

Research Report on the Construction Method of the Curriculum Ideological and Political Teaching System for “Practical Financial Planning”

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Abstract: Taking the “Practical Financial Planning” course as an example, this report explores how to integrate ideological and political education into professional courses and construct a curriculum ideological and political teaching system. The report is divided into three parts: the first part analyzes the functional orientation of curriculum ideological and political education in professional talent training and value shaping, and proposes design principles for curriculum ideological and political teaching content and implementation methods; the second part introduces the research on the integration and integration model of curriculum ideological and political elements, adopting Derrick Bell’s Storytelling Model for curriculum element integration, and organically combining professional knowledge with ideological and political elements through situational stories as carriers; the third part constructs the evaluation principles and system of curriculum ideological and political teaching, and designs multi-dimensional and comprehensive evaluation indicators and methods from the perspective of combining process evaluation and developmental evaluation. This report aims to provide a feasible path and reference for reforming ideological and political teaching in professional courses.

Keywords: Practical financial planning; Curriculum ideological and political education; Derrick Bell’s Storytelling Model; Evaluation system

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1. Introduction

1.1. Research background and significance

With changes in the financial market, the “Practical Financial Planning” course not only needs to impart professional theories but also cultivate students’ correct financial concepts, social responsibility, and professional ethics. Integrating ideological and political education into the course is an inevitable requirement for talent training in colleges and universities. However, traditional ideological and political education is often rigid and

difficult to resonate with students. Therefore, exploring a new curriculum ideological and political model that conforms to professional characteristics and can stimulate students' initiative has become an urgent problem to be solved^[1-3].

1.2. Research objectives and content

Taking the "Practical Financial Planning" course as an example, this report explores methods for constructing a curriculum ideological and political teaching system, mainly divided into three parts:

- (1) The first part analyzes the functional orientation of curriculum ideological and political education and proposes design principles for teaching content and implementation methods;
- (2) The second part studies the integration model of curriculum ideological and political elements, adopting Derrick Bell's Storytelling Model to organically combine professionalism and ideological and political education through situational stories as carriers;
- (3) The third part constructs a curriculum ideological and political teaching evaluation system and designs multi-dimensional evaluation indicators combining process and developmental evaluation.

1.3. Research methods and ideas

This study adopts literature analysis, case analysis, and empirical research methods. First, sort out the teaching syllabus and objectives, and clarify the ideological and political functional orientation and design principles through literature analysis; second, use Derrick Bell's Storytelling Model to select five chapters (financial planning basics, financial management, housing purchase planning, education fund planning, and pension planning) for element integration design; finally, collect teaching feedback and achievement data to construct and verify a multi-dimensional and comprehensive evaluation system^[4,5].

2. Design of curriculum, ideological and political teaching content and implementation methods for practical financial planning

2.1. Functional orientation of curriculum, ideological and political education in professional talent training and value shaping

Practical Financial Planning is a comprehensive and applied course. Integrating ideological and political education mainly has the following functions:

- (1) Guide students to establish correct financial concepts. Finance can not only promote resource allocation but also has risks and bubbles. The course needs to guide students to view the role of finance dialectically, pursue maximum benefits while taking into account social benefits, and strictly abide by laws and regulations.
- (2) Cultivate students' correct value orientation. In wealth management, students should be educated to balance material and spiritual wealth, personal happiness and national development, and respect individuality while following conscience.
- (3) Shape good social responsibility and professional ethics. Financial planners need to maintain neutrality and impartiality in services, safeguard customer interests, avoid conflicts of interest, and promote the standardized development of the industry.

2.2. Design principles for curriculum, ideological and political teaching content and implementation methods

Based on the above functional orientation, the following design principles are proposed:

- (1) Principle 1: Goal-oriented principle. Clarify the ideological and political goals to be achieved in each teaching link, that is, specific requirements for financial concepts, value orientation, sense of responsibility, and professional ethics.
- (2) Principle 2: Content integration principle. Avoid rigid addition and achieve in-depth integration: at the theoretical level, combine financial systems with national strategies; at the method level, combine planning tools with scientific spirit; at the practical level, combine service processes with professional norms.
- (3) Principle 3: Form innovation principle. Break through traditional methods, adopt Derrick Bell's Storytelling Model for element integration, use modern educational technology to enrich forms, create immersive financial service scenarios, and enhance teaching experience.

3. Research on the integration model of curriculum, ideological and political elements

3.1. Basic principles of Derrick Bell's Storytelling Model

Proposed by Derrick Bell, Derrick Bell's Storytelling Model is a curriculum integration model based on situational stories. The model divides stories into three levels: the personal level shows specific experiences to arouse resonance; the cultural level reflects on the influence of beliefs and values; the social level considers individuals' responsibilities for social development. Through progressive thinking, this model can effectively connect knowledge, emotions, and actions, making it suitable for curriculum ideological and political teaching^[6-8].

3.2. Application of Derrick Bell's Storytelling Model in the Practical Financial Planning Course

Taking five chapters of the Practical Financial Planning course as examples, this section introduces how to use Derrick Bell's Storytelling Model for curriculum element integration. The specific steps are as follows:

- (1) Step 1: Determine the theme and goals of the story. The theme is "How to formulate a reasonable financial plan", and the goal is to master professional methods and cultivate correct values.
- (2) Step 2: Set up characters: a middle-aged couple, Zhang Qiang (a state-owned enterprise employee) and Li Na (a foreign-funded enterprise employee), who face financial planning dilemmas. Other characters include their son Zhang Chen, their retired fathers, and a professional financial planner, Zhao Ming.
- (3) Step 3: Design the plot and dialogue of the story. The plot is divided into the following parts:
 - (a) Plot 1 (Financial Planning Basics): The couple seeks help from Zhao Ming, who explains the systematic steps of financial planning, corresponding to Chapter 1.
 - (b) Plot 2 (Financial Management): The couple collects information, and Zhao Ming assists in compiling family financial statements and conducting diagnostics, corresponding to Chapter 2.
 - (c) Plot 3 (Specialized Planning): For the goals of housing purchase, children's education, and pension, Zhao Ming quantifies the goals and formulates strategies, corresponding to Chapters 3 to 5.
 - (d) Plot 4 (Service Model): Implement the plan and make regular adjustments; Zhao Ming provides continuous services, corresponding to Chapter 6.
- (4) Step 4: Design ideological and political elements in the story. The following ideological and political

elements are integrated into the story:

- (a) Financial concepts: Through the couple's dilemmas, guide students to think and establish a scientific financial concept that balances risks and returns, and current and future needs.
- (b) Value orientation: In financial decision-making conflicts, guide students to reflect on the relationship between material and spirit, rationality and emotion, and cultivate a comprehensive value orientation.
- (c) Social responsibility: Through pension and education planning, let students realize their responsibilities to families and society, and think about how to contribute to society through financial planning.
- (d) Professional ethics: Through Zhao Ming's professional services, demonstrate the professional ethics of integrity, objectivity, and impartiality, and guide students to reflect on the moral norms of professionals^[9,10].

4. Construction of evaluation principles and system for curriculum, ideological and political teaching

4.1. Evaluation principles for curriculum, ideological and political teaching

Curriculum ideological and political evaluation should follow the following principles: the goal consistency principle (evaluation content should cover changes in cognition, emotion, and behavior); the multi-subject principle (combining evaluations from teachers, students, peers, etc.); the diverse methods principle (comprehensively using observation, interviews, case analysis, etc.); the effectiveness principle (focusing on feedback and continuous improvement)^[11,12].

4.2. Evaluation system for curriculum ideological and political teaching

Based on the above principles, this report constructs a curriculum ideological and political teaching evaluation system combining process evaluation and developmental evaluation, as follows.

Process evaluation: Continuous, dynamic, and formative evaluation conducted during the teaching process, mainly focusing on students' participation, performance, and satisfaction in curriculum ideological and political teaching, as well as teachers' design, implementation, and feedback in the teaching process. It mainly adopts qualitative or quantitative methods such as observation, interviews, and questionnaires to obtain feedback from teachers and students on problems and improvement suggestions in the teaching process^[13–15].

Table 1. Process evaluation table

| Evaluation Method | Specific Content |
|----------------------|---|
| Observation Method | Teachers observe students' performance in class, including attendance, speech, discussion, homework, and practice, record students' participation, performance, and satisfaction, as well as teachers' design, implementation, and feedback. Teachers can adjust teaching methods and strategies in a timely manner based on observation results to improve teaching effectiveness. |
| Interview Method | After class or the course, teachers conduct individual or group interviews with some students to understand their feelings, opinions, and suggestions on curriculum ideological and political teaching, as well as changes in their cognition, emotion, and behavior regarding financial concepts, value orientation, social responsibility, and professional ethics. Teachers can gain an in-depth understanding of students' needs and problems based on interview results to improve teaching quality. |
| Questionnaire Method | In the middle or at the end of the course, teachers distribute questionnaires to all students to collect their evaluations of curriculum ideological and political teaching, including evaluations of teachers, course content, course forms, and course effects. Teachers can conduct data analysis and summary based on questionnaire results to improve teaching standards. |

The specific content of the questionnaires is as follows:

(1) Questionnaire 1: Evaluation of Teachers

Please score the following items based on your impression of the course teacher, with 1 being the lowest and 5 being the highest.

(2) Questionnaire 2: Evaluation of Course Content

Please score the following items based on your understanding of the course content, with 1 being the lowest and 5 being the highest.

(3) Questionnaire 3: Evaluation of Course Effects

Please score the following items based on your cognition of the course effects, with 1 being the lowest and 5 being the highest.

Table 2. Questionnaire—Evaluation of Teachers

| Item | Score |
|--|-------|
| 1. Teacher's professional level | |
| 2. Teacher's teaching methods | |
| 3. Teacher's teaching attitude | |
| 4. Teacher's ideological and political education ability | |
| 5. Teacher's classroom interaction | |
| 6. Teacher's after-class feedback | |

Table 3. Questionnaire—Evaluation of Course Content

| Item | Score |
|--|-------|
| Financial Basics Module | |
| Personal or Family Financial Management Module | |
| Housing Purchase Planning Module | |
| Education Fund Planning Module | |
| Pension Planning Module | |

Table 4. Questionnaire—Evaluation of Course Forms

| Item | Score |
|---|-------|
| Derrick Bell's Storytelling Model | |
| Modern educational technologies such as multimedia, network, and simulation | |
| Open, immersive, and situational teaching scenarios | |

Table 5. Questionnaire—Evaluation of Course Effects

| Item | Score |
|---|-------|
| Improved your mastery and application ability of basic financial planning theories and methods | |
| Cultivated your correct financial concepts, value orientation, social responsibility, and professional ethics | |

Developmental evaluation: Summative, static, and terminal evaluation conducted after the end of curriculum ideological and political teaching, mainly focusing on changes and improvements in students' cognition, emotion, and behavior regarding correct financial concepts, value orientation, social responsibility, and professional ethics, as well as the effect and quality of teachers' achievement of curriculum ideological and political teaching goals. It mainly adopts quantitative or qualitative methods such as tests, case analysis, and situational simulation, to obtain evaluations of teaching achievements and effects from teachers and students.

Table 6. Developmental Evaluation Table

| Evaluation Method | Specific Content |
|-------------------------------|--|
| Test Method | At the end of the course, teachers conduct a comprehensive test for all students to assess their mastery and application ability of basic financial planning theories and methods, as well as their cognition and emotion regarding correct financial concepts, value orientation, social responsibility, and professional ethics. Test question types can include multiple-choice questions, fill-in-the-blank questions, short-answer questions, and calculation questions, covering the five chapters of the course. Teachers can conduct data analysis and summary based on test results to evaluate students' financial planning knowledge level and ideological and political education effects. |
| Case Analysis Method | At the end of the course, teachers provide some students with a real or fictional financial planning case, requiring them to formulate a reasonable financial planning plan for the client in the case and write a financial planning report based on the learned financial planning theories and methods. Teachers can conduct content analysis and evaluation based on students' plans and reports to assess their practical financial planning ability and ideological and political education effects. |
| Situational Simulation Method | At the end of the course, teachers provide some students with a real or fictional financial planning service scenario, requiring them to play the role of financial planners, communicate with clients, and provide professional financial advice and services. Teachers can conduct behavioral observation and evaluation based on students' performance to assess their financial planning service ability and ideological and political education effects. |

5. Conclusion

This report explores the path of integrating ideological and political education into the “Practical Financial Planning” course. First, it clarifies the functional orientation and design principles of curriculum ideological and political education in cultivating financial concepts and professional ethics. Second, it innovatively introduces Derrick Bell's Storytelling Model, organically integrating professional knowledge with ideological and political elements through situational stories, realizing the sublimation from personal experience to social responsibility. Finally, it constructs a multi-dimensional evaluation system including process and developmental indicators to ensure that teaching effects are quantifiable and feedback-oriented. This study aims to provide a feasible paradigm for the reform of curriculum ideological and political education in professional courses, promoting the organic unity of professional talent training and value shaping.

Disclosure statement

The authors declare no conflict of interest.

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An Empirical Study on the Integration Path of “Culture–Competence–Internalization” in the Secretarial Major of Vocational Education in Yunnan

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Abstract: To address the imbalance between skills training and value cultivation in vocational education within China’s ethnic regions, this study developed and validated a Culture Resources–Workplace Competence–Internalization of Values model (CCI Model). Through course redesign incorporating localized cases, scenario-based tasks, and reflective practice, the model systematically connects cultural resources with professional skill development. A quasi-experiment with 98 students in a Yunnan higher vocational college demonstrated significant improvements in cultural cognition, workplace competence, and internalization of values (all Cohen’s $d > 1.25$). The results confirm that integrating ethnic culture into professional modules simultaneously enhances technical skills and value cultivation, offering a replicable approach for curriculum reform in ethnic regions.

Keywords: Secretarial major; Internalization of values; Cultural integration; Vocational education; Empirical research

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1. Introduction

In China’s current context, integrating values education into the vocational education system, which is fundamentally oriented toward virtue cultivation and talent development, has become a core requirement ^[1,2]. However, current related research exhibits significant limitations. On the one hand, existing achievements predominantly concentrate on the level of ideological and political courses ^[4–6], lacking systematic exploration targeted at professional courses. On the other hand, teaching in the secretarial major in borderland higher vocational colleges has long exhibited a tendency of “emphasizing skills over values” ^[7,8], where ethnic cultural resources are severely disconnected from the cultivation of workplace abilities, resulting in a “superficial attachment” of elements to the curriculum ^[9].

In-depth analysis reveals two key gaps in the research field. First, theoretical research is disconnected from

practical needs. Although some scholars advocate mining local cultural resources^[10], their work often remains at the level of cultural display, failing to systematically transform these resources into trainable and assessable professional competency modules. Second, support systems are insufficient. The “triple lag” problem of teachers in higher vocational colleges in ethnic regions, revealed by Gao Yuehan^[11], directly restricts the in-depth implementation of integrated teaching.

From an international perspective, theories of learning and identity development offer valuable frameworks for addressing these gaps. Situated learning theory^[3,12] emphasizes that learning is inherently tied to the activities, context, and culture in which it occurs. This suggests that embedding secretarial skill acquisition within authentic, culturally-rich scenarios should enhance learning transfer and professional identity formation. Furthermore, theories of identity development in education highlight that professional and national identities are not merely taught but are developed through reflective practice and meaningful engagement within a community of practice^[13].

Based on this, this study innovatively constructs a three-dimensional integration model of “Cultural Resources—Workplace Competence—Internalization of Values” (abbreviated as the CCI Model). Using the secretarial major in Yunnan higher vocational colleges as the empirical field, and through systematic path design and practical verification, it aims to break through existing research limitations and provide a replicable solution for deeply integrating education on internalization of values into professional curricula. This study focuses on the following questions:

- (1) RQ1: Can culture-embedded instructional design enhance students’ understanding of Chinese culture?
- (2) RQ2: Can integrating local cultural resources into workplace scenarios improve students’ vocational competence?
- (3) RQ3: Can such an integrated pathway facilitate the internalization of values education?

The objective is to build a replicable paradigm for embedding internalization of values into vocational professional curricula through empirical validation.

2. Construction of the CCI Model

The CCI Model is an organic whole, founded on the creative transformation of cultural resources, centered on the immersive training of workplace skills, and aimed at the deep internalization of values.

2.1. Diagnostic and transformation mechanism for cultural resources

This mechanism focuses on resolving the disconnection between cultural resources and professional teaching, achieving the transformation from cultural elements to teaching elements through a systematic conversion process.

First, a cultural resource diagnostic system is established, organizing professional teams to assess the educational value of Yunnan’s ethnic minority cultural resources. The focus is on examining the alignment between cultural elements and the core competencies of the secretarial major. For instance, the narrative structure of the Dai people’s palm-leaf manuscripts aligns with the normative requirements of business document writing, and the organizational logic of multi-ethnic festival activities has intrinsic connections with meeting management processes.

Second, the pedagogical transformation of cultural resources is achieved through case-based reconstruction. Real operational scenarios of ethnic enterprises are developed into teaching cases. For example, the Dai Water-

Splashing Festival is transformed into a “Human Resource Scheduling Plan for Festival Activities,” and multi-ethnic team collaboration models are converted into “Cross-cultural Communication Training Modules.”

2.2. Immersive training system for workplace competence

This system achieves the deep integration of skill training and cultural edification through multi-level training design.

The Basic Skills Level revolves around the core competencies of the secretarial major, designing serialized situational tasks. Multi-ethnic cultural communication elements are embedded in official document writing, and cross-cultural coordination links are integrated into meeting management, enabling students to acquire cultural understanding while mastering professional skills.

The Comprehensive Application Level adopts project-based learning, designing complex tasks that simulate complete work processes. For example, the “Anniversary Celebration Planning for a Borderland Multi-ethnic Enterprise” project requires students to holistically consider the cultural customs of different ethnic groups and formulate culturally inclusive activity plans, thereby cultivating cultural adaptation and integration capabilities.

2.3. Design of the internalization path for internalization of values

Through a progressive path design, a deep transformation from cultural cognition and skill mastery to internalization of values is achieved.

The Experience phase emphasizes emotional engagement, allowing students to personally feel the unique charm and mutual integration of various ethnic cultures during culturally immersive skill training, forming intuitive cultural experiences.

The Reflection phase focuses on rational sublimation. Through structured reflection guides, students are helped to extract the “pluralistic and integrated” characteristics of Chinese culture from cultural phenomena and to perceive the personal value of serving the borderlands from professional skills.

The Practice phase concentrates on action transformation, encouraging students to apply their secretarial expertise to serve the development of ethnic regions (e.g., participating in rural revitalization), thereby solidifying the internalization of values consciousness through practice.

Through the organic connection of these three phases, the model forms a complete transformation chain from resources to skills, and from skills to identity, providing a theoretical framework and practical guidance for the empirical research.

3. Research design

3.1. Participants

A quasi-experimental study was conducted with 98 first-year students majoring in Secretarial Studies at a public higher vocational college in Yunnan Province. The sample consisted of 86 females and 12 males, aged between 17 and 20. Whole-class convenience sampling was adopted due to administrative constraints, precluding random assignment across classes. The significant gender imbalance (approximately 88% female) reflects the typical enrollment profile of secretarial majors but may limit the generalizability of findings to more gender-balanced populations. No participants withdrew, resulting in complete pre-test and post-test data from all 98 students.

3.2. Instruments

Three instruments were developed and validated, corresponding to the three core dimensions of the CCI Model.

3.2.1. Cultural cognition and affection scale

This scale measured students' knowledge, recognition, and emotional engagement with Yunnan's ethnic cultures. Items were generated based on literature review and analysis of local cultural characteristics, and refined through review by a panel of three experts in vocational education and ethnology. The 15-item scale demonstrated good internal consistency ($\alpha = .87$) in the main study, using a five-point Likert scale.

3.2.2. Workplace competence scenario test

This performance-based instrument assessed students' ability to apply secretarial skills in simulated cross-cultural workplace scenarios (e.g., drafting documents for an ethnic enterprise, resolving communication misunderstandings arising from cultural differences). A standardized scoring rubric focused on task completion, cultural appropriateness, and procedural accuracy. Inter-rater reliability, assessed by two independent raters on a randomly selected 30% of responses using ICC, was .91, indicating excellent agreement.

3.2.3. Internalization of values scale

This scale was adapted from established values measures used in recent studies on higher vocational students^[4]. Item wording was modified to fit the secretarial profession and Yunnan's regional context. The adapted scale showed high internal consistency reliability ($\alpha = .89$) in this study.

3.3. Instructional intervention

The intervention was systematically implemented across two core secretarial courses: *Human Resource Management* and *Modern Chinese*. In *Human Resource Management*, a "Yunnan Multi-ethnic Enterprise Case Bank" was developed, transforming ethnic festival cultures into teaching modules like "HR Scheduling Plans for Festival Events." In *Modern Chinese*, administrative documents from multi-ethnic regions were used as teaching materials, guiding students to analyze linguistic expression characteristics across different cultural contexts.

