. Before class, do teachers use smart platforms to assign pre-assessment questions and clearly inform students of the key and difficult learning points as well as the professional competencies to			

IV. Learning Process	For experts		
	-1	0	+1
be mastered?			
2. During class, do teachers focus on cultivating students' professional competencies as the core objective, adopt the integrated "Smart Classroom + Practical Training" model to deliver new learning content, and thereby improve students' professional abilities?			
3. After class, can teachers use smart platforms to assign knowledge tests on new courses to assess the achievement of teaching objectives?			

V. Learning Interaction	For experts		
	-1	0	+1
1. In the learning process, do you excel at using human-computer interaction tools (e.g., smart platforms, authorized online courses, AI applications) to enhance your personalized learning experience?			
2. Do you frequently interact and communicate with group members or learning partners via social software and smart platforms to obtain peer support for learning?			
3. Do teachers encourage students to seek consultations through offline classes or smart teaching platforms and support students' personalized learning needs?			

VI. Learning Evaluation	For experts		
	-1	0	+1
1. Have you received evaluations of your learning outcomes (based on professional competency cultivation) from teachers, experts from off-campus practice bases, and peers?			
2. Can teachers generate learner profiles (reflecting your learning preferences, knowledge level, and competency development needs) based on your relevant learning data to guide your subsequent learning?			
3. Do you think the current learning evaluation methods can comprehensively assess students' knowledge level and professional literacy?			

Appendix D

The Results of the Quality Analysis of Research Instruments

Appendix D1: The results of experts' evaluation of “Questionnaire on the Learning Status of Primary Education Major in Vocational Colleges Based on Professional Competency Cultivation”

Experts scored each item of the questionnaire using the IOC (Item Objective Congruence) method. In the table, E1 to E5 represent the sequential scoring results of the five experts respectively. The scoring criteria are as follows: 1 point (highly relevant), 0 point (moderately relevant), and -1 point (not relevant).

I. Learning Objective Dimension	Expert opinion					
	E1	E2	E3	E4	E5	IOC
1. Do you have any confusion about understanding the professional competencies required for primary school teachers when learning courses related to the Primary Education major?	1	1	0	1	1	0.8
2. Do you have a comprehensive career plan for becoming a primary school teacher, and have you set clear learning objectives based on professional competency requirements?	1	1	1	1	1	1
3. Can you proactively incorporate national teaching competition standards and teacher qualification examination requirements into your own learning objectives during the learning process?	1	1	0	1	1	0.8
4. Have you received professional career planning advice from teachers regarding your learning objectives, so as to fully prepare for future employment?	1	0	1	1	1	0.8
5. Do you think the college’s talent cultivation objectives are clear and highly aligned with the core competency requirements of primary school teaching positions?	1	1	1	1	1	1

II. Curriculum Design Dimension	Expert opinion					
	E1	E2	E3	E4	E5	IOC
6. Do you think the schedule and frequency of various courses offered are reasonable, and in line with students' learning rhythm and examination requirements?	1	1	1	0	1	0.8
7. Do you think the college has integrated the professional competency-oriented talent training program into the curriculum system?	1	1	1	0	1	0.8
8. What do you think are the main problems with the current curriculum system? (Multiple choices allowed)	1	1	1	1	1	1
9. Do you think the curriculum design and teaching arrangements are in line with the cognitive characteristics of Primary Education majors?	1	0	1	0	1	0.6
10. Do you think the proportion of theoretical courses and practical courses is balanced at present, and can the practical courses meet the needs of cultivating professional skills for primary school teachers?	0	1	1	1	1	0.8

III. Learning Content Dimension	Expert opinion					
	E1	E2	E3	E4	E5	IOC
11. What are the main problems you encounter when learning public basic courses in class? (Multiple choices allowed)	1	1	0	1	1	0.6

III. Learning Content Dimension	Expert opinion					
	E1	E2	E3	E4	E5	IOC
12. Do you think the content of professional core courses (e.g., Educational Psychology, Primary School Pedagogy, Subject Teaching Methodology, etc.) offered by the college can meet the requirements of the unified teacher qualification examination and the professional competencies of primary school teachers?	1	1	1	0	1	0.8
13. What are the main difficulties you encounter when learning professional core courses at college? (Multiple choices allowed)	0	1	1	1	1	0.8
14. Do you think the current arrangement of practical teaching courses (e.g., graduation internship, teaching observation, skill training, etc.) can effectively improve students' professional literacy?	1	1	1	1	-1	0.8
15. What are the main problems you encounter when participating in practical teaching courses? (Multiple choices allowed)	0	0	1	1	1	0.6

IV. Learning Resource Dimension	Expert opinion					
	E1	E2	E3	E4	E5	IOC
16. Do you think teachers often use modern information technology to assist teaching, so as to improve students' learning efficiency?	1	1	-1	1	1	0.8
17. Do you think teachers can appropriately and fully utilize on-campus, off-campus, online and offline teaching resources to stimulate students' learning	1	1	1	0	1	0.8