Structured role-playing and project-based learning (PBL) were employed to create workplace scenarios, such as "Cross-border Business Negotiation" and "Multi-ethnic Enterprise Event Planning." Through carefully designed scenario scripts and project guidelines, students engaged with practical problems arising from cultural differences in highly realistic work environments. Following each project, scaffolded reflection sessions were conducted to guide students in exploring the significance of cultural integration embedded within the tasks, thereby facilitating the transition from practical experience to value identity.

3.4. Post-test assessment

Post-test assessment employed instruments identical to the pre-test. Questionnaires and scenario tests from the pre-test were readministered to directly compare changes across the three dimensions. Student project outputs and reflective reports were also collected as process evaluation materials.

Data analysis utilized a mixed-methods approach: Quantitative analysis involved paired-sample t-tests on pre- and post-test data to quantitatively assess significant changes in the three dimensions. Qualitative analysis employed content analysis to code and extract themes from student projects and reflective reports, providing an in-depth interpretation of cognitive deepening and value internalization. Triangulation of quantitative and qualitative analyses ensured the reliability of the findings.

4. Results and discussion

4.1. Data comparison

Paired-sample t-tests on the pre- and post-test questionnaire data from the 98 students showed statistically significant improvements across all dimensions of the CCI Model (**Table 1**).

Table 1. Comparison of pre-test and post-test scores across three dimensions ($n = 98$)

| Assessment Dimension | Pre-test Mean (Max 5) | Post-test Mean (Max 5) | Mean Increase | t-value | p-value | Effect Size (Cohen's d) |
|---|--------------------------|---------------------------|---------------|---------|-------------|----------------------------|
| Regional Cultural Cognition & Affection | 3.12 | 4.35 | +1.23 | 15.674 | $p < 0.001$ | 1.59 (large) |
| Workplace Ability Application | 2.89 | 4.18 | +1.29 | 17.892 | $p < 0.001$ | 1.82 (large) |
| Internalization of Values | 3.45 | 4.52 | +1.07 | 12.345 | $p < 0.001$ | 1.25 (large) |

4.2. Interpretation of results

The pre- and post-test data indicate significant improvements across all three dimensions, with effect sizes reaching large levels (Cohen's $d > 1.20$), demonstrating that the intervention had both statistical significance and substantial practical impact. These marked improvements underscore the appropriateness and effectiveness of the CCI Model within the higher vocational secretarial program.

Firstly, the cultural cognition and affection dimension showed an increase from 3.12 to 4.35, a substantial gain of 1.23 points. Students demonstrated more systematic understanding and more positive attitudes towards cultural symbols, festival systems, communication etiquette, and contemporary applications of multi-ethnic cultural elements. This suggests that systematically embedding Yunnan's ethnic cultural resources into the secretarial curriculum not only makes cultural knowledge more "perceivable" but also facilitates a shift from instrumental understanding to emotional identification. For example, during the "Coordinating the Dai Water-Splashing Festival Event" simulation, students were required to research cultural origins, taboos, and procedural norms, prompting them to actively construct their own cultural understanding frameworks.

Secondly, workplace competence showed the greatest improvement among the three dimensions, with an increase of 1.29 points. In the post-test scenario-based assessment, students performed substantially better in selecting cross-cultural communication strategies, organizing meetings, and designing event procedures. For instance, in the "Cross-Border Business Negotiation" simulation, students proactively considered communication style differences among neighboring cultures like Myanmar and Thailand, demonstrating cross-cultural sensitivity and adaptability. This indicates that cultural elements did not weaken professional training but enhanced students' workplace transferability through "situational reinforcement," aligning with the situated learning principle that knowledge embedded in authentic practice contexts is more readily transferable ^[12].

Finally, students also showed a significant improvement (+1.07) in Internalization of Values. Although the baseline score for this dimension was relatively high in the pre-test, the intervention still produced a large effect size, suggesting that the CCI Model effectively facilitates the shift from superficial cognitive awareness to deeper internalized value identification. For example, in reflective journals, some students expressed intentions such as "hoping to work in Yunnan's ethnic regions after graduation and contribute my secretarial expertise to promoting local cultural brands," highlighting meaningful value-oriented outcomes ^[14].

Overall, these results demonstrate that the CCI Model successfully establishes a synergistic developmental pathway where knowledge, competence, and values are enhanced through the internal linkage of cultural

resources, professional skills, and values development within the vocational curriculum.

4.3. Exploring the mechanisms

A key finding is that integrating cultural content did not interfere with secretarial skill training but significantly enhanced the acquisition of workplace competence.

4.3.1. Cultural elements increase the “authenticity” of scenarios

Secretarial work inherently involves cross-cultural communication and navigating diverse situations, and practical work contexts in Yunnan’s multi-ethnic regions demand sensitivity to cultural differences. Introducing elements like cultural taboos and festival arrangements into teaching made simulated tasks closer to real workplaces, effectively promoting skill transfer and application.

4.3.2. Cultural scenarios enhance students’ “learning motivation”

Compared to the “task completion” focus often observed in traditional skill training devoid of cultural context, culturally rich scenarios significantly boosted students’ initiative to explore and engage. Students actively sought information, discussed cultural differences, and simulated conflict resolution. Culture acted as an “emotional activator,” driving them to delve into more complex and challenging tasks.

4.3.3. Culture serves as a “cognitive scaffold” for deep understanding.

Cultural symbols, ritual structures, and traditional logic are inherently systematic, providing structured content that supports the comprehension of underlying professional principles. For example, the narrative structure of Dai palm-leaf manuscripts aids in training logical organization in business writing; the compositional patterns of Yi embroidery inform aesthetic application in document layout; multi-ethnic festival procedures offer natural frameworks for event planning.

4.4. Implications for vocational education curriculum reform in ethnic regions

The CCI Model clearly demonstrates that ethnic cultural resources can, through systematic pedagogical transformation, become significant carriers for cultivating vocational competence, rather than merely serving as decorative cultural add-ons in the curriculum. Embedding cultural content into professional tasks enhances students’ situational understanding, strategic application, and cross-cultural communication skills, thereby promoting integrated learning of “culture—competence—values” in both authentic and simulated workplace environments^[15].

More importantly, the CCI Model is not confined to the secretarial major; its theoretical structure and practical mechanisms exhibit strong cross-disciplinary scalability. For instance, in Tourism Management, the organizational logic of ethnic festivals can be reconstructed as project-based tasks like “Multi-ethnic Festival Experience Design,” enabling students to learn event planning and public service through cultural immersion. In E-commerce programs, the cultural symbols, narratives, and branding strategies of ethnic enterprises can form the core of learning units like “Digital Communication and Marketing for Ethnic Brands,” helping students understand the commercial value of cultural assets in digital business contexts.

5. Conclusion and recommendations

5.1. Conclusion

This study constructed and validated the three-dimensional “Cultural Resources—Workplace Competence—Internalization of Values” (CCI) integration model. Theoretically, it breaks through the traditional disconnect between curriculum-based education and professional teaching, proposing a new paradigm of “workplace-contextualized integration.” It reveals the intrinsic connections between regional culture, vocational ability, and community value, confirming their synergistic development through scientific curriculum design.

Practically, the study explored an effective pathway for transforming ethnic cultural resources into measurable professional competencies. Through dynamic, modularized cultural teaching and scenario simulation, it facilitated the deep internalization of student learning, moving from cultural cognition to professional behavior. Empirical data indicate this path significantly enhances students’ cultural confidence, professional capabilities, and internalization of values.

Furthermore, the school-enterprise dual evaluation mechanism established, relying on positive enterprise feedback regarding students’ “cultural adaptability,” creates a “demand—curriculum—talent” virtuous cycle, achieving effective alignment between curriculum reform and market needs.

5.2. Research limitations and prospects

This study has limitations. The teaching experiment lasted one semester; the long-term stability of the internalization of values requires sustained tracking. The study focused primarily on the secretarial major; the model’s applicability to other professional fields warrants further testing.

Future research can develop along two dimensions: Vertically, tracking graduate career development to assess the long-term effects of the “CCI” competencies cultivated during their studies. Horizontally, extending the model to other regionally distinctive majors like Tourism Management and Cross-border E-commerce to explore more universal paradigms for vocational education in border regions.

In summary, this study provides a replicable curriculum reform plan for higher vocational education, holding theoretical and practical value for forging a strong sense of internalization of values within the secretarial major.

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Exploration of Paths for AI-Enabled Construction of Characteristic General Education Courses: A Case Study of the “Metrology +” Model at China Jiliang University

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Abstract: As a crucial component of cultivating well-rounded talents, general education has garnered widespread attention for its characteristic and intelligent development. This paper takes the existing “Metrology +” characteristic general education system of China Jiliang University as the research object, conducts an in-depth analysis of the current status and existing problems of the curriculum system, and focuses on exploring how to leverage artificial intelligence (AI) technology to empower the construction of a characteristic general education curriculum system. By proposing strategies such as AI-driven reconstruction of the characteristic general education curriculum system, innovation of teaching models, resource development and sharing, and quality assessment and optimization, this study aims to construct an intelligent, personalized, and high-efficiency new model of “AI + Metrology +” characteristic general education. It provides a referential path and example for general education reform in universities with industry characteristics and even across universities nationwide.

Keywords: Artificial intelligence; General education; Characteristic courses; Metrology +; Curriculum construction; China Jiliang University

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1. Introduction

General education, as a key link in achieving the goal of cultivating well-rounded talents, is of paramount importance. As the only university in China integrating metrology, standards, quality, market supervision, inspection, and quarantine, China Jiliang University shoulders the mission of serving national strategies and the development of the metrology industry. Constructing a “Metrology +” characteristic general education curriculum system holds significant exploratory value for leveraging the university’s characteristic advantages

and cultivating interdisciplinary talents with industry heritage and international perspectives.

2. Current status of general education curriculum system construction at China Jiliang University

China Jiliang University originated from Hangzhou Jiliang School, established by the National Bureau of Metrology in 1978. It was upgraded to China Jiliang College in 1985, renamed China Jiliang University in 2016, and became a university co-constructed by Zhejiang Province and the State Administration for Market Regulation, as well as a key construction university in Zhejiang Province in 2019. The university offers 44 undergraduate programs, including 18 national first-class programs, 4 national characteristic programs, 1 national professional comprehensive reform pilot program, 9 programs accredited by the National Engineering Education Accreditation, and 24 provincial first-class programs. These programs cover 8 disciplines: Engineering, Science, Management, Literature, Law, Economics, Medicine, and Art (**Figure 1**), forming a discipline pattern characterized by strong engineering, integration of science, engineering, and management, and coordinated development of multiple disciplines.

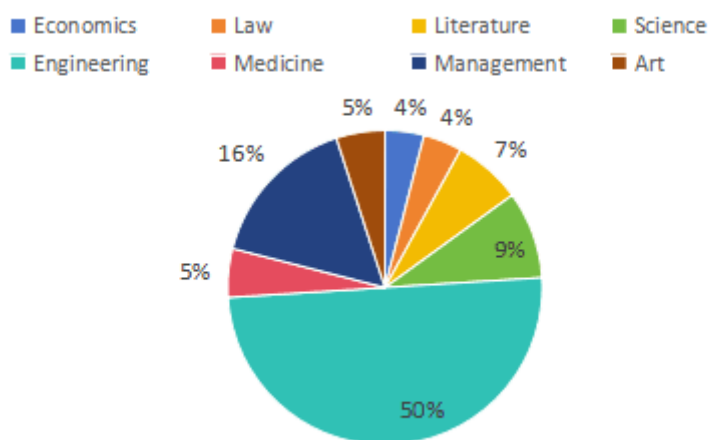


Figure 1. Distribution of undergraduate programs by discipline category.

Adhering to the basic laws of higher education and teaching, as well as the laws of students' physical and mental development, the university takes "fostering virtue through education" as its fundamental task, regards promoting students' all-round development and adapting to social development needs as the fundamental standard, and is guided by the core concept of engineering education professional certification. It coordinates general education and professional education, strengthens innovation and entrepreneurship education, and forms a high-level talent training system centered on student development and oriented by student achievements and social needs.

2.1. Construction of the core general education system

The university's overall talent training goal of "all-round development of morality, intelligence, physical fitness, aesthetics, and labor education" serves as the fundamental guideline. The "Guiding Opinions on Formulating (Revising) Undergraduate Program Training Plans" clearly states that "the concept of general education

should be integrated into the entire process of talent training to promote students' all-round development" and constructs a progressive curriculum system of "General Education Courses - Disciplinary Basic Education - Professional Education". The existing general education curriculum system consists of two parts: compulsory general education courses and elective general education courses. The compulsory general education system mainly includes public basic courses such as College Chinese, Advanced Mathematics, and Foreign Languages. The elective general education curriculum system sets 6 categories: "Chinese Culture and World Civilization", "Social Sciences and Modern Society", "Science and Technology Development and Scientific Literacy", "Art Appreciation and Aesthetic Experience", "Innovation Entrepreneurship and Vocational Education", and "Language and Cross-Cultural Communication". Furthermore, in order to strengthen the cultivation of students' concepts of quality, awareness of standards, and metrological capabilities, a specific "University Characteristics" module has been designed. This module, combined with the previous six categories, forms the "6+1" General Education Elective Curriculum framework (**Figure 2**). In addition to relying on independent applications from on-campus colleges for elective general education courses, the university also introduces high-quality online general education resources such as Erya, aiming to build an "online + offline" diversified curriculum system and enrich students' curriculum choices.



Figure 2. Elective general education curriculum system of China Jiliang University.

2.2. Analysis of problems in the existing elective general education curriculum system

Currently, the construction of the elective general education curriculum system faces numerous urgent problems. These problems not only hinder the fulfillment of the talent cultivation function of elective general education courses but also impede the university's goal of characteristic development. Specifically, the problems are as follows: Firstly, there is a prominent imbalance in the curriculum system structure. Secondly, the curriculum content lacks innovation and suffers from severe homogenization. Furthermore, mechanisms for cross-college curriculum co-creation are difficult to form. High-quality teaching resources are mainly concentrated

in professional courses, with insufficient attention paid to general education courses. Moreover, most teachers develop general education courses independently (“solo efforts”) without cross-college collaboration and integration, failing to achieve effective sharing of general education curriculum resources. These issues reduce teachers’ enthusiasm for general education teaching, thereby affecting the educational effectiveness of general education courses and exerting a negative impact on the university’s talent cultivation quality.

3. Feasibility and advantages of AI-enabled construction of characteristic general education courses

AI technology has undergone five stages of evolution: initial exploration (1950s–1970s), technical accumulation (1980s–1990s), deep learning (2000s–2010s), the rise of AIGC (2010s–2021), and the diversification and popularization of AIGC (2022–present)^[1]. Currently, AI has become a key driving force for social development and has brought profound changes to the field of education and teaching. Wu Yan, Vice Minister of Education, also pointed out that AI will become an important engine for promoting the high-quality development of education and shape new paradigms and forms of education^[2].

In the field of higher education, AI applications have extended from teaching tools to curriculum system construction. Nanjing University has launched a “1 + X + Y” core general education curriculum system for AI^[3], Fudan University has constructed an “AI-BEST” framework^[4], and Beijing University of Posts and Telecommunications has developed systematic teaching materials, courseware, and video resources^[5]. These practices demonstrate that AI technology can effectively support personalized learning navigation and precise learning evaluation in general education courses, enhancing students’ participation and higher-order learning abilities.

4. Practical paths for AI-enabled construction of the “Metrology +” characteristic general education courses at China Jiliang University

To address the imbalance in the curriculum system structure, AI technology can be used to construct a modular curriculum framework of “Basic General Education - Disciplinary Integration - Industrial Application”, organically integrating characteristic disciplines such as metrology and standardization into the general education system.

4.1. Constructing an interdisciplinary curriculum network with knowledge graphs

By building a knowledge graph network integrating metrology and AI, interdisciplinary knowledge points are integrated to form a searchable curriculum resource library. This structured knowledge connection can break disciplinary barriers, enabling students to advance from “basic understanding of AI” to “rational use of AI” and further to “innovative application of AI”^[6], making general education courses an important window for students to understand the university’s characteristic disciplines.

4.2. AI teaching assistants supporting personalized learning paths

Drawing on the successful experience of Hubei University’s “Chemistry and Human Civilization” course^[7], knowledge graphs and AI teaching assistants are applied to personalized learning navigation for students of different majors. Based on students’ learning history and performance, AI teaching assistants can automatically

recommend resources most suitable for their current learning stage and abilities, such as industry application cases in metrology and interpretations of standardization policies. This broadens students' knowledge horizons and avoids the limitations of single information sources.

4.3. Dynamic optimization of the curriculum weight mechanism

AI is used to analyze students' course selection data and feedback to automatically adjust curriculum weights, ensuring a reasonable proportion of characteristic disciplines in general education courses. For example, machine learning algorithms are used to analyze students' preferences and learning effects in metrology, standardization, and other courses, dynamically adjusting the number of courses offered and the depth of content, thereby achieving a more balanced and reasonable structure of general education courses^[8].

5. AI-assisted mechanism for curriculum content innovation

To address the lack of innovation and severe homogenization in curriculum content, universities can develop an AI-assisted mechanism for curriculum content innovation to promote cross-college resource integration and teacher collaboration.

5.1. Generative AI building a characteristic case library

Generative AI (e.g., ChatGPT) is used to quickly integrate industry application data (such as smart city data calibration cases) and the latest academic achievements in metrology, converting them into general education course materials. This mechanism significantly reduces the repetitive work of teachers in course development and improves the innovation and timeliness of curriculum content^[9].

5.2. AI-driven matching for cross-college teacher collaboration

An AI-driven curriculum co-creation platform is developed to support cross-college teacher team formation, resource matching, and intelligent feedback. The platform also provides collaboration tools, resource sharing spaces, and teaching feedback systems to promote knowledge exchange and teaching innovation among teachers^[10].

5.3. Virtual laboratories expanding practical teaching

AI-based virtual laboratories for metrology and standardization are constructed, and standardized simulation scenarios (e.g., application of AI algorithms in quality inspection) are developed, enabling students to understand the practical application of characteristic disciplines through virtual experiments. This practice-oriented teaching model effectively addresses content homogenization and enhances students' sense of participation and learning effectiveness.

6. AI-enabled curriculum evaluation and update system

To ensure the cutting-edge nature and practicality of curriculum content, universities need to construct an AI-enabled evaluation and update system for general education courses.

6.1. Multi-dimensional intelligent evaluation system

Based on the OBE concept and entropy weight calculation method^[11], an intelligent evaluation system covering

four dimensions—knowledge, skills, thinking, and values—is constructed. Evaluation results are intuitively presented in forms such as competency radar charts, helping teachers understand students’ learning status and adjust teaching strategies in a timely manner.

6.2. Automated content update system

AI is used to monitor cutting-edge disciplinary developments (e.g., papers, industry reports) and automatically trigger curriculum content iteration. The system automatically compares changes in industrial needs, accurately identifies outdated or disconnected content in materials, and provides specific optimization suggestions, ensuring that curriculum content remains synchronized with industrial development. Additionally, the system supports flexible template library management, allowing universities to customize standard formats and content frameworks, achieving curriculum updates that comply with national standards while incorporating industrial cutting-edge and school-based characteristics.

6.3. Dynamic optimization platform for interdisciplinary courses

Combining AI analysis and teacher feedback, a dynamic optimization platform for interdisciplinary courses is built. The platform real-time monitors students’ course selection preferences, learning effects, and feedback data, automatically recommends interdisciplinary knowledge connections (e.g., integration of metrology and ethics), and optimizes the content structure of courses.

7. Future outlook and challenge response

The prospect of AI-enabled construction of a characteristic general education curriculum system is broad, but it also faces challenges that require proactive anticipation and response strategies.

7.1. Ethical risks of technology application

AI technology may bring ethical issues such as data privacy and algorithmic bias in the process of curriculum content generation and evaluation. To address this challenge, universities should strengthen AI ethics education and establish an AI curriculum content review mechanism to ensure technology is used for good ^[12].

7.2. Demand for improving teacher competence

Currently, frontline university teachers generally lack systematic understanding and teaching experience in AI. To solve this problem, universities should strengthen AI literacy training for teachers, establish an “AI + Discipline” teacher development community, and encourage teachers to participate in AI general education course development. For example, Beijing No. 80 Middle School has collaborated with technology enterprises to establish AI laboratories, providing teachers with practical platforms and teaching guidance to enhance their AI teaching capabilities ^[13].

7.3. In-depth integration of technology and education

AI technology needs to be deeply integrated with education and teaching, avoiding technology from overriding education. Universities should adhere to the principles of “people-oriented, active embrace, guided application, and maximizing benefits while avoiding harms” to ensure AI technology serves educational goals ^[14].

7.4. Improvement of resource sharing mechanisms

AI general education course construction requires a sound resource-sharing mechanism to avoid teachers working in isolation. Universities should establish curriculum resource libraries, encourage teachers to share AI course development experiences and teaching resources, and foster a culture of collaborative innovation^[15].

8. Conclusion

The construction of an AI-enabled characteristic general education curriculum system is a key strategy for universities to respond to the digital transformation of education. By building knowledge graphs, developing intelligent matching systems, establishing virtual laboratories, designing multi-dimensional evaluation systems, and implementing automated update systems, universities can effectively address the imbalance in the general education curriculum system and insufficient content innovation, promote cross-college resource integration and teacher collaboration, and enhance the educational effectiveness of general education courses.

However, the process of AI-enabled education also faces challenges such as ethical application of technology, improvement of teacher competence, in-depth integration of technology and education, and improvement of resource sharing mechanisms. Universities need to adhere to the “people-oriented” educational philosophy, balance technology application and educational goals, and promote in-depth integration of AI technology and characteristic general education courses through policy guidance, institutional guarantees, and continuous training, thereby cultivating interdisciplinary talents adaptable to an intelligent society.

AI empowerment is not about replacing teachers but enhancing their teaching capabilities; it is not about weakening disciplinary characteristics but expanding application scenarios of disciplines; it is not about solving all problems but providing new ideas and tools. In this process, universities should uphold their original mission of education, ensuring that AI technology truly serves the goals of talent cultivation and the characteristic development of the university.

Disclosure statement

The author declares no conflict of interest.

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Research on the Practice of Virtual Digital Humans Empowering the Digital-Intelligent Transformation of Higher Vocational Education

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Abstract: With the in-depth integration of digital technology and modern vocational education, virtual digital humans have become an important factor driving the digital-intelligent transformation of vocational education in the new era. Based on this research background, this paper deeply analyzes the connotation and characteristics of virtual digital human technology, expounds its application value in modern higher vocational education, and then puts forward practical strategies and scientific measures for virtual digital humans to empower the digital-intelligent transformation of higher vocational education from four dimensions: teaching scenario reconstruction, training mode innovation, evaluation system reshaping, and school-enterprise collaboration mechanism. It aims to provide assistance and support for breaking through educational reform dilemmas in aspects such as the teaching ecosystem, educational resources, evaluation systems, and talent supply and demand.

Keywords: Virtual digital humans; Higher vocational education; Digital-intelligent transformation; Virtual simulation; Practical strategies

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1. Introduction

In the context of a digital society, the integration of technologies such as artificial intelligence, big data, and virtual reality with vocational education has continuously deepened, promoting the reform and reconstruction of the educational ecosystem and talent training models. In the process of building an educational digitalization strategy, higher vocational colleges should continuously explore the development path of the organic combination of emerging digital technologies and vocational skills education. As an integration achievement of generative artificial intelligence technology and virtual simulation technology, virtual digital human technology has shown a good application trend in various industries and fields. Higher vocational colleges should create highly realistic digital images and interactive environments to provide innovative solutions for vocational education that break time and space limitations, reduce training costs, and improve teaching efficiency, providing reference for the

digital-intelligent transformation of vocational education.

2. Overview of virtual digital human technology

Virtual digital humans are digital images with human appearance characteristics, behavioral patterns, and interactive capabilities created relying on information technology. They are mainly supported by multiple technologies such as computer graphics, virtual reality, and artificial intelligence, and are driven through character modeling, speech synthesis, and animation driving^[1].

From the perspective of technological evolution, current virtual digital humans have transitioned from “pre-recorded animations” to “real-time interactive agents”, which can dynamically adjust behaviors and feedback according to interactive scenarios^[2]. The introduction of this technology into the context of higher vocational education can be applied at three levels. Firstly, construct digital avatars of teachers to assist them in completing routine teaching tasks and answering questions. Secondly, build virtual training mentor roles to provide practical guidance for students on simulation environments or virtual platforms. Thirdly, simulate interactive objects, such as patients for medical majors and customers for business majors, to provide students with a realistic training atmosphere.

Virtual digital human technology has a good adaptation relationship with higher vocational education, which can also be analyzed from three aspects. Firstly, the plasticity of teaching scenarios: virtual digital humans can simulate complex situations in real work environments^[3] to help students solve practical training problems. Secondly, the personalized support characteristic: virtual digital humans can analyze students’ learning behaviors and habits based on big data technology, and then provide adaptive learning paths. Thirdly, the resource reuse characteristic: virtual digital humans can be reused in different scenarios and projects, which is conducive to reducing teaching costs.

3. Application value of virtual digital humans in higher vocational education

3.1. Reshape the teaching paradigm and build a “teacher-machine-student” ternary teaching ecosystem

In traditional higher vocational education, a “teacher-student” binary interaction structure is mainly adopted, but the number of teachers and teaching time directly limit the teaching level, making it impossible to achieve in-depth guidance for personalized education. Virtual digital humans can break this limitation by building a “teacher-machine-student” ternary teaching ecosystem. By replacing some teacher responsibilities with machines, repetitive tasks such as knowledge transmission and answering questions can be entrusted to intelligent assistants^[4], which are tireless and can provide students with 24/7 full-cycle learning support. Firstly, the intelligent teaching management function: the intelligent assistant can automatically classify generated teaching resources, set labels and indexes for easy access and use by teachers and students^[5]. Secondly, the real-time data analysis function: the intelligent assistant can intelligently analyze students’ online interaction records and learning behaviors to understand their learning habits and achievements. Thirdly, the immersive simulation function: the intelligent assistant can provide students with diverse practical opportunities through highly realistic simulation environments.

3.2. Solve training difficulties and create a safe and efficient simulated training environment

In modern higher vocational education, practical training teaching is one of the core dilemmas. Especially in professional fields such as chemical engineering, medical care, and intelligent manufacturing, the obstacles are mainly reflected in the “three highs and three difficulties”, namely “high investment, high difficulty, high risk; difficult to implement, difficult to observe, difficult to reproduce”. Virtual digital human technology can break through training difficulties by creating a highly simulated virtual training environment. Firstly, it can provide standardized operation demonstrations. Through video demonstrations, text descriptions, graphic guidance, etc., it can accurately restore operation processes, practical skills, and precautions^[6], providing students with standardized guidance and suggestions. Secondly, it can create training projects in dangerous scenarios. Virtual digital humans can use virtual environments to create extreme practical environments and emergencies, allowing students to solve problems while avoiding actual risks. Thirdly, it helps share scarce resources. Virtual digital humans can reuse and promote relevant educational resources, including virtual equipment and high-quality training cases^[7].

3.3. Achieve precise evaluation and draw dynamic portraits of students’ skill growth

The evaluation of higher vocational education currently relies heavily on teachers and summative examinations, which cannot fully and comprehensively reflect changes in students’ abilities and mastery of skills throughout the process. Virtual digital humans can not only conduct tracking observations and multi-dimensional evaluations of students through data collection, behavioral analysis, and pattern recognition, but also build quantitative and refined evaluation tools to assist teachers in constructing student portraits.

4. Practical strategies of virtual digital humans empowering the digital-intelligent transformation of higher vocational education

4.1. Build a new “teacher-machine-student” ternary teaching ecosystem and innovate teaching organization forms

The in-depth integration of virtual digital human technology and higher vocational education should start with the reconstruction of teaching organization, and promote the reform and development of vocational education simultaneously through the construction of a ternary teaching ecosystem of “teacher guidance, digital human assistance, and student-centeredness”.

Firstly, from the perspective of technical architecture, schools should fully establish a highly integrated intelligent teaching platform that integrates the functions of virtual digital humans, resource libraries, teaching management platforms, and other modules. At the same time, this integrated platform needs to meet two-way interaction functions: it can not only transmit knowledge to students through virtual digital humans and provide personalized educational support by automatically collecting student behavior data but also allow students to independently raise questions and doubts to virtual digital humans^[8] to help them solve learning difficulties.

Secondly, from the perspective of role division, schools should reposition teachers’ teaching positions and responsibilities, and clearly divide the teaching division of labor between them and virtual digital humans. Teachers should transition from “knowledge transmitters” to roles such as “growth guides” and “learning designers”, mainly creating learning scenarios, planning learning paths, and conducting emotional exchanges for students^[9]; virtual digital humans assume tasks such as knowledge transmission, skill demonstration, and

answering questions, thereby releasing teachers' subjective initiative to develop more valuable teaching activities.

Thirdly, from the perspective of interaction mechanisms, schools should build multi-level and multi-form interaction models. For example, "teacher-student interaction" should emphasize heuristic teaching behaviors led by teachers; "student-machine interaction" should highlight independent learning activities carried out between students and virtual digital humans; "teacher-machine-student interaction" involves teachers organizing students to carry out collaborative learning activities with the help of virtual digital humans, so as to meet the actual needs of different learning scenarios^[10].

4.2. Develop virtual simulation training resources to address the "three highs and three difficulties" dilemma in higher vocational education

In higher vocational colleges, the development of virtual simulation training resources is an important link in the application of virtual digital humans and a key factor affecting the value implication of technological empowerment. In response to the current problems of homogenization, gamification, and fragmentation of virtual training resources, schools should systematically solve them with the help of virtual digital humans.

Firstly, establish a dynamic content generation mechanism based on real work scenarios. The development of training resources should be connected with the needs of industries and enterprises. Therefore, schools can dynamically optimize training courses and projects based on generative artificial intelligence technology. Taking the animation design major as an example, schools can create a full-process simulation environment for animation production based on the virtual digital human system^[11], where digital humans simulate project managers to guide students to master core skills such as character design and action debugging through interaction with them.

Secondly, build a modular and systematic virtual training resource system. Resource fragmentation is one of the core problems faced in practical training teaching in higher vocational colleges. In this regard, schools should adopt a "platform + module" plan to establish unified resource standards and a flexible and free resource system. On the one hand, they can plan virtual training projects covering three gradients of "basic skills—specialized skills—comprehensive abilities" around professional groups; on the other hand, they should provide corresponding virtual digital human teaching plans and projects based on the corresponding training resource modules to form a complete learning path.

Thirdly, focus on safety awareness training and balance interestingness and professionalism. In practical training teaching, some majors or projects have high-risk characteristics, which requires schools to use virtual simulation equipment and resources to assist in completing teaching with the help of virtual digital humans^[12]. In this process, virtual digital humans can simulate the consequences of wrong operations and assess responsibility weights, allowing students to understand the hazards caused by illegal operations, recognize the significance of responsibilities, and improve their awe of safety norms.

4.3. Build an AI-driven dynamic evaluation system to achieve precise portraits of skill growth

The digital-intelligent transformation of higher vocational education is reflected not only in teaching methods and models but also in teaching evaluation and assessment. Virtual digital human technology can realize the transformation of the "experience-driven" evaluation system to "data-driven", forming an objective and complete evaluation carrier.

Firstly, construct a full-process and multi-dimensional data collection system. Schools can collect microdata

such as students' learning behaviors, operation processes, decision-making paths, and reaction times based on the interaction process with virtual digital humans, thereby establishing a student personal portrait database ^[13]. In teaching evaluation, teachers can conduct a comprehensive evaluation based on the results of process data analysis and traditional test scores to more comprehensively present students' learning achievements.

Secondly, establish a skill assessment model based on big data. With the support of big data technology, schools can also use machine algorithms to analyze students' learning behavior data, deeply interpret the correlation between students' learning behaviors and skill mastery, and thus establish a more scientific competency assessment index system, providing more objective and relevant evaluation indicators for teachers to implement teaching evaluation. For example, schools can establish an integrated system of intelligent analysis, evaluation and teacher evaluation. On the one hand, algorithms assist in analyzing students' behavior records, and virtual digital humans evaluate and provide feedback to students; on the other hand, teachers evaluate students based on their actual learning achievements and performance, forming a "qualitative + quantitative" evaluation path ^[14].

Thirdly, develop personalized feedback and intervention mechanisms. The purpose of teaching evaluation is not evaluation itself, but to promote students' learning through evaluation feedback. Therefore, schools should also establish feedback and intervention mechanisms with the help of virtual digital human systems, automatically generate personalized learning suggestions and resource recommendations based on intelligent evaluation results, and infiltrate and guide them in subsequent "student-machine" interactive learning to achieve the effect of promoting learning through evaluation.

4.4. Deepen the school-enterprise collaboration mechanism and co-construct a virtual training resource library

From the perspective of integration of production and education, the collaborative development of virtual digital human technology and higher vocational education also needs to be based on school-enterprise cooperation to assist in resource development and updating, provide students with cutting-edge knowledge and skills, and avoid the disconnection between teaching and industry.

Firstly, co-construct a virtual training resource development team. Professional teachers from schools should be responsible for the design of teaching content and the guidance of educational theories to ensure the educational characteristics of virtual training resource development. Enterprise experts should clarify the details of real work scenarios and case construction to ensure the scientificity and accuracy of virtual resources. Technology companies should develop a virtual digital human system with in-depth integration of "education + industry + technology" according to the requirements of school teachers and enterprise experts ^[15].

Secondly, co-cultivate a teaching team proficient in digital technology. Virtual digital human technology cannot replace teachers, and teachers are needed as the core subject for its application. Therefore, schools also need to improve teachers' digital literacy and technical operation capabilities through enterprise practice, technical training, and project cooperation.

5. Conclusion

In summary, virtual digital human technology is a cutting-edge field in the digital-intelligent transformation of modern education, and is reshaping the higher vocational education ecosystem with unprecedented depth and breadth. Schools should comprehensively solve the practical dilemmas faced by vocational education by building

a new “teacher-machine-student” ternary teaching ecosystem, developing virtual simulation training resources, innovating dynamic evaluation systems, and deepening school-enterprise collaboration. They should give full play to its educational values, such as personalized teaching, precise evaluation, and immersive experience, thereby promoting the transformation of higher vocational education from standardized and large-scale training to personalized and adaptive development, and opening up a new path for cultivating high-quality technical and skilled talents adapting to the digital era.

Disclosure statement

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Research on the Reform Path of “Fundamentals of Circuit Analysis” Empowered by Knowledge Graphs

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Abstract: Under the background of the development of emerging engineering disciplines and the digital transformation of education, the curriculum reform of “Fundamentals of Circuit Analysis” has become an urgent priority. Focusing on the application of knowledge graphs in this curriculum reform, this paper conducts an in-depth analysis of its enabling pathways. By sorting out the curriculum’s knowledge system, integrating interdisciplinary knowledge, and constructing multi-dimensional knowledge graphs, the structured and interconnected presentation of knowledge is achieved. Leveraging knowledge graphs to optimize the organization of teaching resources, implement blended teaching, promote personalized learning, and improve the intelligent evaluation system, the transformation of the teaching model from “knowledge point indoctrination” to “competence-oriented” is realized. This provides a theoretical basis and practical plan for cultivating compound engineering talents with interdisciplinary thinking and practical abilities.

Keywords: New engineering; Knowledge graph; “Fundamentals of Circuit Analysis”; Blended learning

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1. Introduction

With the comprehensive advancement of emerging engineering disciplines, construction and the in-depth implementation of the educational digitalization strategy, university curriculum teaching is facing unprecedented challenges and opportunities. As a core foundational course for majors such as Electrical Engineering, Electronic Engineering, and Automation, “Fundamentals of Circuit Analysis” plays a pivotal role in shaping students’ engineering thinking, developing learning methods, and fostering a craftsman’s spirit ^[1]. However, under the traditional teaching model, the teaching of “Fundamentals of Circuit Analysis” is often carried out chapter by chapter, making it easy for students to engage in fragmented learning and difficult to form a systematic understanding of the course knowledge. The course content has problems such as scattered knowledge points and weak correlations, which make it difficult to meet the needs of emerging engineering disciplines for cultivating compound talents. As an emerging technology, knowledge graphs can effectively integrate knowledge and

reveal the inherent connections between knowledge. The organic integration of knowledge graph technology and the content of “Fundamentals of Circuit Analysis” helps construct a structured and visualized knowledge system, expand interdisciplinary research fields, and provide innovative ideas and methods for curriculum reform^[2]. Using knowledge graphs to sort out the course knowledge system, select appropriate intelligent teaching resources for development based on the characteristics of the course and students’ needs, and build a rich digital resource library including microlecture videos, interactive courseware, and virtual experiment modules. Integrating digital resources into knowledge graphs can create a network with abundant resources to meet students’ diverse learning needs.

2. Reconstruction of the course knowledge system based on knowledge graphs

Focusing on the “Fundamentals of Circuit Analysis” course, a visual knowledge graph is constructed, and a multi-dimensional knowledge graph is developed by combining the knowledge connection points of prerequisite and subsequent courses. Knowledge points and their relationships are digitally represented to form a curriculum knowledge network with a topological structure. This graph not only presents the overall framework of the knowledge system but also reveals the attribute characteristics and association paths of each knowledge point, laying a foundation for the subsequent organization of intelligent teaching resources and the planning of personalized learning paths. Through this reconstruction of the knowledge system, the transformation from traditional linear knowledge transmission to networked and structured knowledge construction is realized, effectively supporting the achievement of the talent training goals of emerging engineering disciplines. The construction method of the knowledge graph for “Fundamentals of Circuit Analysis” is shown in **Figure 1**.

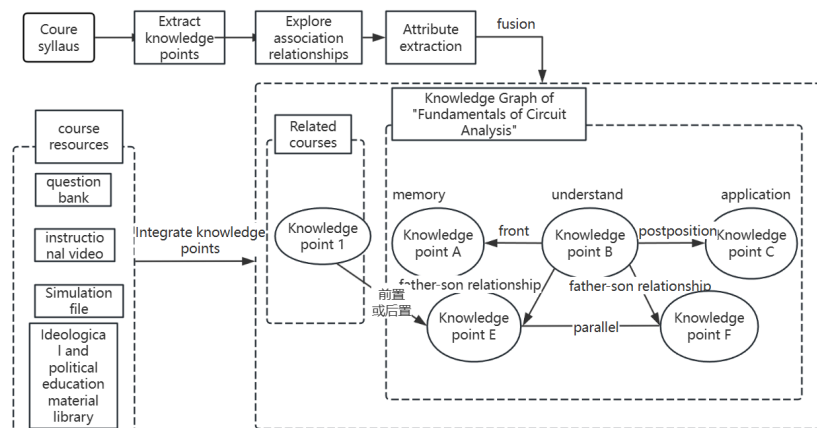


Figure 1. Knowledge graph construction method.

2.1. Construction of the course knowledge graph

Combining the engineering education certification standards and the needs of industrial digital transformation, the focus is on strengthening students’ engineering practice capabilities and digital literacy. The teaching objectives of the traditional “Fundamentals of Circuit Analysis” course are upgraded to clearly cultivate students’ abilities in circuit modeling, simulation analysis, and solving complex engineering problems. Starting from the course objectives, decomposed teaching objectives in three aspects (knowledge, ability, and value) are established, teaching content and resources are sorted out, the granularity of knowledge points is refined, and course objectives, teaching objectives, knowledge points, and engineering practice analysis are connected

with the knowledge graph ^[3]. Based on the revised curriculum syllabus, a structured analysis method is used to deconstruct the content of “Fundamentals of Circuit Analysis,” sorting out core knowledge modules such as “Basic Circuit Laws,” “Dynamic Circuit Analysis,” and “Frequency Domain Analysis Methods,” which are then refined into individual knowledge point units. Finally, a knowledge representation model is designed to clarify the attributes of knowledge points (such as difficulty coefficient, importance level, prerequisite knowledge, etc.) and association relationships (such as sequential relationships, inclusion relationships, application relationships, etc.). For example, Kirchhoff’s Laws were previously taught as a whole in a 90-minute class period; through the construction of the knowledge graph, the knowledge points are sorted out and decomposed into two knowledge points: Kirchhoff’s Current Law (KCL) and Kirchhoff’s Voltage Law (KVL). The VCR relationships of circuit components and the directions of voltage and current are set as prerequisite knowledge points for these two laws, and Kirchhoff’s Laws in sinusoidal AC circuits are set as subsequent knowledge points, constructing a complete knowledge network of Kirchhoff’s Laws in the course.

2.2. Horizontal integration graph

Based on the content of “Fundamentals of Circuit Analysis,” the focus is on constructing a knowledge association network between mathematics (calculus, linear algebra), physics (basic electromagnetism), and circuit theory to address the cognitive barriers of freshmen in interdisciplinary connections and promote the integration of knowledge. When students encounter difficulties in circuit analysis (such as solving differential equations of dynamic circuits), the system can automatically associate and recommend corresponding review content of mathematical foundations (such as the solution method of first-order differential equations), helping students fill knowledge gaps and improve learning efficiency.

2.3. Vertical progression graph

The construction of the vertical progression graph focuses on building a complete knowledge development context, forming a progressive learning path of “basic theory → analysis method → engineering application”. For the “Fundamentals of Circuit Analysis” course, taking “time-domain analysis → frequency-domain analysis → system synthesis” as the main line, the core teaching content is systematically integrated to construct a hierarchical knowledge progression system. It breaks the limitation of isolated presentation of knowledge points in traditional teaching, forming a logically rigorous and hierarchically clear knowledge development path, effectively supporting students’ ability leap from basic theory to engineering application, which is in line with the progressive requirements of emerging engineering talents training.