IV. Learning Resource Dimension	Expert opinion					
	E1	E2	E3	E4	E5	IOC
interest and motivation?						
18. Can you proactively search for various online and offline course resources related to Primary Education to study and improve your professional competencies in daily study?	1	0	0	1	1	0.6
19. How well do you understand digital resources such as the National Smart Education Platform for Primary and Secondary Schools, MOOCs, and AI-assisted learning tools?	1	1	1	1	1	1
20. What are the main difficulties you encounter when using digital resource libraries? (Multiple choices allowed)	0	1	1	1	1	0.8

V.Teaching Implementation Dimension	Expert opinion					
	E1	E2	E3	E4	E5	IOC
21. Do you think teachers adopt diversified teaching methods and often use innovative approaches such as inquiry-based, situational, and project-based learning to enhance students' learning interest?	1	1	0	1	1	0.8
22. Do you think teachers' instructional design is student-centered, focusing on students' learning outcomes and the improvement of their professional competencies?	1	1	1	1	1	1
23. What are the main problems with interactive	1	1	1	0	1	0.8

V.Teaching Implementation Dimension	Expert opinion					
	E1	E2	E3	E4	E5	IOC
practice sessions in class? (Multiple choices allowed)						
24. What are the main problems in current classroom learning? (Multiple choices allowed)	0	0	1	1	1	0.6
25. What are the main problems you encounter in the after-class consolidation and improvement stage? (Multiple choices allowed)	1	0	1	1	1	0.8

VI. Learning Methods Dimension	Expert opinion					
	E1	E2	E3	E4	E5	IOC
26. Can you independently plan personalized learning (e.g., using digital course resources, AI-assisted tools, and online research) based on your own professional competency weaknesses?	1	1	1	1	1	1
27. What are the main problems you encounter during independent learning? (Multiple choices allowed)	1	1	1	0	1	0.8
28. When encountering problems you do not understand during independent learning, will you proactively seek help from teachers or classmates?	1	1	0	1	1	0.8
29. Do you think teachers can evaluate your learning outcomes in class and after class, and provide corresponding learning suggestions?	1	1	1	1	1	1
30. What is your acceptance level of the "Smart Classroom + Practical Training" teaching model?	1	1	0	0	1	0.6

VII. Learning Evaluation Dimension	Expert opinion					
	E1	E2	E3	E4	E5	IOC
31. Do you think teachers can currently evaluate students' learning outcomes by assessing both the mastery of professional knowledge and the achievement of professional competencies?	1	1	1	1	0	0.8
32. Do you think current course evaluation can focus not only on students' examination scores but also on learning processes (e.g., classroom participation, practical performance, self-study frequency, etc.)?	1	1	1	0	1	0.8
33. What do you think are the main problems with current learning evaluation? (Multiple choices allowed)	1	1	1	1	1	1
34. What do you think are the main problems with professional competency-based evaluation criteria? (Multiple choices allowed)	1	1	0	1	1	0.8

Appendix D2: The results of experts' evaluation of “Learning Quality Assessment Questionnaire for Primary Education Majors in X Vocational College of Yunnan Province”

Experts scored each item of the questionnaire using the IOC (Item Objective Congruence) method. In the table, E1 to E5 represent the sequential scoring results of the five experts respectively. The scoring criteria are as follows: 1 point (highly relevant), 0 point (moderately relevant), and -1 point (not relevant).

I.Career Competency-Oriented Learning Objectives	**Expert opinion**					
	E1	**E2**	**E3**	**E4**	**E5**	**IOC**
1. Do you have a clear understanding of the core professional competencies required for primary school teachers of Primary Education majors as specified by the Ministry of Education of China?	1	1	0	1	1	0.8
2. Do you think the teaching model for the Primary Education major in higher vocational colleges aligns with the training objectives for core professional competencies of primary school teachers?	1	0	1	0	1	0.6
3. Do you think teachers in higher vocational colleges can align teaching content with professional competencies and clearly inform students of effective learning approaches?	0	1	1	1	1	0.8
4. Do you think the learning model in higher vocational colleges has effectively improved your career adaptability to meet the requirements of primary school teaching positions?	1	1	1	1	1	1

II. Learning Content	Expert opinion					
	E1	E2	E3	E4	E5	IOC
1. Can you clearly identify which parts of the public basic courses you are currently studying are relevant to the cultivation of your professional competencies?	1	0	1	0	1	0.6
2. Can you clearly understand how the content of the professional core courses you are currently studying cultivates your professional competencies?	1	1	1	1	1	1
3. Do you think the content of practical teaching courses for the Primary Education major provides effective guidance based on the professional competencies required for primary school teachers?	1	1	0	1	1	0.6
4. Do you think the content of the quality development courses you are currently studying can further enhance your professional competencies?	1	1	1	1	1	1

III. Learning Resources	Expert opinion					
	E1	E2	E3	E4	E5	IOC
1. Beyond in-class learning, do you take the initiative to access on-campus course resources (e.g., books and documents, online teaching case libraries, school-based textbooks) for supplementary learning?	1	1	0	1	1	0.8
2. Beyond in-class learning, do you take the initiative to access off-campus course resources (e.g., resources from off-campus practice bases, lectures and training sessions by education industry experts) for supplementary learning?	1	0	0	1	1	0.6