2.4. In-depth expansion graph

The construction of the in-depth expansion graph aims to break the course boundaries and establish a knowledge bridge between “Fundamentals of Circuit Analysis” and subsequent professional courses. By systematically sorting out the extended applications of circuit theory in engineering practice, a knowledge expansion network oriented to practical engineering problems is constructed, focusing on strengthening students’ knowledge transfer ability and engineering thinking cultivation. It not only enhances students’ knowledge transfer ability of “basic theory - professional courses - engineering practice” but also cultivates their systematic engineering thinking, effectively solving the problems of course separation and knowledge fragmentation in traditional teaching, and providing a coherent knowledge development path for the ability training of emerging engineering talents. Through explicit knowledge association annotation, it helps students establish a complete professional knowledge system

and improve their comprehensive ability to solve complex engineering problems.

2.5. Integration of teaching resources

The construction of knowledge graphs not only realizes the structuring of knowledge but also provides a core framework for the systematic integration and intelligent application of teaching resources. The course team takes the knowledge graph as the “hub” to accurately anchor and semantically associate originally discrete and heterogeneous teaching resources (including textbooks, academic literature, microlecture videos, interactive courseware, virtual simulation experiments, question banks, engineering cases, etc.) with the knowledge point nodes in the graph. For example, when students focus on the knowledge point of “Kirchhoff’s Laws”, the knowledge graph can not only present its conceptual definition but also actively push associated prerequisite review resources (such as “VCR of Circuit Components” videos), core explanation resources (such as interactive courseware for law derivation), application verification resources (such as virtual experiments for circuit simulation), and consolidation and expansion resources (such as hierarchical exercise sets and practical engineering application cases). In this way, the knowledge graph acts as an “intelligent knowledge navigation”, providing students with a highly contextualized and integrated learning environment. It greatly improves the efficiency of students in locating and using resources, effectively supporting on-demand learning and personalized exploration, meeting the diverse learning needs of students at different levels, and laying a solid resource foundation for the blended teaching and personalized learning paths described in the subsequent chapters.

3. Application of knowledge graphs in teaching model innovation

Based on the structured and associated course knowledge system constructed by knowledge graphs, the teaching model of “Fundamentals of Circuit Analysis” has been systematically innovated. Knowledge graphs not only serve as content organization tools but also become the core engine driving the reconstruction of teaching processes and the transformation of learning methods, which are specifically reflected in the following aspects.

3.1. Construction of a blended teaching model based on knowledge graphs

Relying on knowledge graphs, a deeply integrated “online-offline” blended teaching model is constructed^[4]. Before class, teachers accurately design learning task chains based on the knowledge point network and association relationships in the knowledge graph, and push personalized preview resource packages (such as micro-videos, prerequisite knowledge review materials, etc.) to students through online platforms. During class, teachers use knowledge graphs to visually present core knowledge points and their multi-dimensional associations, guide students to carry out inquiry-based and discussion-based learning, focus on explaining key nodes and complex associations in the knowledge network, and help students construct a systematic knowledge structure. After class, the system automatically assembles homework and extended learning resources according to the knowledge graph to strengthen students’ mastery of weak links in the knowledge network. This model effectively solves the problems of fragmented knowledge presentation and implicit logical associations in traditional teaching, realizing the transformation from “teacher-centered” to “student-centered” and from “knowledge indoctrination” to “thinking training.”

3.2. Planning of personalized learning paths based on knowledge graphs

Knowledge graphs provide a technical foundation for the real realization of personalized learning. By recording students' learning behaviors (such as video viewing duration, exercise accuracy rate, virtual experiment operation trajectory, etc.), the system dynamically evaluates their mastery of each knowledge node, and intelligently plans and dynamically adjusts learning paths based on the topological relationships (such as prerequisite dependencies, difficulty progression) and semantic associations of the knowledge graph^[5]. For example, when the system detects that a student has difficulties in the knowledge point of "time-domain analysis of first-order dynamic circuits," it can automatically trace back and recommend the learning of prerequisite knowledge points such as "solution of differential equations" or "VCR relationships of capacitor and inductor components," or horizontally associate with the "mathematical foundation review module" to achieve precise knowledge supplement and ability enhancement; for students with spare capacity, based on the "in-depth expansion graph," it recommends extended application resources of "Fundamentals of Circuit Analysis" in subsequent professional courses such as "power system analysis" and "electronic circuit design" (such as simple amplifier circuit design cases based on circuit analysis), guiding them to carry out inquiry-based learning. This closed-loop mechanism of "evaluation - recommendation - learning - re-evaluation" ensures that students carry out efficient learning within their "zone of proximal development," effectively respecting individual differences among students.

3.3. Empowering process-oriented intelligent evaluation and feedback

Breaking through the traditional single evaluation model of "final assessment + regular homework", taking knowledge graphs as the data carrier, a multi-dimensional intelligent evaluation system of "process-oriented evaluation + summative evaluation + ability dimension evaluation" is constructed to realize a comprehensive and dynamic evaluation of students' learning effects and ability development. The system accurately anchors various assessment tasks, such as homework, quizzes, and projects, to the knowledge points in the knowledge graph, enabling formative evaluation of students' learning outcomes with finer granularity and wider dimensions. It can not only evaluate students' mastery of individual knowledge points but also assess their ability to integrate and apply knowledge by analyzing their performance in complex problems involving multiple associated knowledge points. The analysis based on the graph can generate visual learning situation reports, providing teachers with an overall perspective of the class's knowledge mastery situation to help them adjust teaching strategies; at the same time, it provides students with personalized learning diagnosis and feedback, clarifying the strengths and weaknesses in their knowledge network, and guiding them to carry out independent targeted enhancement.

3.4. Driving the deep integration of virtual simulation and inquiry-based learning

Combining the virtual experiment modules and simulation resources associated with knowledge graphs, the course vigorously promotes inquiry-based learning of "learning by doing". Knowledge graphs structurally associate theoretical knowledge points with corresponding virtual experiments and engineering case simulations. After learning a certain theory (such as "resonant circuits"), students can immediately enter the virtual experiment platform through the graph entrance to independently build circuits, modify parameters, observe phenomena, verify theories, and explore engineering application scenarios associated with knowledge nodes (such as "frequency-selective circuits of radio receivers"). This seamless switching between "theory and practice" based on knowledge graphs materializes abstract theories, greatly enhancing students' learning immersion and initiative, and effectively cultivating their engineering practice capabilities and innovative thinking.

4. Conclusion

Through the path and practice of knowledge graph-empowered curriculum reform of “Fundamentals of Circuit Analysis,” multi-dimensional course knowledge graphs (horizontal integration, vertical progression, in-depth expansion) are constructed, realizing the structured, associated, and systematic reconstruction of the course knowledge system, and effectively solving the problems of knowledge fragmentation and weak correlations in traditional teaching. On this basis, knowledge graphs have driven a series of teaching innovations such as blended teaching models, personalized learning path planning, intelligent evaluation systems, and virtual inquiry-based learning, successfully promoting the fundamental transformation of course teaching from “teacher-centered knowledge indoctrination” to “student ability development-centered”. It provides an effective solution for cultivating compound emerging engineering talents with solid theoretical foundations, interdisciplinary thinking, and engineering practice capabilities.

Future research can be further advanced from three aspects:

- (1) Construct a dynamically updated knowledge graph ecosystem, establish a tripartite collaborative graph update mechanism of “universities - enterprises - certification institutions” in combination with the needs of industrial digital transformation and the iteration rhythm of course content, and real-time incorporate new circuit technologies, engineering practice cases, and certification standard requirements to ensure the timeliness and practicality of the knowledge system;
- (2) Optimize the intelligent adaptation model of personalized learning paths, introduce cognitive science theories, construct multi-dimensional learner portraits integrating “knowledge foundation - cognitive style - learning scenarios”, and use machine learning algorithms to realize the dynamic adjustment and precise push of learning paths, improving the personalization level of learning support;
- (3) Improve the multi-scenario evaluation mechanism of the intelligent evaluation system, build a virtual-real integrated engineering practice platform, track students’ operation processes and problem-solving ideas in real circuit experiments and engineering projects through Internet of Things technology, and combine the associated data of knowledge graphs to construct a dual-dimensional ability evaluation model of “process + result”, further improving the scientificity and application value of evaluation results, and providing more precise quality assurance for the training of emerging engineering talents.

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Research on the Innovation of Interactive Modes in Higher Vocational English Classrooms Driven by Multimodal Teaching Resources

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Abstract: To address problems such as insufficient interaction in higher vocational English classrooms and disconnection from vocational needs, this study focuses on the application value of multimodal teaching resources and explores their driving role in innovating classroom interactive modes. It first analyzes the importance of vocational scenario-based micro-courses, “text-image-practical operation” trimodal micro-course resources, and AI-enabled blended teaching closed loops in interactive innovation. Furthermore, it proposes targeted innovative strategies, including precise development of micro-courses, integration of trimodal resources, construction of AI closed loops, and optimization of evaluation systems. The research shows that multimodal teaching resources can effectively improve the quality of classroom interaction in higher vocational English, align with the talent training goals of vocational education, and provide practical references for the teaching reform of higher vocational English.

Keywords: Multimodal teaching resources; Higher vocational English; Classroom interactive modes; Vocational scenario-based micro-courses; AI empowerment

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1. Introduction

As a core public basic course in vocational education, higher vocational English undertakes the important mission of cultivating students’ professional English application abilities. Currently, some higher vocational English classrooms face problems such as single interaction forms, low student participation, and disconnection between teaching content and vocational scenarios, which restrict the improvement of teaching quality. Relying on diversified presentation forms such as text, images, videos, and practical operations, multimodal teaching resources provide a new path for innovating classroom interactive modes^[1]. Among them, the development of vocational scenario-based micro-courses, the construction of “text-image-practical operation” trimodal resources, and AI-enabled blended teaching closed loops have become key carriers connecting teaching with vocational needs. Based on this, this paper explores the importance and implementation strategies of multimodal teaching resources in the interactive innovation of higher vocational English classrooms, providing support for improving

teaching effectiveness.

2. The importance of multimodal teaching resources in innovating interactive modes of higher vocational English classrooms

2.1. Vocational scenario-based micro-courses lay a vocational-oriented foundation for interaction

The core goal of higher vocational English teaching is to cultivate students' English application abilities in vocational scenarios. However, traditional classroom interactions mostly revolve around textbook texts, which are disconnected from actual vocational situations, resulting in low student participation. Vocational scenario-based micro-courses, relying on real vocational scenarios, deeply integrate English knowledge with post skill requirements, laying a distinct vocational-oriented foundation for classroom interaction. By simulating typical post scenarios such as foreign trade negotiations, hotel services, and mechanical operation guidance, these micro-courses transform abstract English vocabulary and sentence patterns into concrete vocational behaviors, enabling students to clearly perceive the practical value of English learning ^[2]. In classroom interactions, students participate in micro-course-related role-playing and scenario simulation activities as “post practitioners,” proactively using English to solve practical problems in vocational scenarios. This changes the previous state of passive knowledge acceptance and effectively improves the pertinence and effectiveness of interaction.

2.2. “Text-image-practical operation” trimodal resources enrich the multidimensional presentation of interaction

Traditional higher vocational English classroom interactions mostly rely on a single mode of text, with interaction forms limited to question-and-answer and reading, which are difficult to meet students' diverse cognitive needs. The “text-image-practical operation” trimodal micro-course resources integrate the accuracy of text information, the intuitiveness of image information, and the experience of practical operation links, providing a multidimensional presentation dimension for classroom interaction and making interaction forms more hierarchical and interesting. As the foundation, the text mode provides the core framework of English knowledge, such as key sentence patterns and professional vocabulary in vocational scenarios, ensuring the knowledge accuracy of interaction ^[3]; the image mode visualizes text content through pictures, animations, short videos, etc., reducing students' understanding difficulty. For example, when explaining mechanical operation English, the operation process is demonstrated through animations, combined with text explanations, enabling students to quickly master English expressions related to operation instructions; the practical operation mode guides students to transform learned knowledge into practical behaviors, such as completing the interpretation of English instructions for equipment operation and English expression of service processes according to the vocational scenario requirements in micro-courses ^[4]. During interaction, students can carry out diversified activities around trimodal resources, such as organizing information by combining text and images, verifying learning results through practical operations, and sharing practical experience through group discussions, forming an interactive closed loop of “cognition-practice-reflection”.

2.3. AI-enabled blended teaching closed loops improve the precision of interaction

In traditional classroom interactions, it is difficult for teachers to fully grasp each student's learning status and interaction effects, resulting in a lack of precision in interaction guidance. The integration of multimodal teaching

resources and AI technology constructs a blended teaching closed loop of “pre-class preview - in-class interaction - post-class consolidation”, providing technical support for improving the precision of interaction. Before class, the AI platform pushes multimodal preview resources, such as vocational scenario-based micro-courses and trimodal exercises, and records students’ preview progress, answer accuracy, and other information through data monitoring to accurately identify students’ knowledge weaknesses^[5]. During in-class interaction, based on the preview data fed back by AI, teachers design targeted interactive tasks. For example, for the knowledge point of “cross-border e-commerce logistics English expression” that students generally fail to master, group cooperation activities such as interpreting logistics documents and simulating logistics communication scenarios are carried out. At the same time, AI captures data such as students’ language expression and task completion during interaction in real time, analyzes indicators such as students’ pronunciation accuracy and participation through speech recognition and image recognition technologies, and timely feeds back interaction effects to teachers^[6]. After class, AI pushes personalized consolidation resources according to in-class interaction data, such as special pronunciation correction micro-courses for pronunciation problems and extended scenario exercises for insufficient scenario expression, and provides Q&A guidance for students through online interaction communities, forming a continuous optimization closed loop of interaction effects.

3. Innovation strategies of interactive modes in higher vocational English classrooms driven by multimodal teaching resources

3.1. Precisely develop vocational scenario-based micro-courses to build an interactive content support system

Vocational scenario-based micro-courses are the core carriers of interaction driven by multimodal resources, and their development quality directly determines the interaction effect. The principle of “post demand orientation and precise content adaptation” should be adhered to. First, conduct post research, form a development team composed of front-line enterprise experts and English teachers, and sort out core vocational scenarios and English ability requirements corresponding to different majors through interviews and on-site investigations. For example, focus on scenarios such as inquiry, quotation, and contract signing for international trade majors, and form a “major-scenario-English knowledge point” correspondence list^[7]. Second, optimize micro-course design. Each micro-course focuses on one core vocational scenario, with a duration of 5-8 minutes, and integrates “text-image-practical operation” trimodal elements: the text part refines core vocabulary, sentence patterns, and pragmatic rules in the scenario, with concise and standardized language expression; the image part presents visual information such as scenario environments and operation processes through on-site shooting and animation production^[8]; the practical operation part designs 1-2 key operation links, such as simulating the filling of customs declaration forms and demonstrating English communication scripts for international trade contract signing. At the same time, set up interaction guidance links in micro-courses, such as questions like “How to respond to customers’ price doubts in this scenario” and “Try to describe the next operation steps in English”, reserving interfaces for classroom interaction. Finally, establish a micro-course resource library, store resources by major characteristics and teaching progress, and update them regularly according to changes in post demands to ensure the timeliness and applicability of resources, providing continuous and stable content support for classroom interaction^[9].

3.2. Integrate “Text-image-practical operation” trimodal resources to design hierarchical interactive activities

Based on the characteristics of “text-image-practical operation” trimodal resources, design hierarchical and progressive classroom interactive activities to guide students to deepen from knowledge cognition to practical application, and improve the participation and depth of interaction. Basic cognitive interaction focuses on the integration of text and images, with the goal of knowledge understanding. Teachers can use multimedia equipment to display text and image content in trimodal resources and design interactive tasks such as “information matching” and “key point extraction”. For example, when explaining the “product introduction” scenario, present product manual texts and product structure diagrams, and let students work in groups to match professional vocabulary in the text with corresponding parts in the image and extract the core selling points of the product in English^[10]. Through this level of interaction, students can consolidate their language foundation and understand the semantic connection between modes. Ability application interaction focuses on the integration of practical operation modes, with the goal of skill application. Combined with the practical operation links in micro-courses, carry out interactive activities such as “scenario simulation” and “role-playing”. For example, in hotel English courses, provide text scripts, service process images, and practical operation requirements for guest room service scenarios. Students are divided into groups to play waiters and guests, completing practical interactions such as check-in guidance and demand response. Teachers record the interaction process through on-site observation and video recording, and organize review and comments after class. Thinking expansion interaction focuses on the comprehensive application of multimodal resources, with the goal of cultivating innovative abilities^[11]. Design open interactive tasks such as “problem solving” and “scheme design”. For example, provide text cases of foreign trade order delays and logistics tracking images, and let students work in groups to develop English communication schemes, solving problems through simulated phone calls and writing apology letters, cultivating students’ comprehensive application and innovative thinking abilities. Hierarchical interactive activities take into account the needs of students at different levels, enabling each student to improve in interaction.

3.3. Build an AI-enabled blended teaching closed loop to realize dynamic optimization of interaction

Relying on AI technology, build an integrated blended teaching closed loop of “pre-class - in-class - post-class”, and realize precise design, real-time feedback, and dynamic optimization of interaction through data-driven methods. In the pre-class preview stage, the AI platform pushes adaptive multimodal preview resources according to teaching goals, including vocational scenario-based micro-courses, trimodal exercises, and online preview questionnaires. After students complete the preview, AI automatically analyzes the preview data, generates knowledge mastery reports for the whole class and individual students, and identifies common weaknesses of the class and personalized needs of students. Based on the reports, teachers design targeted in-class interaction plans. For example, for the knowledge point of “past participles and present participles as attributes” that the class generally confuses, design multimodal comparative analysis interactions; for individual students with unsmooth expression in vocational scenarios, arrange one-on-one scenario simulation interactions^[12]. In the in-class interaction stage, carry out diversified interactive activities with the help of AI interactive teaching platforms, such as English pronunciation competitions through speech recognition technology, evaluation of the standardization of practical operations through image recognition technology, and collection of students’ interactive answers through real-time answering systems. AI captures interaction data in real time, such as participation, answer accuracy, and pronunciation accuracy, and generates an in-class interaction data dashboard

immediately. Teachers can dynamically adjust the interaction rhythm and difficulty according to the data. For example, when finding a group has problems with non-standard expression in scenario simulation interaction, pause immediately and provide targeted guidance through replaying micro-course clips^[13]. In the post-class consolidation stage, AI pushes personalized multimodal consolidation resources to students according to pre-class preview and in-class interaction data, such as special pronunciation correction micro-courses and speech practice tasks for students with weak pronunciation, and extended scenario simulation materials for students with insufficient scenario application.

3.4. Improve the multidimensional evaluation system to ensure the implementation effect of interactive modes

Construct a multidimensional evaluation system adapted to the interactive mode driven by multimodal resources, and ensure the implementation effect of teaching reform through comprehensive and objective evaluation. The evaluation subjects adopt a diversified model of “teacher evaluation + student self-evaluation + group mutual evaluation + AI evaluation” to ensure comprehensiveness. Teacher evaluation focuses on knowledge application, skill performance, and professional literacy during interaction, and conducts comprehensive scoring based on classroom observation and interaction records; student self-evaluation focuses on self-reflection on participation, learning gains, and shortcomings during interaction, completed by filling out self-evaluation questionnaires^[14]; group mutual evaluation centers on team collaboration and task contribution, with scores jointly given by group members; AI evaluation relies on technical advantages to conduct objective scoring on data-based indicators such as students’ pronunciation accuracy, interactive task completion efficiency, and online interaction activity. The evaluation content covers three core dimensions: knowledge mastery, ability improvement, and literacy development. The knowledge mastery dimension focuses on students’ mastery of English vocabulary, sentence patterns, and pragmatic rules, evaluated through in-class answers and post-class tests; the ability improvement dimension focuses on professional English application abilities, evaluated based on performance in scenario simulation and practical interaction; the literacy development dimension focuses on professional literacy such as team collaboration, communication, and professional responsibility, evaluated through behavioral performance during interaction. The evaluation results adopt a combination of “process evaluation + summative evaluation”, with process evaluation accounting for 60%, covering pre-class preview, in-class interaction, and post-class consolidation; summative evaluation accounts for 40%, mainly based on comprehensive application assessment of English in vocational scenarios^[15]. At the same time, establish an evaluation feedback mechanism, regularly feed back evaluation results to students, put forward improvement suggestions for shortcomings, and guide students to actively adjust their interaction participation methods, forming a continuous improvement mechanism of “evaluation - feedback - improvement”.

4. Conclusion

Multimodal teaching resources provide important support for innovating the interactive modes of higher vocational English classrooms, and their importance in vocational orientation guidance, interaction dimension enrichment, precision improvement, and collaborative education is increasingly prominent. Through strategies such as precisely developing vocational scenario-based micro-courses, designing trimodal hierarchical interactive activities, building AI-enabled blended teaching closed loops, and improving the multidimensional evaluation system, the problems of traditional classroom interaction can be effectively solved, and students’ classroom

participation and professional English application abilities can be improved. The interactive innovation mode constructed in this study conforms to the type characteristics of higher vocational education, provides a practical path for the teaching reform of higher vocational English, and promotes the further improvement of higher vocational English teaching quality.

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Exploration of the Cultivation Mode of Critical Thinking Ability in College English Teaching Under the Background of the Belt and Road

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Abstract: With the advancement of the Belt and Road Initiative, the importance of cross-cultural communication and international cooperation has become increasingly prominent. To respond to these evolving demands, college English teaching urgently needs transformation, shifting its focus toward cultivating critical thinking skills, creating a conducive educational environment, aligning with international talent development requirements, and enhancing educational effectiveness. Grounded in the context of the Belt and Road Initiative, this paper analyzes the significance of fostering critical thinking ability within college English teaching and proposes specific practical strategies. The objective is to construct a reasonable training system that nurtures English professionals with global perspectives and critical awareness, thereby providing a reference for the ongoing reform of college English teaching.

Keywords: The Belt and Road; College English; Critical thinking in teaching

Online publication: December 31, 2025

1. Introduction

The Belt and Road Initiative represents a major Chinese contribution to China's globalization, involving more than 150 countries and regions to form an extensive international cooperation network. In this process, language communication is the foundation of people-to-people bonds. As an international lingua franca, English teaching has transcended its traditional role of teaching grammar and vocabulary, and it now bears the additional responsibilities of fostering cross-cultural understanding, critical thinking, and innovative expression. At present, issues in global governance, economic and trade cooperation, cultural exchange and other fields require practitioners not only to communicate effectively in English, but also to use critical thinking to distinguish cultural differences, verify the authenticity of information, and propose rational solutions. However, traditional college English teaching has the problem of emphasizing linguistic form while neglecting thinking training. Exploring the cultivation mode of critical thinking ability in college English teaching under the background of the Belt and Road is thus an essential response to national strategic needs and a key avenue for advancing foreign

language education reform and improving talent quality.

2. The importance of cultivating critical thinking ability in college English teaching under the background of the Belt and Road

2.1. Serve national strategies: The inherent requirement of cultivating cross-cultural critical thinking talents

The focus of the Belt and Road construction is extensive consultation, joint contribution and shared benefits, involving dialogue and cooperation among different political systems, cultural traditions and development models. In this process, language is not only a communication tool, but also a cultural carrier and a manifestation of thinking modes^[1]. For example, in the operation of China-Europe Railway Express, cross-border e-commerce negotiations or international environmental protection cooperation projects, practitioners must understand the logic behind each other's words, and critically view the interests and potential risks of cooperation topics; otherwise, it is easy to fall into a situation of "having a lively conversation but failing to reach an agreement". Therefore, college English teaching must attach importance to the cultivation of critical thinking ability, enabling students to have the ability of rational dialogue in cross-cultural contexts and become qualified bridges in the process of the Belt and Road Initiative.

2.2. Adapt to disciplinary development: The inevitable trend of foreign language education from "instrumentality" to "humanity"

Traditional foreign language teaching emphasizes the instrumentality of language, focusing on mechanical practice of listening, speaking, reading and writing skills, while ignoring the connection between language and thinking. Modern linguistics research shows that language is a mirror of thinking, and the development of critical thinking ability, such as logical reasoning, evidence evaluation, and multi-angle argumentation, can only be deepened through language^[2]. Under the background that the Belt and Road promotes the global flow of knowledge, the goal of foreign language education has shifted from "teaching students how to use English" to "using English to enable students to understand the world and analyze problems". For example, when students read English literature related to the Belt and Road, they need to use critical thinking to identify whether the data source is reliable, analyze the stance of the text, and compare the advantages and disadvantages of different development models, rather than simply memorizing words and sentence patterns. This requires English teaching to integrate the cultivation of critical thinking ability into the whole process of language learning, promoting the unity of instrumentality and humanity^[3].

2.3. Improve students' core competitiveness: the core literacy to cope with global challenges

In the contradictory environment of globalization and deglobalization, cooperation among countries along the Belt and Road faces both opportunities and challenges. Students with critical thinking ability can remain sober in multiple information, acknowledge the characteristics of different civilizations without falling into "cultural centralism", and refute fallacies based on facts and logic to convey Chinese voices^[4].

3. The cultivation mode of critical thinking ability in college English teaching under the background of the Belt and Road

3.1. Improve teaching concepts: The transformation from “knowledge-oriented” to “thinking-oriented”

The traditional teaching concept is teacher-centered and textbook-based, focusing on the imparting of systematic language knowledge, and students passively accept standard answers. Under the background of the Belt and Road, it is necessary to establish a student-centered and thinking development-oriented concept, and take the cultivation of critical thinking ability as the core element of teaching objectives. First, establish an integrated view of “cross-cultural critical thinking”. English teaching should not only cultivate language users, but also cross-cultural critical thinkers^[5]. Integrate comparative cultural content of the Belt and Road into teaching, such as the differences in “family values” and “contract spirit” between China and Southeast Asian countries, to guide students to think about how culture affects communication methods and decision-making logic. Second, strengthen the “problem-oriented” teaching concept, abandon “fragmented knowledge explanation”, and construct driving question chains around real issues of the Belt and Road to stimulate students’ active exploration. For example, when talking about the theme of “Green Silk Road”, set progressive questions: “What are the main environmental challenges facing countries along the Belt and Road?” Let students obtain answers through group discussions, literature review, field trips and other ways, and teachers should guide them to question assumptions, test evidence, and revise conclusions throughout the process to cultivate critical thinking habits^[6]. Third, advocate the evaluation concept of “error tolerance and reflection”, change the evaluation inertia of “pursuing the only correct answer”, and encourage students to boldly express different views.

3.2. Improve the cultivation mode: Construct a “three-dimensional integration” practical path

The cultivation of critical thinking ability relies on systematic and scenario-based practical paths. Combined with the characteristics of cross-cultural communication of the Belt and Road, the cultivation mode can be formed from three aspects: curriculum content reconstruction, teaching method innovation, and practice platform construction.

First, reconstruct curriculum content and integrate critical thinking elements with Belt and Road themes. Integrate critical thinking training into basic courses. Add a “critical reading section” to courses such as “Comprehensive English”, select argumentative essays and news reports related to the Belt and Road, and let students learn to find the author’s arguments, evidence and logical fallacies^[7]. Set up “refutation writing” tasks in writing courses, requiring students to write response articles to negative reports on the Belt and Road by Western media, and refute them with data and cases in a reasonable and evidence-based manner. At the same time, offer special critical thinking courses on the Belt and Road, add elective courses such as “Cross-Cultural Critical Thinking and International Communication”, systematically teach critical thinking skills such as inductive and deductive reasoning, analogical argumentation, and causal analysis, and carry out situational teaching such as Model United Nations and business negotiations around themes such as “Digital Silk Road” and “mutual learning among civilizations”.

Second, innovative teaching methods and active thinking with “interactive” and “inquiry-based” approaches. Case teaching method: select typical Belt and Road cases, let students group to analyze the “cultural conflict points”, “interest game logic”, and “effectiveness of solutions” in the cases, and train the critical thinking chain through the process of “problem diagnosis - scheme design - effect evaluation”^[8]. Project-based learning

(PBL): take “Belt and Road Youth Voice” as the theme, requiring student teams to complete a cross-cultural communication project. The whole process is led by students, and teachers only provide framework guidance. Students need to independently investigate the needs of target audiences, screen information, conceive narrative logic, and finally test their critical thinking and expression abilities through achievement display and defense. Debate and role-playing methods: regularly hold “Belt and Road hot topic debates” with topics such as “Should the Belt and Road give priority to economic cooperation or cultural and people-to-people exchanges”. Through the processes of argumentation, inquiry, and summary, students can exercise their skills in quickly organizing arguments, identifying logical loopholes of opponents, and flexibly responding to challenges; role-playing simulates international organization meetings, such as the Belt and Road International Cooperation Summit Forum, allowing students to experience the discourse strategies of different positions in this context and deepen their understanding of multiple perspectives ^[9].

Third, build practice platforms to link real scenarios with diverse resources. School-enterprise/school-media cooperation platforms: establish practice bases with foreign-related enterprises such as Huawei and ZTE, as well as international media such as CGTN and China Daily, and send students to participate in Belt and Road project translation, overseas social media operation of “overseas promotion”, and international news compilation. In real tasks, use critical thinking to handle cultural differences and information deviations ^[10]. When compiling foreign media reports on the “opening of the China-Laos Railway”, it is necessary to identify the false accusations of Western media about China’s “debt trap” in building railways in Southeast Asia, supplement employment data and people’s livelihood improvement cases provided by China, and achieve objective and balanced dissemination of Chinese culture. International exchange platforms: rely on college international student programs from countries along the Belt and Road and online international academic forums, and arrange students to pair up with foreign students for joint research. When encountering cultural misunderstandings in cooperation, enhance trust through critical communication. Virtual simulation platforms: create a virtual simulation experiment system for cross-cultural communication of the Belt and Road, simulate high-risk scenarios such as diplomatic negotiations and crisis public relations, allowing students to repeatedly practice critical thinking response strategies in a safe environment, and improve their on-the-spot adaptability.

3.3. Construct a multi-dimensional evaluation system to strengthen process feedback on critical thinking ability

The cultivation of critical thinking ability not only depends on the design of the teaching process, but also requires a scientific evaluation mechanism to guide, test and continuously improve. Under the background of the Belt and Road, a “multi-dimensional, process-oriented and developmental” evaluation system should be established to make evaluation itself a booster for the cultivation of critical thinking ability ^[11].

First, diversify evaluation dimensions, expanding from “language skills” to “critical thinking literacy.” Add special indicators for critical thinking ability in the evaluation system, specifically involving logical structure and argumentation ability, i.e., whether students can construct clear arguments and reasonable argument chains in written or oral expression, avoiding logical fallacies ^[12]. Information discrimination and critical awareness: when facing multi-source information, whether students can evaluate the reliability of information sources and identify biases and misleading. Second, attach importance to the evaluation method throughout the whole teaching cycle, embed evaluation into pre-class, in-class and after-class stages to form a closed-loop feedback. Conduct pre-class diagnostic evaluation, implement in-class formative evaluation, and carry out after-class summative evaluation.

3.4. Strengthen the teaching team: Build a “dual-qualified” and “cross-cultural” teaching team

First, enhance teachers' critical thinking and teaching ability. Regularly organize teachers to participate in “critical thinking teaching training workshops” to learn critical thinking teaching theories and design methods such as Paul's critical thinking hierarchy model and Ennis' critical thinking assessment framework; encourage teachers to participate in Belt and Road scientific research projects, such as cross-cultural communication and international public opinion analysis, to better understand the cultures of countries along the route and transform research results into teaching cases. For example, teachers can use data from the “Survey on the Cognition of the Belt and Road in Southeast Asian Countries” in class to let students conduct data analysis and discuss the reasons for cultural cognitive differences^[13].

Second, optimize the structure of the teaching team. Introduce teachers with overseas study experience and cross-cultural work backgrounds to enrich the “dual-qualified” team. Hire foreign experts and international organization officials as part-time teachers to offer courses such as “Practical Cross-Cultural Communication” and “International Rules and Critical Thinking”, bringing diverse perspectives and practical experience. For example, invite engineers who have participated in the China-Pakistan Economic Corridor project to share cultural adaptation cases, allowing students to understand the critical thinking points in engineering cooperation^[14].

Third, establish an incentive mechanism and teaching and research community. Incorporate the achievements of critical thinking teaching into teachers' performance evaluation and professional title evaluation indicators to stimulate the motivation for teaching innovation. Establish a teaching and research team on “cultivating critical thinking ability in English teaching”, regularly carry out collective lesson preparation, teaching observation and case discussion, share high-quality teaching resources, and form a good cycle of “promoting teaching through research and research through teaching”^[15].

4. Conclusion

In summary, the deepening of the Belt and Road Initiative has brought about an upgrading demand from “language skills” to “critical thinking ability” in college English teaching. After analyzing the importance of cultivating critical thinking ability, this paper proposes a cultivation path led by “concept renewal - model improvement - teacher team strengthening”, pointing out that the problem of lack of thinking training in traditional teaching can be solved through the teaching concept of integrating cross-cultural critical thinking, the three-dimensional integration training path, and the construction of a dual-qualified teacher team. In the future, colleges and universities need to dynamically adjust educational content and methods, such as adding new modules in connection with the development of digital technology, strengthening international cooperation, and forming a more inclusive ecological system for cultivating critical thinking ability.

Disclosure statement

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Exploration of the Ideological and Political Education Model of Modern Chinese Courses Under the Guidance of Cultural Confidence

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Abstract: Cultural confidence, characterized by inclusiveness, guidance, and inheritance, has become an important core of education popularization in the new era. As a core basic course in the humanities, the Modern Chinese course possesses both instrumental and humanistic attributes, serving as a key position for curriculum ideological and political education. Based on the concept of cultural confidence, the effective integration of the Modern Chinese course and curriculum, ideological and political education can be achieved, enhancing students' language application abilities and ideological and political literacy. Therefore, this paper analyzes the necessity and dilemmas of ideological and political education in the Modern Chinese course under the background of cultural confidence, and explores its practical model, aiming to provide practical reference for the construction of curriculum ideological and political education guided by cultural confidence.

Keywords: Modern Chinese course; Cultural confidence; Curriculum, ideological and political education; Career development; Fostering virtue through education

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1. Introduction

The "Guidelines for the Construction of Curriculum Ideological and Political Education in Colleges and Universities" emphasizes the importance of curriculum ideological and political education in the teaching of professional courses in institutions of higher learning, and points out that fostering virtue through education should be the fundamental task, integrating value shaping, knowledge impartment, and ability training into one. As a core basic course in the humanities and social sciences, Modern Chinese not only undertakes the instrumental mission of cultivating students' language and character application abilities but also contains rich resources of excellent traditional Chinese culture, revolutionary culture, and advanced socialist culture. It is a key position for implementing the fundamental task of fostering virtue through education in curriculum ideological and political education and cultivating students' cultural confidence^[1]. In the new era, the public's demand for

cultural identity is increasingly urgent, while there are individual differences among different groups in terms of cultural cognitive depth and inheritance awareness, and their acceptance of cultural ideological and political content presents diverse characteristics. Against this background, how to construct an ideological and political education model for the Modern Chinese course based on the goal of cultivating cultural confidence and the characteristics of the audience has become an important issue that needs to be explored urgently.

2. The value of ideological and political education in the modern Chinese course from the perspective of cultural confidence

2.1. Meeting the contemporary demand for cultivating cultural confidence

Cultural confidence is a more fundamental, extensive, and profound confidence, and the most basic, profound, and enduring force for the development of a country and a nation. As an important carrier of Chinese culture, Modern Chinese itself is a vivid embodiment of cultural confidence. Implementing ideological and political education in the Modern Chinese course can deeply integrate language knowledge learning with cultural cognition, cultural identity, and cultural inheritance, realizing the coordinated improvement of language ability and cultural literacy^[2]. On the one hand, audiences in the new era, whether students or social learners, are facing an environment of interweaving diverse cultures, and their demand for exploring their own cultural roots and confirming their cultural identity is increasingly prominent. Ideological and political education in the Modern Chinese course can, through the unique perspective of language and characters, enable audiences to deepen their understanding and recognition of Chinese culture while mastering language tools, meeting their spiritual and cultural needs; on the other hand, the content involved in the Modern Chinese course, such as language norms, character evolution, and rhetorical art, are important witnesses to the inheritance and development of Chinese culture. Combining curriculum ideological and political education with the Modern Chinese course can further strengthen the audience's cultural awareness and cultural responsibility, making them consciously spread excellent Chinese culture in language practice and practice cultural confidence^[3].

2.2. Implementing the fundamental task of fostering virtue through education

The "Several Opinions on Deepening the Reform and Innovation of Ideological and Political Theory Courses in Schools in the New Era" clearly proposes to integrate ideological and political work into the entire process of education and teaching, realizing education throughout the whole process and in all aspects. As one of the most widely covered and popular humanities courses, the Modern Chinese course contains rich cultural resources that provide a natural carrier for ideological and political education. The exertion of its ideological and political education function is directly related to the effectiveness of cultural education^[4]. Therefore, taking curriculum ideological and political education as the educational carrier and relying on the Modern Chinese course can effectively implement the fundamental task of fostering virtue through education. Through the transmission of cultural connotations and ideological values behind language and characters, it cultivates compound talents with firm cultural confidence, good language literacy, and noble moral sentiments, who can meet the needs of social development in the new era.

2.3. Fully reflecting the humanistic nature of the modern Chinese course

In traditional Modern Chinese teaching, affected by the examination-oriented orientation and the limitations of teaching resources, teaching often overemphasizes the systematic explanation and application skill training of

language knowledge such as phonetics, vocabulary, and grammar, while ignoring the cultural genes, ideological emotions, and value pursuits carried by language and characters^[5]. Integrating ideological and political education into the Modern Chinese curriculum can provide a deeper exploration of cultural and ideological elements in each teaching module, and integrate the cultivation of cultural confidence into the entire process of knowledge and skill development. This not only allows audiences to receive cultural nourishment and spiritual edification while mastering language tools but also enhances the teaching depth and temperature of the Modern Chinese course, truly realizing the effective unity of knowledge impartment, ability training, and value shaping, making language teaching an important way to cultivate cultural confidence and enhancing the effectiveness of ideological and political education in the Modern Chinese course.

3. Dilemmas in ideological and political education of the modern Chinese course from the perspective of cultural confidence

3.1. Insufficient focus on educational goals

Most of the traditional ideological and political education goals of the Modern Chinese course focus on macro value guidance, lacking precise positioning and detailed paths with cultural confidence as the core. The cultivation of cultural confidence needs to take into account multiple dimensions such as cultural cognition, cultural identity, cultural inheritance, and cultural innovation. However, the current ideological and political education goals of some courses fail to fully combine the linguistic and cultural attributes of the Modern Chinese course, and the entry point for cultivating cultural confidence is not clear, leading to vague goals. At the same time, there are significant differences in the cultural foundation, cognitive level, and learning needs of the audience. If the ideological and political education goals cannot be designed hierarchically according to the characteristics of different groups, it is difficult to meet the needs of beginners for basic cultural cognition, nor can it adapt to the in-depth exploration needs of those with a certain cultural accumulation, which is likely to arouse learning resistance and reduce the pertinence of ideological and political education. In addition, the integration of ideological and political education goals with the instrumental goals of the Modern Chinese course is insufficient. Teachers often regard the cultivation of cultural confidence as an additional task, which is disconnected from language knowledge teaching, making it difficult to organically connect course content with ideological and political elements^[6].

3.2. Superficial ideological and political education

The Modern Chinese course contains a large number of ideological and political resources, covering multiple modules such as the rhythmic beauty of phonetics, the cultural accumulation of vocabulary, the logical wisdom of grammar, and the aesthetic implication of rhetoric. However, these resources need to be systematically sorted out, deeply interpreted, and accurately transformed by teachers to achieve natural integration with teaching content^[7]. In current teaching practice, some teachers still stay at the level of “focusing on language knowledge and interspersing ideological and political elements”, only briefly mentioning culturally related terms and concepts, lacking the interpretation of the historical background, cultural connotation, and practical value of ideological and political elements. As a result, ideological and political education is in a superficial stage of “touching on the surface”, making it difficult for the audience to truly understand the cultural spirit behind language and characters and unable to effectively stimulate cultural confidence. At the same time, the excavation of ideological and political elements lacks systematicness and contemporaneity, mostly limited to traditional

classic cultural content, failing to expand the boundary of ideological and political content in combination with the development trend of new-era culture, social cultural hotspots, and the life experience of the audience. This leads to the difficulty of deep coupling between ideological and political elements, language knowledge, and the needs of the times, affecting the effectiveness of cultivating cultural confidence^[8].

3.3. Insufficient audience participation initiative

The information acquisition methods of audiences in the new era are diversified and fragmented, and their acceptance of boring theoretical indoctrination and single value promotion is low. At present, some ideological and political education teaching of the Modern Chinese course still adopts the traditional teaching model, focusing on classroom lectures, and unilaterally transmitting content related to cultural confidence as theoretical knowledge. It fails to fully combine the cognitive characteristics and learning habits of the audience, and lacks an interactive and experiential teaching design. The presentation of ideological and political elements is mostly in the form of textual theoretical elaboration, lacking visual and situational presentation carriers, making it difficult to stimulate the audience's learning interest. In addition, some teaching content has little relevance to the real life of the audience, failing to make the audience truly feel the important significance of cultural confidence for personal growth and social development. As a result, the audience's internal motivation to participate in ideological and political learning is insufficient, making it difficult to achieve the expected goal of cultivating cultural confidence^[9].

4. The ideological and political education model of the modern Chinese course from the perspective of cultural confidence

4.1. Anchoring the core of cultural confidence and improving the curriculum goal system

Ideological and political education should run through the entire teaching process, be integrated into all teaching links, and realize all-round education. To improve the effectiveness of ideological and political education in the Modern Chinese course, it is necessary to take the cultivation of cultural confidence as the core, optimize the teaching system in combination with the disciplinary attributes of the Modern Chinese course and the characteristics of the audience, and realize the organic unity of language knowledge teaching and cultural ideological and political education^[10].