III. Learning Resources	Expert opinion					
	E1	E2	E3	E4	E5	IOC
3. Beyond in-class learning, do you take the initiative to access digital resource libraries online (e.g., resources from the National Smart Education Platform for Primary and Secondary Schools, the National Smart Education Platform for Vocational Education, and China University MOOCs) for supplementary learning?	1	1	1	1	1	1

IV. Learning Process	Expert opinion					
	E1	E2	E3	E4	E5	IOC
1. Before class, do teachers use smart platforms to assign pre-assessment questions and clearly inform students of the key and difficult learning points as well as the professional competencies to be mastered?	0	1	0	1	1	0.6
2. During class, do teachers focus on cultivating students' professional competencies as the core objective, adopt the integrated "Smart Classroom + Practical Training" model to deliver new learning content, and thereby improve students' professional abilities?	1	1	0	1	0	0.6
3. After class, can teachers use smart platforms to assign knowledge tests on new courses to assess the achievement of teaching objectives?	1	1	1	1	1	1

V. Learning Interaction	Expert opinion					
	E1	E2	E3	E4	E5	IOC
1. In the learning process, do you excel at using human-computer interaction tools (e.g., smart platforms, authorized online courses, AI applications) to enhance your personalized learning experience?	1	0	1	1	0	0.6
2. Do you frequently interact and communicate with group members or learning partners via social software and smart platforms to obtain peer support for learning?	1	1	1	1	0	0.8
3. Do teachers encourage students to seek consultations through offline classes or smart teaching platforms and support students' personalized learning needs?	1	1	1	0	0	0.6

VI. Learning Evaluation	Expert opinion					
	E1	E2	E3	E4	E5	IOC
1. Have you received evaluations of your learning outcomes (based on professional competency cultivation) from teachers, experts from off-campus practice bases, and peers?	0	1	1	1	1	0.8
2. Can teachers generate learner profiles (reflecting your learning preferences, knowledge level, and competency development needs) based on your relevant learning data to guide your subsequent learning?	1	1	1	1	0	0.8

VI. Learning Evaluation	Expert opinion					
	E1	E2	E3	E4	E5	IOC
3. Do you think the current learning evaluation methods can comprehensively assess students' knowledge level and professional literacy?	1	1	1	0	1	0.8

Appendix E

Certificate of English

BANSOMDEJCHAOPRAYA
RAJABHAT UNIVERSITY

This is to certify that

LI CHUAN CHUAN

Achieved BSRU English Proficiency Test (BSRU-TEP) level

C1

Given on 13th December 2025

(Assistant Professor Dr Kulsirin Aphiratvoradej)

Director

Appendix F

The Document for Acceptance Research

ที่ อว ๐๖๑๖.๐๖/๐๔๒๒

คณะครุศาสตร์
มหาวิทยาลัยราชภัฏนครสวรรค์
อ.พยุหะคีรี จ.นครสวรรค์ ๖๐๑๓๐

๘ เมษายน ๒๕๖๙

เรื่อง ตอบรับการตีพิมพ์บทความ

เรียน คุณ Li Chuanchuan , คุณPrapai Sridama , คุณSombat Teekasap และคุณKanakorn Sawangcharoen

ตามที่ท่านได้ส่งบทความเรื่อง**"Development and Evaluation of a Career Competency-Oriented Intelligent Learning Model for Primary Education Major in Vocational Colleges in Yunnan Province"**เพื่อตีพิมพ์ในวารสารการบริหารการศึกษาและนวัตกรรมการศึกษา คณะครุศาสตร์ มหาวิทยาลัยราชภัฏนครสวรรค์ นั้น

บัดนี้กองบรรณาธิการวารสารการบริหารการศึกษาและนวัตกรรมการศึกษาฯ ได้ส่งให้ผู้ประเมินอิสระตรวจอ่านบทความ (Peer Reviewer) จำนวน ๓ ท่านแล้ว ซึ่งเห็นว่าบทความงานวิจัยดังกล่าวมีรูปแบบและเนื้อหาเหมาะสม มีคุณค่าต่อการตีพิมพ์เผยแพร่เพื่อประโยชน์ทางวิชาการในวารสารการบริหารการศึกษาและนวัตกรรมการศึกษา คณะครุศาสตร์ มหาวิทยาลัยราชภัฏนครสวรรค์ ปีที่ ๖ ฉบับที่ ๓ ประจำเดือน กันยายน – ธันวาคม ๒๕๖๙ (ISSN: ๒๘๒๒-๐๐๕๖) ซึ่งได้รับการรับรองคุณภาพจากศูนย์ดัชนีการอ้างอิงวารสารไทย (Thai Journal Citation Index Centre) ให้อยู่ในวารสารกลุ่มที่ ๒ ตั้งแต่วันที่ ๑ มกราคม ๒๕๖๘ จนถึง ๓๑ ธันวาคม ๒๕๗๒

จึงเรียนมาเพื่อโปรดทราบ

ขอแสดงความนับถือ

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