On the one hand, based on the linguistic and cultural characteristics of the Modern Chinese course, reconstruct the curriculum goal system and design hierarchical and progressive goals for cultivating cultural confidence. For audiences in the primary stage, focus on basic language knowledge and standardized expression, integrate basic cultural and ideological elements such as the origin of Chinese characters and phonetic evolution, and cultivate basic cultural cognition and language confidence; for audiences in the intermediate stage, deepen the explanation of the cultural connotation of vocabulary, the logical wisdom of grammar, etc., integrate ideological and political themes such as cultural inheritance and cultural tolerance, and strengthen cultural identity; for audiences in the advanced stage, focus on the aesthetic appreciation of rhetorical art and the innovative application of language, integrate ideological and political elements such as cultural responsibility and cultural innovation, and improve cultural inheritance and innovation capabilities, realizing the precise adaptation between the audience's cognitive level and the cultivation of cultural confidence^[11].

On the other hand, continuously track the development trend of new-era culture, social cultural needs, and audience cognitive feedback, and update curriculum goals and content in a timely manner. Incorporate the

creative transformation of excellent traditional Chinese culture, the contemporary interpretation of revolutionary culture, and the innovative communication of advanced socialist culture into the curriculum system, and add emerging themes such as language and cultural communication in the context of new media and language confidence in cross-cultural communication, ensuring the contemporaneity and pertinence of curriculum ideological and political education goals, and realizing the effective connection between the cultivation of cultural confidence, the development of the times, and the needs of the audience.

4.2. Digging deep into the connotation of language and culture and systematically integrating ideological and political elements

The content of the Modern Chinese course revolves around Chinese language and characters, containing rich cultural and ideological resources. Teachers need to follow the knowledge logic of the Modern Chinese course and the cognitive laws of the audience, systematically sort out and deeply excavate the cultural and ideological elements in each knowledge module, and build a comprehensive and systematic network of ideological and political content to improve the quality of curriculum ideological and political education^[12].

First, dig deep into ideological and political elements by module to achieve full coverage and precise connection. In the phonetics teaching module, combine the promotion of Mandarin and the protection of dialects, interpret the diversity of language and the inclusiveness of culture, and infiltrate the concept of recognition of the national common language and characters and inheritance of local culture; in the vocabulary teaching module, explain themes such as cultural inheritance and innovation, and the exchange and mutual learning of Chinese and foreign cultures through content such as the evolution of ancient and modern word meanings, the origin of idioms and allusions, and the absorption and local adaptation of foreign words, guiding the audience to establish an open and inclusive cultural mentality and firm cultural confidence; in the grammar teaching module, cultivate a rigorous and realistic thinking quality and a sense of rules with the logic and standardization of Chinese grammar; in the rhetoric teaching module, let the audience feel the aesthetic charm of excellent Chinese culture and improve their cultural aesthetic literacy through the appreciation of rhetorical art in poetry, ci, fu, and classic prose; in the practical writing module, focus on the standardization of official document writing, the authenticity of news writing, and the contemporaneity of literary creation, cultivating a sense of responsibility and contemporary responsibility.

Second, integrate knowledge content from different modules around the core theme of cultural confidence to form thematic teaching units with inherent logical connections. For example, take “Chinese character culture and national confidence” as the theme, integrate content from multiple modules such as the origin of Chinese characters, the evolution of Chinese characters, the standardization of Chinese characters, and the aesthetics of Chinese characters, and carry out a series of teaching activities; take “language communication and cultural responsibility” as the theme, integrate content such as the promotion of Mandarin, cross-cultural language communication, and the application of language in new media, and strengthen the audience’s awareness of cultural communication. Theme design should take into account cultural depth, contemporaneity, and audience relevance, enhancing the systematicness and appeal of ideological and political education.

Finally, pay attention to the organic combination of explicit and implicit ideological and political education. Explicit ideological and political content, such as family and country feelings and socialist core values, directly conveys mainstream values through thematic explanations and group discussions^[13]; implicit ideological and political content, such as language standard awareness, cultural aesthetic taste, and thinking quality, subtly influences the audience through the explanation of language knowledge, the appreciation of classic texts, and

language practice activities. The two complement each other, ensuring the comprehensiveness and systematicness of the integration of ideological and political elements, and enhancing the attractiveness and penetration of the content.

4.3. Innovating teaching implementation paths and building a diversified education model

With the rapid development of information technology, profound changes have taken place in education and teaching models. Teachers of the Modern Chinese course can fully leverage modern educational technology, innovate teaching methods and approaches, and build a diversified education model integrating online and offline teaching, and combining theory and practice, promoting the deep integration of curriculum, ideological and political education and the cultivation of cultural confidence^[14].

At the online teaching level, build a digital learning resource library relying on online learning platforms, integrating ideological and political theme micro-courses (such as “Cultural Genes in Chinese Characters” and “Historical Wisdom in Idioms”), classic text interpretation videos, language and cultural thematic documentaries, online interactive discussion areas, and cultural knowledge challenge exercises. The audience can learn independently according to their own time and needs. Teachers can design hierarchical learning tasks through online platforms, such as basic-level completion of cultural knowledge check-ins, intermediate-level participation in cultural theme debates, and advanced-level conduct of language and cultural research. At the same time, real-time track the audience’s learning situation through platform background data, understand their acceptance of ideological and political content, adjust teaching strategies and content in a timely manner, and provide targeted guidance for offline teaching. In addition, real-time interactive teaching can be carried out through live classrooms, inviting language and cultural experts to give special lectures, and organizing activities such as “Language and Cultural Confidence” theme debates and online cultural salons, enhancing the flexibility and openness of teaching and stimulating the audience’s learning enthusiasm.

In the offline teaching link, carry out in-depth teaching activities in combination with the key content of the course and online learning results. Select classic language cases and social language phenomena containing ideological and political elements for in-depth analysis, such as interpreting cultural phenomena in internet buzzwords and analyzing the language art and cultural connotation in classic literary works, guiding the audience to think about the contemporary value of cultural confidence from a language perspective^[15]; organize group cooperative inquiry activities around themes such as “dialect protection and cultural inheritance”, “language standardization and cultural communication in the new media era”, and “construction of language confidence in cross-cultural communication”, allowing the audience to deepen their understanding and practice of cultural confidence through on-the-spot research, data collection, and achievement display; carry out language practice activities, such as classic poetry recitation competitions, Chinese character writing competitions, cultural theme essay activities, and language and cultural cultural and creative work design, allowing the audience to feel the charm of language and culture in practice and strengthen cultural identity and cultural confidence.

5. Conclusion

In summary, from the perspective of cultural confidence, the construction of curriculum, ideological and political education in the Modern Chinese course is an important practice based on the needs of building a cultural power in the new era and implementing the fundamental task of fostering virtue through education. By anchoring the core of cultural confidence to improve the curriculum goal system, digging deep into the connotation of

language and culture to integrate ideological and political elements, and innovating teaching paths to build a diversified education model, the organic integration of the Modern Chinese course and ideological and political education can be achieved, enhancing the effectiveness of curriculum education. In the future, it is necessary to continuously deepen the adaptability between curriculum goals and the cultivation of cultural confidence, strengthen the deep coupling between ideological and political elements and language knowledge, innovate teaching models and educational carriers, realize the coordinated improvement of language ability and cultural literacy, provide useful reference for the construction of curriculum ideological and political education in the new era, and help the cultivation of cultural confidence and the construction of a cultural power.

Disclosure statement

The author declares no conflict of interest.

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Thoughts on the Teaching of English Reading and Continuation Writing in Senior High Schools Under Digital Empowerment

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Abstract: In recent years, the development of digital technologies such as virtual reality and artificial intelligence has provided strong technical support for English reading and continuation writing in senior high schools, offering new ideas and directions for teaching reform and innovation. This paper first briefly expounds the application advantages of digital technologies in this teaching field; then, based on the current situation of English reading and continuation writing in senior high schools, proposes teaching strategies under digital empowerment. It aims to provide a reference paradigm for the in-depth integration of digital technologies with the teaching of English reading and continuation writing, comprehensively improve students' writing ability, and offer new ideas for building intelligent English classrooms.

Keywords: Digital empowerment; Senior high school English; Reading and continuation writing; Teaching reflections

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Introduction

The “General High School English Curriculum Standards (2017 Edition Revised in 2020)” (hereinafter referred to as the “New Curriculum Standards”) clearly emphasizes that students' language learning should not merely focus on memorizing words and sentence patterns, but should organically combine receptive skills with productive skills, which is of great benefit to improving students' pragmatic competence. Traditional teaching methods for reading and continuation writing are relatively single and classroom teaching is boring, making it difficult to fully arouse students' participation interest and thus reducing teaching effectiveness. The flexible application of digital technologies can inject new vitality into English reading and continuation writing classes in senior high schools, playing a positive role in cultivating students' creative and innovative thinking.

2. Application advantages of digital technologies in the teaching of English reading and continuation writing in senior high schools

2.1. Situational immersion: Stimulating creative motivation and emotional resonance

Previous teaching of English reading and continuation writing in senior high schools basically adopted the traditional model of text presentation or teacher's oral narration, which not only made it difficult to create an immersive reading and writing atmosphere for students, but also might reduce their learning interest and lead to low learning efficiency. With the help of diversified digital technologies, teachers can build a multi-dimensional and dynamic "story world" for students according to teaching content, fully stimulating their writing enthusiasm. For example, teachers can flexibly use short videos, animations, virtual reality technologies, etc., to vividly present reading texts to students. In addition to setting the atmosphere, these technologies can also simulate characters' emotions, bringing students an immersive experience, fully stimulating their desire to continue writing, strengthening their emotional resonance, and truly enabling them to write with substance and reason ^[1,2].

2.2. Resource linkage: Building dynamic and precise writing scaffolds

Reading and continuation writing place higher requirements on students' language reserve and text organization ability. If teachers adopt a one-size-fits-all writing scaffold, it will not only be difficult to meet students' personalized needs but also may invisibly weaken the learning enthusiasm of some students. With the strong support of digital technologies, in addition to traditional static resources, teachers can also provide students with real-time and intelligent writing support. On the one hand, teachers can use software such as mind mapping and plot development flow chart (e.g., XMind) to help students clearly sort out the original plot, character relationships, and emotional changes; on the other hand, they can establish a multimedia material library covering pictures, vocabulary, sentence patterns, etc., related to the theme. Students can flexibly call digital resources according to their individual needs, making the writing content more abundant ^[3]. More importantly, digital resources are not static but dynamically updated. Both teachers and students have permission to supplement materials, enabling writing scaffolds to achieve precise adaptation and greatly improve resource utilization efficiency.

2.3. Process interaction: Realizing real-time feedback and collaborative optimization

On the one hand, teachers can use online collaborative documents such as Tencent Docs and Google Docs to guide students to carry out online creation. Students can check each other's ideas and writing content, express their opinions and put forward suggestions, optimize expressions through intense ideological collisions, and provide new perspectives for future writing; on the other hand, teachers can monitor the entire writing process of students online, insert comments at problematic points at any time, put forward guiding questions at key points and give rewards. In this way, the previous one-size-fits-all evaluation can gradually shift towards personalized evaluation, achieving the teaching goal of teaching students in accordance with their aptitude ^[4,5].

3. Teaching strategies for English reading and continuation writing in senior high schools under digital empowerment

3.1. Leveraging digital resources to enrich writing materials

Generally speaking, senior high school English teaching is basically organized in units, aiming to integrate discourse materials of different contents based on specific themes, promote the organic connection of fragmented

knowledge points, and help students form a systematic knowledge system. For reading and continuation writing teaching, teachers usually guide students to carry out writing exercises around unit reading texts. Undoubtedly, the quality of reading materials is closely related to students' writing quality. To effectively break through the limitations of traditional resources, teachers can use digital resources to deepen students' understanding of unit themes and provide inspirational support for their writing, so that the written content will not be too empty.

Taking the teaching of Unit 3 “The Internet” in Senior High School English Compulsory 2 (People's Education Press Edition) as an example, this unit takes “Man and Society” as the thematic context, covering basic network technologies, social impacts of the Internet, network security and privacy, etc., aiming to guide students to establish a correct view of the Internet. Although the teaching content of this unit is closely related to students' daily life, some senior high school students lack a systematic and in-depth understanding of the Internet. Therefore, teachers can rely on rich digital resources to provide students with material support for effective reading and continued writing. In the pre-class preparation stage, teachers can use professional software such as Liulishuo (English Speaking), Newsela, and BBC Learning English to collect and organize relevant texts or video materials around the theme of “the Internet”, aiming to guide students to examine “the Internet” from multiple perspectives ^[6]. Then, in the formal classroom teaching, teachers can select 1-2 representative articles, guide students to think about and analyze the writing skills and text structure of the target articles, further expand their writing ideas, and help them master the skills and methods of analyzing text structure, laying a solid foundation for subsequent writing. In the after-class expansion link, teachers can push extracurricular reading articles matching the theme for students through digital libraries such as the National Public Service Platform for Educational Resources and the school's local resource library, aiming to help students continuously accumulate writing materials.

Research shows that the systematic integration of digital resources can not only greatly improve teachers' lesson preparation efficiency, but also allow teachers to spare more energy and time to focus on the teaching process of reading and continuation writing. By broadening students' reading horizons and providing them with rich writing materials, it can promote the in-depth integration and collaborative development of teaching and learning.

3.2. Skillfully using virtual technologies to stimulate writing inspiration

The generation of writing inspiration is the result of the interaction between emotional resonance and cognitive immersion. Teachers can use advanced virtual reality (VR) and augmented reality (AR) technologies to create realistic and vivid virtual scenarios around reading and continuation writing tasks. Students only need to wear VR devices to “enter” the created scenarios, so as to deepen their understanding of the text content, break through the limitations of mechanical writing, make students more interested in writing, and fully stimulate their writing motivation.

For example, when teaching Unit 1 “Festivals and Celebrations” in Senior High School English Compulsory 3 (People's Education Press Edition), teachers should understand that although students are not unfamiliar with festival culture, it is not easy for them to deeply explore the connotation and spiritual value behind festival culture. Therefore, teachers can design a continuation writing project of “Cross-Cultural Festival Diary” based on the teaching content of this unit and students' learning situation, targeting to exercise students' reading and continuation writing ability ^[7,8]. The specific operations are as follows:

First, in the preparation stage, teachers guide students to divide into learning groups and flexibly use the Internet to collect festivals not involved in the textbook, such as Mexico's Día de los Muertos, India's

Diwali, Brazil's Carnival, etc. By systematically collecting pictures, texts, videos and audio materials related to the festivals, students can have a more comprehensive understanding of the background, value implication, celebration methods, etc., of the corresponding festivals. In the formal classroom teaching link, teachers use VR panoramic images or AR interactive displays to create realistic festival scenarios for students, guiding them to "be in" the carnival, allowing students to immersively experience the dynamic details of the festival scenes, and truly imprint the sounds, colors, scenes, etc., related to the festivals in students' minds, laying the foundation for later writing^[9]. To stimulate students' emotional resonance, teachers can also carefully design a special activity of "Time and Space Mailbox": students randomly draw a festival record fragment from different historical periods and continue to write about how the protagonist in the record would experience and view the modern manifestations of the same festival if he traveled to the present.

With the strong support of virtual technologies, students can accurately grasp the content of continuation writing, obtain an immersive learning experience, and at the same time give full play to the carrier role of continuation writing in cultural inheritance and innovation, continuously stimulating students' interest and desire for writing, and injecting a steady stream of creative motivation into them.

3.3. Expertly teaching continuation writing skills to lay a solid foundation for writing

The cultivation of reading and continued writing ability cannot be achieved overnight. The key lies in maintaining a balance between methodological standardized guidance and personalized creative vitality. Teachers should attach importance to systematic structural training, aiming to guide students to establish a clear, creative framework. To ensure the uniqueness of works, teachers should also teach students flexible and varied continuation writing skills to help achieve the goal of personalized expression. In this process, the application of digital tools is the fundamental guarantee for improving teaching quality^[10,11].

Taking the teaching of Unit 3 "The Internet" in Senior High School English Compulsory 2 (People's Education Press Edition) again as an example, teachers can assign a continuation writing task of "Science and Technology Ethics Drama". Step 1: Teachers need to guide students to deeply analyze the dialectical views on "the Internet" in the textbook texts and encourage them to sort out the positive and negative impacts of the Internet on people's lives mentioned in the texts with the help of a "technology tree" mind map. Then, teachers use micro-videos to show classic science fiction novel fragments and guide students to compare the narrative techniques of different authors in handling human-machine relationships. In the writing practice link, teachers should carefully design a "decision-making simulation" activity: students play the role of ethics consultants of a certain technology company and need to continue writing an unfinished board report according to the given background materials. To ensure the orderly development of the activity, teachers should provide students with a material package containing many real cases themed on "data leakage" and "algorithm bias", guiding students to carry out creation in accordance with the three-act structure of "problem presentation - conflict intensification - multiple solutions"^[12]. Students can submit reports in groups. Teachers should give targeted evaluations in a timely manner. Teachers can guide students to complete peer evaluation using the "foreshadowing echo evaluation scale" and flexibly use big data to analyze students' specific performance in the entire reading and continuation writing process, providing a scientific basis for formulating personalized guidance plans and meeting students' diverse learning needs.

3.4. Empowering with diversified feedback to optimize writing effects

Diversified feedback refers to building a multi-level, multi-subject, and multi-form feedback mechanism,

giving full play to the empowering role of digital technologies. By constructing a diversified evaluation system integrating teacher comments, peer evaluation, student self-evaluation, and intelligent system feedback, comprehensive evaluations are given on students' reading and continuation writing performance from different dimensions and perspectives. This effectively breaks through the limitations of the traditional single teacher evaluation, helps teachers and students recognize the advantages and disadvantages in the teaching and learning process more timely and completely, and ultimately achieves the goal of promoting learning and writing through evaluation ^[13,14].

Taking the reading and continuation writing teaching of Unit 5 "Music" in Senior High School English Compulsory 2 (People's Education Press Edition) as an example, teachers can design continuation writing tasks around music-themed narratives. After completing the writing, students first enter the structured peer evaluation link. Teachers provide an evaluation scale covering content completeness, language accuracy, emotional expressiveness, and plot rationality; students exchange compositions in groups, score them according to the scale, and write targeted comments. Then, enter the self-evaluation link. Students need to review the writing process with reference to the self-evaluation scale, focus on analyzing their advantages and disadvantages in vocabulary selection, sentence structure, plot advancement, etc., and write a written reflection report. Next, it comes to the teacher's comment link. Teachers should systematically point out the common problems of all students in the use of musical terms, sentence pattern changes, etc., and select compositions with ingenious story settings or delicate emotional expressions as examples for praise. Finally, students submit the revised compositions to the English intelligent evaluation system ^[15]. The system can give targeted revision suggestions from multiple dimensions such as grammar, vocabulary, and sentence patterns and score the compositions submitted by students. In this way, students' reading and continuation writing ability will be comprehensively improved.

4. Conclusion

Reading and continuation writing are committed to closely integrating reading and writing, requiring teachers to timely guide students to continue writing content according to their own understanding and thinking after reading articles, so as to improve students' depth of understanding of the articles, actively exercise their language expression ability, and thus help them learn English scientifically and efficiently. Teachers should give full play to the empowering role of digitalization and truly integrate technology with teaching. Research shows that the application of digital technologies in the teaching of English reading and continuation writing in senior high schools has a profound impact on both teaching innovation and student development.

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The Educational Value Pursuit and Optimization Paths of Young Pioneers' Activities

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Abstract: As an important carrier of ideological and moral education for children, Young Pioneers' activities possess unique educational value for Young Pioneers and Young Pioneer organizations. Currently, these activities exhibit problems such as formalization, prominent utilitarianism, and insufficient intelligence. The traditional activity model, lacking innovation and a sense of participation, struggles to meet the diverse needs of teenagers and fails to reflect the inherent educational value of Young Pioneers' activities. To return to the essence of Young Pioneers' activities, centered on the growth and development needs of members, the study should be based on children's subjective needs, adhere to the principle of individualized development, and integrate digital technology to implement Young Pioneers' activities, aiming to achieve the value adjustment of these activities.

Keywords: Young Pioneers; Young Pioneers' activities; Educational value

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1. Introduction

Young Pioneers hold the hope of the motherland and shoulder the future of the nation. Strengthening the cultivation of Young Pioneers is inseparable from the design and implementation of Young Pioneers' activities; optimizing and implementing these activities helps improve the construction of the Young Pioneers, enabling children to better play their important role in the development of the Party's cause. Faced with the current inadequacies of Young Pioneers' activities, exploring organized implementation plans and strategies from the perspective of educational value can more effectively exert the educational value of these activities.

2. The value essence of young pioneers' activities

Young Pioneers' activities are important paths for Young Pioneer workers to conduct ideological education for Young Pioneers through purposeful and planned organization and implementation in accordance with certain political and cultural requirements. Activity courses are the main carrier of Young Pioneers' activities, and activities are the main form of activity courses. For individual Young Pioneers, the core purpose is to give play

to their main role, conduct political enlightenment and value shaping through activities, and guide children to transform the principles of life and work into their own habits through personal practice^[1]. For example, through political enlightenment and practical education, Young Pioneers' activities help them establish correct ideological concepts, political awareness, and personal values. When children are young and highly malleable, it is easy to carry out political enlightenment, which is conducive to forming stable and long-term political concepts, strengthening their ideals and beliefs, fostering their determination to strive for the cause of communism for life, and helping them grow into new-era talents who can shoulder the responsibility of national rejuvenation. At the same time, these activities can stimulate individuals to produce positive exploration behaviors and self-directed behaviors. When Young Pioneers' behaviors conflict with their concepts, they can be prompted to act in line with social values and make choices consistent with training goals, encouraging them to study harder academically, work harder in the team, and always strictly demand themselves according to the standards of a Young Pioneer, thereby realizing the educational goals of the Young Pioneer organization.

The higher the quality of Young Pioneers' activities, the more conducive it is for Young Pioneer organizations to carry out educational work and exert their educational functions on Young Pioneers; to cultivate more excellent Young Pioneers for the organization, accumulate strength for the development of the Young Pioneers, build a powerful collective, enable the Young Pioneers to better shoulder the responsibility of cultivating socialist successors, promote the construction and development of the Party-Communist Youth League-Young Pioneer organization, transport excellent talents for the Communist Youth League, and cultivate new forces for the Communist Party of China. The Communist Youth League of China, entrusted by the Communist Party of China, leads the Chinese Young Pioneers. Leading the Young Pioneers well is an important task entrusted by the Party to the Communist Youth League. To adhere to educating children with socialist ideas and communist spirit, the Communist Youth League must continuously strengthen the comprehensive education of Young Pioneers, optimize the implementation paths of Young Pioneers' activities, and inspire Young Pioneers to grow into genuine socialist successors and new-era talents who can shoulder the responsibility of national rejuvenation.

3. Manifestations of the deviation of Young Pioneers' activities

Young Pioneers' activity courses are important carriers for implementing the fundamental task of fostering virtue through education and strengthening children's political enlightenment and value shaping in the new era^[2]. As an educational method, activities have unique educational value in the field of education. However, looking at the current situation, the educational value of activities is insufficiently highlighted, mainly manifested in the following aspects:

3.1. "Formalization" of Young Pioneers' activities

Young Pioneers' activities play a role of political enlightenment and value guidance for children, such as weekly flag-raising activities, Young Pioneer thematic activities, and evaluation activities. However, over a long period of time, compared with more important learning activities, Young Pioneers' activities have gradually become marginalized and tend to be formalized. For example, some teachers perfunctorily handle Young Pioneers' activities. Faced with the requirements and instructions issued by the school, counselors can only carry out activities step by step, adopt a conservative attitude, and try to avoid personal losses caused by carrying out unique Young Pioneer thematic activities. To save time and effort, some Young Pioneers' activities are mostly

carried out in the form of speeches and recitations. Some activities lack interaction and depth, with Young Pioneers acting as “audience” rather than “protagonists”^[3]. In the long run, Young Pioneers’ activities will inevitably lose their inherent educational value.

3.2. “Utilitarianism” of Young Pioneers’ activities

At present, most Young Pioneers’ activities carried out by schools lack inherent educational significance, and the organization of activities is arbitrary. For example, based on the current “badge-winning” series, some Young Pioneers even regard it as an “honor contest, only caring about how many badges they obtain, without realizing the true meaning behind the badges. Young Pioneers participate in activities mostly focusing on external forms, lacking a deep understanding of the activities themselves and insufficient in-depth thinking about their implications and connotations, which fails to truly exert the educational role of Young Pioneers’ activities. In addition, most school activities are related to learning, and time is mainly allocated to academic courses, which occupy most of the students’ time and energy. Although quite a few activities are interesting, for most children, participating in such activities can not only gain some knowledge and skills but also obtain corresponding honors, albeit for a utilitarian purpose. Furthermore, during the implementation of some activities, team members take the oath neatly dressed and with firm beliefs, and participate in activities vigorously, holding the team flag. It seems that the expected activity effects are achieved, but in fact, the significance of the activities has not been deepened.

3.3. “Insufficient intelligence” of Young Pioneers’ activities

With the rise and application of informatization, digitalization, and intelligence, intelligence has penetrated into all walks of life. The wide application of new technologies has brought tremendous changes to all industries, and at the same time, new opportunities and challenges for the innovation and development of Young Pioneers’ activities. At present, some schools still use traditional methods for Young Pioneers’ activities, or the application of intelligence is superficial, which obviously makes it difficult to meet the various needs of current Young Pioneers. For example, some schools fail to use digital tools to achieve cross-regional resource sharing, leading to an expanded gap in Young Pioneer education between urban and rural areas^[4]. Although individual Young Pioneer organizations have launched online platforms, they mostly stay at the level of sending activity news or notifications, failing to make full use of digitalization and intelligence to carry out activities. In addition, although some activities can use certain educational platforms or read resources, their use is often just simple visits, without forming a systematic learning process. Some activities pursue intelligence for the sake of intelligence, simply using some intelligent devices such as AR, but the actual content is not combined with political enlightenment and value shaping. Therefore, the application of intelligence should not be “superficial” but deeply integrated with educational value.

4. Optimization paths of Young Pioneers’ activity education

With the continuous progress of the times, traditional educational approaches for Young Pioneers are difficult to meet the diverse growth needs of contemporary children. Actively exploring diverse educational methods and optimizing them reasonably have become the key to enhancing the effectiveness of Young Pioneer education^[5]. Faced with the current prominent problems of Young Pioneers’ activities, adjustments should be made in the following aspects:

4.1. Adhere to the principle of subjectivity and focus on process and effectiveness

A common feature of high-quality Young Pioneer political enlightenment education is the use of surrounding resources to implement activity courses and focus on children's practical experience ^[6]. Activity effects should not only stay on the surface; instead, we should pay attention to whether team members have real gains and positive feedback in activities, and whether the activities achieve comprehensive educational effects. We should also focus on whether Young Pioneers can achieve self-development and self-education through activities.

First, Young Pioneers are the main body of activities, and children are the starting point and destination of all educational activities. The principle of subjectivity means that in the integration process, we should establish students' dominant position, mobilize their enthusiasm, initiative, and activity, cultivate their abilities of self-management and self-education; foster Young Pioneers' awareness of procedures and rules, enhance their negotiation skills and democratic awareness, and let them learn to express, listen, and cooperate through participation ^[7]. Educators shoulder the mission of cultivating talents for the Party and the country, with the core task of cultivating children's socialist core values and enhancing their organizational awareness and teamwork spirit ^[8]. In this process, teachers should cherish students' desire to perform and strive to create opportunities for them to experience success. The design of Young Pioneers' activities should first be closely connected to children's life world, conform to their age characteristics, start from their own interests, carry out activities that students love, and integrate education with fun. As Young Pioneer workers, counselors should fully respect and encourage Young Pioneers, creating room for them to give full play to their talents ^[9].

In addition, since not all activities can arouse children's interest, on the premise of respecting students' dominant position, educators must propose attractive goals, continuously enrich the forms of activities for students to integrate independently, and use the rigorous organizational form of the Young Pioneers to ensure the orderly development of comprehensive practical activities. People develop dynamically. During activities, while focusing on the inherent needs of students' lifelong development, teachers should assume a guiding role, and truly realize children's dominant position through teacher-student interaction and peer interaction.

Second, it is necessary to strengthen the effectiveness of activities and deeply integrate them with educational effects. Children are the masters of Young Pioneer organizations and the main participants and experiencers of Young Pioneers' activities. Therefore, Young Pioneer workers must pay attention to and safeguard children's growth in the organization.

4.2. Follow the principle of individualization and eliminate "utilitarian" tendencies

The existence of utilitarianism is due to the lack of attractiveness of activities. Too many activities are stereotyped and uniform, requiring children to meet the same standards. Therefore, to eliminate utilitarianism, we should attract Young Pioneers with activities that interest them and meet their own needs. Individualized education means conducting targeted education, fully understanding the age characteristics of children at different stages, and designing diverse activities. Promoting education that respects children's inherent nature means respecting their individuality based on their natural instincts and carrying out education suitable for their personalized development. Only in this way can children's subjectivity be genuine, vibrant, and energetic.

The design of activities should be based on students' interests. For example, for different age groups and class characteristics, activities reflecting individual characteristics should be designed, allowing students to choose independently according to their own interests, hobbies, strengths, and needs. Activities originate from life. Team members are often interested in things around them. We can start from life, learn to capture the traces of activities from life, and explore the space for activities from life. For example, use community resources

to establish Young Pioneers' activity positions, give full play to the strengths of each team member in Young Pioneers' activities, and intentionally create some challenging activities to allow team members to develop their strengths and avoid weaknesses, gradually overcome their shortcomings, and fully demonstrate their advantages.

4.3. Practice the principle of practicality and integrate digital technology

The “Opinions on Accelerating the Digitization of Education” jointly issued by the Ministry of Education and eight other departments proposes the overall requirement of “focusing on integration, intelligence, and internationalization, expanding the coverage of high-quality educational resources, promoting artificial intelligence to assist educational reform, and accelerating the formation of a ubiquitous lifelong education system”^[10]. Based on this, the adjustment of Young Pioneers' activities should balance traditional advantages and era innovation. In view of the current development of science and technology, the forms of activity courses can use digital technology to enter nature and stimulate Young Pioneers' interest in exploration. For example, Young Pioneers' practical processes can be transmitted through digital platforms, allowing them to express their thoughts and feelings in real time through technology; in the process of exploring red resources, scientific and technological means can be used to map the development course; in social practice, virtual identities can be endowed through technology to experience roles and promote comprehensive and harmonious personal development; enabling Young Pioneers to truly realize the integrated development of technology and practice in practical activities.

The growth and insight of Young Pioneers are mainly achieved through Young Pioneers' activities, so the value of activity content is particularly important. Carrying out student-centered activities, adhering to personalized education, and creating a real and appealing life world for Young Pioneers help build a vibrant Young Pioneer cultural atmosphere, contribute to the personal development and growth of Young Pioneers, allowing them to experience happiness and gain true knowledge in activities.

Disclosure statement

The author declares no conflict of interest.

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Exploration of the Improvement Paths of University Informatization Project Management Under the Background of Digital Campus

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Abstract: This study focuses on the optimization paths of university informatization project management under the background of digital campus. By analyzing the key problems and challenges such as poor management systems and mechanisms, insufficient depth of technology application, and resource integration dilemmas, and based on the whole-life cycle management theory and the mixed management concept of "rigid framework and flexible execution", a systematic four-dimensional improvement path framework of "system integration - intelligent drive - flexible management - security governance" is proposed. Research shows that the management foundation is reconstructed through system integration and data governance, process reengineering is driven by intelligent technology, and the unification of standardization and flexibility in project management is realized relying on improved management mechanisms. Meanwhile, a solid implementation support system is constructed from three dimensions: organization, system and technology, providing multi-faceted support for the digital transformation of project management. The research results provide theoretical and practical support for the reform of the digital governance paradigm of university informatization projects, and have important reference value for promoting universities to achieve high-quality digital transformation.

Keywords: Educational digitalization; Informatization project management; Whole-life cycle; Data Governance; Improvement paths

Online publication: December 31, 2025

1. Introduction

1.1. Research background and significance

Amid the global wave of educational digital transformation, China has successively issued landmark documents such as the "Planning Outline for Building an Educational Power (2024—2035)" and "China Education Modernization 2035", clearly emphasizing the strategic task of "promoting the renewal of educational concepts, model reform, and system restructuring". The promotion of higher education digital transformation has become a core driving force for reshaping university governance systems and talent training models, and the

improvement of informatization project management is a key breakthrough in this reform. The level of university informatization project management is directly related to the effectiveness of digital transformation ^[1].

1.2. Domestic research progress

Research on university informatization project management in China presents the characteristics of “practice-led and theory-following”. Tsinghua University took the lead in proposing a whole-life cycle-oriented project management system, including bidding, execution, and customer feedback ^[2]. Dalian University of Technology implemented the overall management idea of “project warehousing and three-year rolling”, realizing the overall planning of the three-year construction cycle through rolling management of the project library ^[3]. Ji Ya ^[4] explored the architectural design of informatization systems using database technology and constructed an informatization management model suitable for university needs. Sun Qiang, Wang Shixian, et al. ^[5-6] analyzed the existing problems and their causes in the informatization construction of universities, and put forward suggestions and measures for the construction of systems and mechanisms to promote the scientific management of university informatization projects. Li Jiangjing ^[7] proposed a multi-participation strategic improvement strategy for university digital transformation by analyzing the opportunities and challenges brought by new technologies such as artificial intelligence to university informatization construction. These practices indicate that domestic research is transforming from decentralized construction to integrated governance, but the construction of the theoretical system is still insufficient.

1.3. Foreign research progress

The exploration of improvement paths for university informatization project management by foreign scholars and practical institutions is characterized by strategic focus, technology integration, and deepened governance. Research shows that effective university informatization project management relies on a hierarchical and collaborative governance structure and dynamically iterative strategic planning. Princeton University has established the IT Strategic Advisory Group (SAGIT) led by the provost as the highest decision-making body, with three domain committees for administration, teaching, and scientific research, forming an IT governance system structure of top-level overall planning and multi-subject collaboration ^[8]; universities such as Harvard University and Yale University are shifting from static multi-year planning to dynamically adjusted agile planning. In addition, the application of artificial intelligence has brought new opportunities for university informatization project management, such as Harvard University’s “AI Sandbox” and Stanford University’s “AI Playground” projects ^[9]; the European Union has proposed a series of digital measures for university project management to achieve information sharing and business process collaboration adaptation for the sustainable development of higher education digitalization ^[10]. The Joint Information Systems Committee (JISC) of the United Kingdom proposes making decisions based on data and evidence and conducting regular reviews to ensure rapid adaptation to changes. These studies collectively reveal that foreign university informatization project management is evolving towards strategic leadership, technology empowerment, agile iteration, and in-depth collaboration.

2. Problems and challenges in university informatization project management

2.1. System isolation and lack of data governance

Current university informatization project management faces severe challenges of system fragmentation and data separation. Each department independently builds business systems without a unified management platform

and interface standards, resulting in serious “data silos” and “process breakpoints”, leading to fragmented user experience and low efficiency^[11]. At the data level, there is a lack of a systematic governance framework, with inconsistent data standards and missing sharing mechanisms. The value of data assets is difficult to realize, making it impossible to achieve business collaboration and overall visual management, which directly affects the scientificity and management efficiency of project decisions.

2.2. Traditional processes and low approval efficiency

Traditional project management processes rely on manual processing, lack intelligent support, and have significant efficiency bottlenecks. Redundant process nodes lead to long approval cycles, seriously affecting project progress^[12]. There is a lack of intelligent process engine tools, making it impossible to realize flexible circulation methods such as automatic condition triggering and intelligent jumping. At the same time, insufficient mobile terminal support and imperfect message reminder mechanisms prevent precise push and real-time response. This inefficient process management is difficult to adapt to the rapidly developing needs of university informatization construction^[13].

2.3. Rigid management mechanisms and insufficient collaboration

The university informatization project management mechanism has not yet achieved effective coverage of the whole-life cycle and refined classification management. On the one hand, project management mostly stays at the two ends of project approval and acceptance, lacking process supervision and dynamic regulation, leading to execution deviations and resource waste; on the other hand, the “one-size-fits-all” management model is common, failing to implement differentiated control according to project scale and type, making it difficult to balance compliance and flexibility^[14].

3. Corresponding solutions for improving university informatization project management

3.1. System integration and reconstruction of data governance foundation

First, construct a comprehensive management platform for informatization construction projects with a unified entrance and user-perceived transparency, connect interfaces between related business systems, and realize data interoperability through in-depth integration of multiple systems. All relevant file data of projects can be viewed on the management platform, making the operation of informatization projects across the university clear at a glance^[15]. In-depth system integration includes: integration with unified identity authentication to realize single sign-on and permission management; integration with public data platforms to support automatic acquisition of project data; connection with financial systems to synchronize project settlement information and fund status in real time; connection with asset management systems to realize linkage of asset accounting, etc. Second, breaking data silos requires the governance and classification reconstruction of educational data. Educational data can be classified into five dimensions: achievement data, management data, shared data, behavioral data, and resource data, transforming data management from passive response to active planning.

3.2. Intelligent-driven process reengineering

Traditional informatization project management processes face the problem of low efficiency, requiring the introduction of intelligent process engines to innovate and reengineer project management processes. First, based

on a low-code platform, quickly and flexibly develop process forms for informatization project management on demand, customize business process links and circulation rules through graphical tools, covering links such as application, approval, procurement, construction, acceptance, and settlement. The platform adopts “drag-and-drop form design” to reduce technical thresholds, allowing business departments to independently configure simple processes, while the Information Technology Center retains the right to review technical specifications. Second, AI empowers intelligent supervision, introducing automatic triggering mechanisms to support intelligent circulation methods such as time triggering and conditional jumping, reducing unnecessary waiting time for process circulation. At the same time, by building a large model of informatization projects, intelligently analyze and evaluate the informatization project documents submitted by users, intelligently circulate and accurately deliver approvals, and improve the efficiency of project processing and circulation. Third, implement multi-terminal and multi-channel intelligent reminders, integrate with a unified messaging system, and support the push of to-do reminders and scheduled reminders through short messages, DingTalk, WeChat, emails, etc. Driving the reengineering of the informatization project management processes through intelligent means helps shorten the average approval and processing cycle of projects and improve the efficiency of project management and processing.

3.3. Improve and optimize management mechanisms

Improve and optimize the informatization project management mechanism to achieve both standardization and flexibility in project management. First, establish a whole-life cycle management mechanism for informatization projects, including the entire process management from project application, expert approval demonstration, fund allocation, project procurement, contract registration, project implementation, project modification, project acceptance, project payment and settlement, project asset accounting and warehousing, project commissioning and operation, to project decommissioning.

Second, implement dynamic management of the project library: adopt a three-level library classification of “application - reserve - approval”, with a validity period of 2 years for projects in the reserve library, which need to be re-demonstrated after expiration. Third, implement classified project control: adopt flexible and differentiated control for projects of different scales and types. The classified control model not only ensures the quality of key projects but also respects the autonomy of colleges and departments, achieving a management balance of “rigid framework and flexible execution”.

Fourth, strengthen the control of key nodes: focus on the management of five key nodes in the management process, including expert approval demonstration, project procurement, project implementation, project acceptance, and project payment and settlement, and set quality red line indicators. Fifth, construct a “grid member system”, where the Information Technology Center assigns full-time technical personnel to each informatization project construction unit. Grid members are responsible for guiding the writing of project application forms, technical communication and coordination, pre-review of acceptance materials, etc. This system effectively bridges the gap in technical capabilities of business departments and builds a collaborative link between “management and construction”.

4. Implementation support for the digital transformation of university informatization project management

4.1. Organizational support

The organizational structure of the informatization project management should be reorganized and governed,

and a special leadership team responsible for digital transformation should be established from a university-wide perspective. The team needs to have a high level of professional literacy and overall planning capabilities to ensure the smooth progress of digital transformation work. At the same time, a three-level organizational structure should be established. The core of this system is a network information leading group headed by university leaders, which is mainly responsible for scientific decision-making on major matters. Next, the Information Technology Center undertakes the task of overall coordination, transforming high-level decisions into specific implementation plans, and reasonably allocating and scheduling resources. Finally, the specific implementation work is completed by the secondary informatization construction departments of the university. These secondary departments directly connect with the needs of teachers and students, and can flexibly adjust implementation strategies according to actual conditions, ensuring that the entire digital transformation process is both efficient and in line with actual needs. Through such a three-level system, seamless connection from decision-making to execution is achieved, providing a solid organizational guarantee for the university's digital transformation.

4.2. System support

A comprehensive system framework, including project management, data management, and security management, should be constructed. First, the “Measures for the Management of Informatization Projects” should be formulated, which will specify the entire life cycle management process of informatization projects, including specific operational norms for each link, such as project application, approval, procurement, implementation, acceptance, and post-evaluation, to ensure that the project can proceed in an orderly manner and achieve the expected goals. Formulate the “Data Standard Specifications”, which will uniformly define data formats, coding rules, exchange methods, etc., involved in the system, providing a solid foundation for data interoperability and sharing across departments and systems. At the same time, formulate the “Measures for the Management of Informatization Data Resources”, clarifying the management requirements for the collection, storage, use, sharing, and destruction of informatization data resources, thereby improving the utilization efficiency of data resources and ensuring data security and integrity. In addition, the “Measures for Network Information Security Management” should be issued, covering network security protection, information security management, emergency response mechanisms, etc., aiming to build a more sound network information security guarantee system, prevent various potential security risks, and ensure the stable operation of informatization systems. The formulation of the above management measures and specifications will provide strong institutional support for the organization's informatization construction.

4.3. Technical support

University informatization project management needs to rely on a multi-level technical support system to ensure the smooth progress and long-term operation of the project. First, cloud computing and virtualization technology are the basic support. Through private cloud or hybrid cloud platforms, elastic allocation and intensive management of computing and storage resources are realized, reducing infrastructure costs. Second, big data and data analysis technology are crucial. By building a data middle platform, the interconnection between the data middle platform and API gateway is realized, breaking data silos between various business systems, achieving unified identity authentication and business process collaboration, and supporting decision optimization and personalized services. In addition, software development and integration technologies (such as microservice architecture) can realize modular development of systems and compatibility with existing systems, improving system scalability and maintainability. Network security technologies include unified identity authentication,

access control, and threat monitoring to ensure the security of campus networks and sensitive information. Finally, project management and collaboration tools (such as low-code platforms) can accelerate the development of lightweight applications, meet personalized needs, and assist team collaboration, progress tracking, and process automation. In summary, these technologies collectively build an end-to-end support from underlying infrastructure to top-level applications, promoting the development of university informatization towards intelligence, collaboration, safety, and reliability.

5. Conclusion

The digital transformation of university informatization project management is a systematic project in the process of education modernization. Focusing on the core issue of improving the efficiency of university informatization project management in the background of educational digital transformation, this study systematically analyzes the current key challenges such as poor management systems and mechanisms, insufficient depth of technology application, and resource integration dilemmas. Based on the whole-life cycle management theory and the mixed management concept of “rigid framework and flexible execution”, it proposes a systematic solution path and a guarantee system. This study not only provides an operable practical framework for university informatization project management but also enriches the connotation of educational digital governance at the theoretical level, which has important reference value for promoting universities to achieve high-quality digital transformation. Future research can further explore the application of educational large models in project risk assessment and the school-based practice of digital ethics frameworks. Only through continuous theoretical innovation and practical iteration can university informatization project management be continuously optimized in dynamic adaptation, constructing a new paradigm of informatization project management that is both in line with the laws of higher education and highly efficient, and truly empowering the construction of a high-quality education system.

Disclosure statement

The authors declare no conflict of interest.

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Emerging Engineering Education Method Based on “Elements Aggregation” for Integrated Circuit Talent Cultivation

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Abstract: Taking “Analog Integrated Circuit Analysis and Design”, the key course of the integrated circuit major, as an example, this paper proposes a new engineering course teaching method based on “elements aggregation” for the cultivation of high-level integrated circuit engineering talents. The aim of this method is to realize the organic integration of the three-dimensional space of knowledge, ability and competence, and the organic integration of basic theory, scientific discovery ability and engineering application ability. The proposed teaching method ensures a multidimensional and composite high-quality engineering talent cultivation in integrated circuits in higher education institutions.

Keywords: Elements aggregation; Emerging engineering education; Engineering talent cultivation; Integrated circuit

Online publication: December 31, 2025

1. Introduction

The integrated circuit (IC) industry is a strategic, foundational, and pioneering sector in national economic and social development. It serves as the core and foundation for cultivating emerging strategic industries and promoting the deep integration of informatization and industrialization. However, there remains a significant gap in the cultivation of IC professionals, and the rapid development of the industry has placed new, higher, and more comprehensive demands on talent training^[1,2]. As the most critical training ground for IC professionals, higher education institutions must engage in serious reflection: “Does the current teaching model meet the urgent demand for IC talent in China?” and “Can the current teaching model cultivate high-quality IC professionals capable of facing future challenges?”

The field of integrated circuits is characterized by several distinct features: on one hand, it is highly practical, requiring close integration of theory and practice; on the other hand, it involves complex and extensive specialized knowledge, with engineering practice emphasizing the comprehensive application of knowledge components, all amid rapid technological evolution^[2-6]. Nevertheless, the current teaching model for IC-related courses tends to overemphasize theoretical principles and formula derivation, while neglecting the practical application and engineering context of circuit design. Moreover, it often fails to address the integrated application

of knowledge components in real-world engineering scenarios. This leads to a lack of clear guidance and application-driven motivation in student learning, dampens their interest, and ultimately compromises learning outcomes. Therefore, how to cultivate high-level talents capable of “flexibly applying knowledge components in engineering practice” remains a critical issue for higher education institutions to explore.

Taking the course “Analysis and Design of Analog Integrated Circuits” as an example, this paper proposes a “New Engineering” curriculum development approach based on “Component Integration,” aimed at cultivating high-level IC engineering talent. It seeks to explore new models, methods, and concepts for engineering education that bridge the gap between academia and society, theory and practice, and education and application. The goal is to develop outstanding engineering talents who possess both innovative spirit and practical ability, as well as capabilities in scientific discovery and engineering application. The proposed approach consists of three main dimensions: a teaching philosophy centered on the “Aggregation of theoretical elements” for imparting basic theoretical knowledge; a teaching methodology that constructs a multidimensional knowledge system through the “Dynamic deduction of performance elements”, using the optimization of typical circuit performance as the main narrative thread; and an engineering capability cultivation method driven by the “Application elements aggregation” through engineering case studies.

2. Overall teaching philosophy and teaching methods

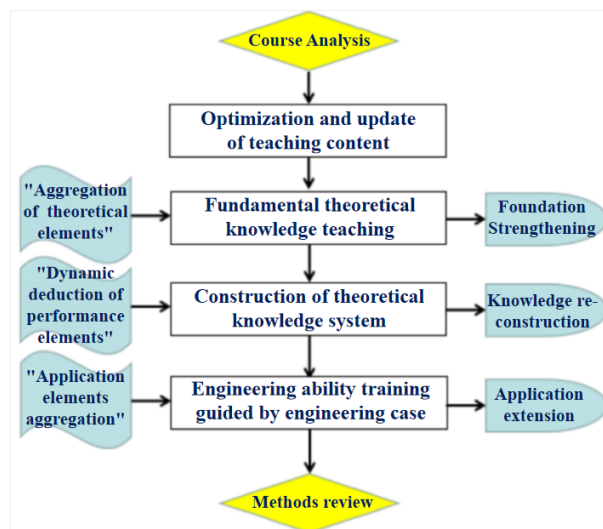


Figure 1. Overall teaching approach of “elements aggregation.”

In order to achieve the ultimate teaching goal of cultivating innovative high-level talents in integrated circuits under the background of emerging engineering education, the teaching process of this course is divided into three stages: fundamental theoretical knowledge teaching stage, construction of theoretical knowledge system stage, and engineering ability training stage. The three stages are indispensable and interrelated. By adopting teaching methods such as “Aggregation of theoretical elements”, “Dynamic deduction of performance elements”, and “Application elements aggregation”, the teaching objectives of strengthening the foundation, reconstructing the knowledge system, and expanding applications are achieved, respectively (**Figure 1**).

2.1. Optimization and update of teaching contents

The content of classic textbooks often lags behind the rapid advancement of integrated circuit technology, resulting in a training approach that fails to closely align with the technological forefront and real-world industrial practices. Given the swift pace of innovation in IC technology, it is essential to continuously update teaching materials with the latest knowledge, technological developments, and future trends in the field of electronics and information. Doing so ensures that talent cultivation remains relevant to societal needs, maintains the timeliness and advanced nature of the curriculum, introduces students to the current state and developmental directions of the industry, stimulates learning interest, enhances teaching outcomes, and broadens students' perspectives.

Therefore, in designing the course content, the teaching team has balanced foundational knowledge, engineering applicability, and contemporary relevance. By integrating the team's specialized technical expertise, outcomes from research projects, and ongoing tracking of the latest academic and industrial trends, the curriculum incorporates explanations and analyses of recent achievements, advanced design methodologies, and cutting-edge application cases in analog integrated circuits. Examples include the gm/Id methodology^[7,8], near-threshold design techniques^[9], EEG acquisition chips for biomedical applications^[10,11], full-duplex transceivers for 5G communications^[12,13], and AI chips^[14,15]. Through these measures, the course maintains its relevance and advanced character, stimulates students' learning interest, and broadens their academic and professional horizons.

2.2. “Aggregation of theoretical elements” facing to fundamental knowledge teaching

Core knowledge elements form the foundation for both course learning and engineering application. These elements, in turn, are supported by fundamental theoretical concepts from prerequisite courses. Taking the analysis and calculation of the differential-mode gain of a fully-differential amplifier as an example, this knowledge element relies on foundational theories such as the Superposition Theorem and Thevenin's Theorem from earlier courses, and requires the integrated application of these fundamentals. Therefore, students' depth of conceptual understanding of these basic theoretical elements, as well as their retention of knowledge from prerequisite courses, directly impacts their learning outcomes.

However, due to insufficient mastery of knowledge elements and the gradual forgetting of content from earlier courses, students often face significant difficulties in comprehensively applying prior knowledge to analyze topics in current courses. To address this, the course integrates core foundational theory elements, such as KVL/KCL theorems and the Superposition Theorem from Fundamentals of Electric Circuits, and the s-domain transfer function from Signals and Systems, by developing micro-lecture videos and compiling comprehensive online resources. These materials provide targeted reinforcement of key knowledge components and guide students in applying them synthetically to analyze core topics of the course. Through this approach, the course strengthens foundational knowledge and cultivates students' ability to integrate and apply fundamental theoretical elements, thereby laying a solid foundation for subsequent instructional activities.

2.3. “Dynamic deduction of performance elements” facing to the construction of multidimensional knowledge system

In traditional teaching of analog integrated circuits, knowledge elements and various classic IC prototype circuits are often presented in a fragmented manner, with instructors seldom exploring the intrinsic connections between these components. However, by integrating engineering practice and deeply examining the historical progression of performance optimization in analog IC design, we can recognize that various types of integrated circuits are in fact part of an evolving system, one that is structured around the optimization of key performance metrics and

exhibits a dynamic, deductive character.

Taking the common-gate amplifier (source follower) shown in **Figure 2** as an example, three circuit variants, the resistor-biased source follower, current-mirror-biased source follower, and PMOS-input source follower, can be understood as successive stages in an engineering effort focused on improving linearity. This optimization trajectory forms a clear deductive thread, where gains in linearity are achieved at the cost of other performance aspects such as output swing and drive capability, illustrating a distinct trade-off relationship.

In response, the course introduces a teaching methodology termed “Dynamic deduction of performance elements.” This approach uses circuit performance optimization as the main narrative thread, dynamically illustrating how to enhance the performance of amplifier circuits in response to practical engineering challenges such as gain boosting, device sizing, output swing extension, and linearity improvement. These deductions are empirically validated through simulation using the Huada Jiutian Analog/Mixed-Signal IC Design Platform, with comparative simulation results presented visually for clarity.

Throughout the process, a series of guided questions is embedded to encourage step-by-step critical thinking and deeper engagement. By addressing real-world design problems, such as those related to gain, sizing, swing, and linearity, the instruction dynamically demonstrates performance optimization strategies for common-source amplifiers and other core circuits.

Furthermore, the course incorporates a central concept in IC design: trade-off analysis. Using fish-bone diagrams with hypothetical branches, students visually grasp how improving one metric (e.g., linearity in a single-stage amplifier) inevitably compromises others (e.g., gain or output swing). This visual and conceptual reinforcement helps students internalize the essential engineering mindset of design trade-offs. Through this dynamic, performance-oriented deduction process, a structured and coherent theoretical knowledge system for integrated circuits is effectively constructed.

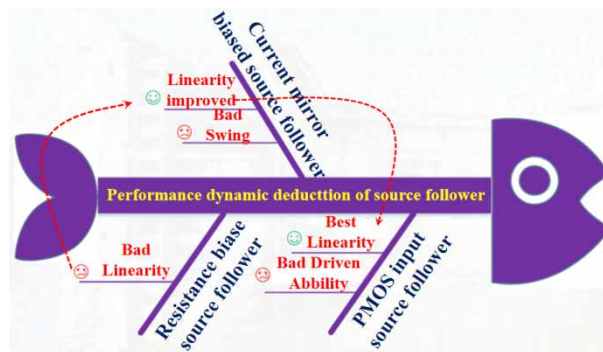


Figure 2. “Performance elements dynamic deduction” of the source follower.

2.4. “Application elements aggregation” guided by engineering cases

The course Analysis and Design of Analog Integrated Circuits aims to familiarize students with common analog IC architectures, master analog IC design processes and methodologies, and build a foundational theoretical knowledge system in the field of integrated circuits. The ultimate instructional goal is to equip students with a professional knowledge system that meets the demands of real-world engineering and to develop their ability to comprehensively apply, analyze, and solve practical engineering problems.

To this end, we propose an application-oriented teaching methodology termed “Application elements aggregation,” which is driven by engineering cases. By selecting representative cases that not only cover key

course knowledge elements but also reflect the forefront of IC scientific research and engineering applications, students are exposed to the complete “forward design” process of practical engineering examples through the use of EDA tools on a full-flow IC design platform. This approach immerses students in a highly visual and impactful learning experience, enabling them to grasp the full spectrum of application elements and engineering thinking specific to analog IC “forward design.” Through the integration of fundamental theory and design elements in practical design contexts, students further consolidate their theoretical knowledge and elevate their engineering application capabilities.

As an example, consider the selected case study of a high-sensitivity wireless energy harvesting chip for wireless sensor networks. Driven by this engineering scenario, students analyze the working principles and performance metrics and decompose the chip into its constituent circuit blocks. From this, the most representative sub-block—the operational amplifier within the linear voltage regulator—is chosen as the focus for design training. First, students evaluate whether previously studied basic amplifier circuits meet the actual engineering requirements of the energy harvesting chip in terms of gain, output impedance, linearity, etc. This leads naturally to the introduction of the two-stage amplifier, followed by an in-depth analysis of its operating principles and design methods.

Based on this analysis, students conclude that the two-stage amplifier fulfills the practical requirements of the energy harvesting chip (**Figure 3**). Then, within an IC design virtual environment using the Huada Jiutian EDA platform, a domestic full-flow analog/mixed-signal IC design tool, the complete design flow of the two-stage amplifier is demonstrated in a realistic setting. Coupled with a structured, summary-oriented teaching approach, this immersive demonstration enables students to assimilate key analog IC design flow elements, core engineering concepts, and practical proficiency with the Huada Jiutian EDA tools, achieving a visually engaging and pedagogically effective experience.

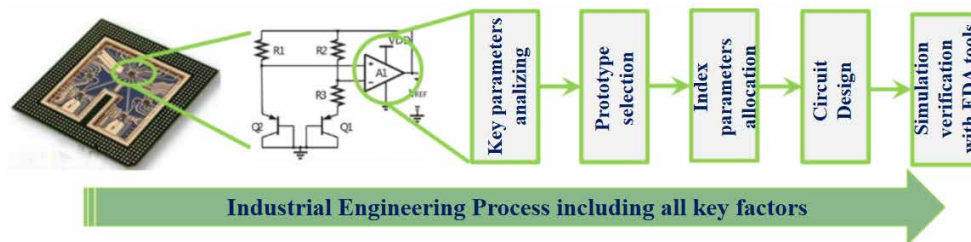


Figure 3. Example of “Application elements aggregation.”

3. Conclusion

Taking the key foundational course in integrated circuits, Analysis and Design of Analog Integrated Circuits, as an example, this paper builds on the proposed “New Engineering” teaching and reform methodology centered on “Elements Integration,” aimed at cultivating high-level engineering talent. Using the domestic Huada Jiutian EDA platform for full-flow analog/mixed-signal IC design as a bridge for forward design in practical engineering applications, we explore new pathways and mechanisms for achieving first-class teaching standards and developing a high-caliber teaching team. This effort aims to accumulate experience for further deepening educational reform and to cultivate multi-dimensional, high-quality engineering talents who are closely aligned with technological frontiers and industrial practices in the integrated circuit industry.

Disclosure statement

The authors declare no conflict of interest.

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On the Differences Between Digital Textbooks and Electronic Textbooks: A Case Study of the Groundwater Engineering Knowledge Micro-Unit at Tongji University

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Abstract: The development and construction of digital textbooks have become the focus and difficulty in promoting the digital transformation of education. Currently, there is no recognized model for the concept and connotation of digital textbooks at home and abroad, and they are often confused with electronic textbooks, which seriously hinders the development of digital textbooks. Electronic textbooks are electronic versions of text-based textbooks that only provide information to students; digital textbooks not only provide information but also collect students' learning data to improve learning effects and textbook quality. They are characterized by personalization, intelligence, and interactivity, constructing a course scenario-based teaching environment for students. Digital textbooks adopt a knowledge graph structure, collect and analyze learning data, generate individual learning behavior portraits for each student, propose and dynamically update intelligent learning management suggestions, and present visual and interactive learning data analysis results. Taking the groundwater engineering knowledge micro-unit at Tongji University as an example, this paper illustrates how digital textbooks help students intuitively understand the hard-to-observe laws of groundwater movement and recognize engineering practices. For similar engineering courses with complex knowledge systems, strong practicality, and rapid updates, the construction of digital textbooks is imperative.

Keywords: Educational digitalization; Digital textbooks; Electronic textbooks; Groundwater engineering

Online publication: December 31, 2025

1. Introduction

With the rapid breakthrough and widespread application of a new generation of information technologies represented by 5G and artificial intelligence, the digital transformation of various industries has become an irresistible trend. The digital transformation of the education industry is crucial to a country's future

competitiveness and an inevitable path to accelerate the modernization of education, attracting widespread attention from countries around the world^[1-3]. China also attaches great importance to the digital transformation of education. In 2021, the Ministry of Education approved Shanghai as the first national “pilot zone for educational digital transformation”. In 2022, the Report to the 20th National Congress of the Communist Party of China proposed “promoting the digitalization of education” for the first time, launching the strategic action for educational digitalization.

Textbooks are important carriers of teaching content for teachers and learning content for students. The development and construction of digital textbooks have become the focus and difficulty in promoting the digital transformation of education. In the task of “promoting new educational infrastructure and creating a new environment for the development of educational digitalization”, Shanghai clearly proposed “promoting the integrated application of educational terminals, digital textbooks, and new educational resources”^[4]. The “Specifications for the Construction of Digital Campuses in Institutions of Higher Education (Trial)” issued by the Ministry of Education also explicitly encourages teachers to actively develop digital textbooks.

However, there is no recognized model for the concept and connotation of digital textbooks at home and abroad. It is a common misunderstanding to confuse digital textbooks with electronic textbooks. In the design, development, and research of digital textbooks, problems such as unclear concepts and ambiguous connotations seriously hinder their development^[5-7]. Therefore, this paper defines the concepts of digital textbooks and electronic textbooks, elaborates on the connotative differences between them in detail, and further explains the concept and connotation of digital textbooks proposed in this paper with the groundwater engineering knowledge micro-unit at Tongji University as an example, aiming to provide reference for relevant scholars and technicians in the design, development, and research of digital textbooks.

2. Conceptual definition of digital textbooks and electronic textbooks

At present, with the continuous development of the education industry and the advancement of science and technology, the form of textbooks is evolving from static paper-based forms to dynamic multimedia forms and then to interactive digital forms^[8]. It is necessary to accurately define the concept of digital textbooks as a reference for their future promotion and construction.

Textbooks refer to basic materials compiled in accordance with curriculum standards for teaching and require students to master. The most common form of textbooks currently is text-based textbooks, which mainly include textbooks, lecture notes, and teaching outlines. Text-based textbooks are the most traditional form of textbooks, with very mature standards for concepts, design, publication, and use. Electronic textbooks are electronic versions of text-based textbooks, serving as multimedia resource libraries containing text, audio, video, and other materials. They can break the limitations of paper-based textbooks with more flexible layout designs, ranging from simple e-books to rich media forms that embed audio, video, animations, and other multimedia resources and interactive tools into textual and graphical content, making them more expressive and appealing^[9].

On the basis of electronic textbooks providing students with rich information, digital textbooks also collect students’ learning data to improve learning effects and textbook quality. They are characterized by personalization, intelligence, and interactivity, constructing a scenario-based teaching environment for students. Digital textbooks are not only an integration of multimedia information required for textbooks but also include an evaluation system for students’ learning, an intelligent management system for learning progress, and an interactive system for learning data. As a digital teaching system and three-dimensional learning support platform

that integrates different forms of learning resources and meets various learning needs, digital textbooks help expand the dimensions of learning resources, comprehensively record the learning process, conduct precise learning evaluations, and effectively promote the improvement of students' information literacy and problem-solving abilities^[10,11].

3. Connotative differences between digital textbooks and electronic textbooks

Based on the above conceptual definitions, the fundamental connotative differences between digital textbooks and electronic textbooks lie in personalization, intelligence, and interactivity. The following elaborates on these differences from five aspects: data interaction, learning behavior portraits, knowledge structure, intelligence, and update methods.

3.1. Knowledge structure

Digital textbooks adopt knowledge graphs to construct the knowledge structure of the courses they teach. A knowledge graph is a large-scale semantic network rich in concepts, entities, and various semantic relationships. It visually displays the core structure, development history, cutting-edge fields, and overall knowledge framework of specific disciplines through visual graphs, and is currently the fastest-growing and most widely used knowledge expression and processing tool^[12]. As a carrier of educational knowledge, the educational knowledge graph is a core component of the educational knowledge engine, aiming to connect fragmented and scattered teaching resources with related entities into a huge semantic network, thereby providing knowledge support for the intelligent application of education^[13].

With the help of a graph-based structure, digital textbooks connect knowledge points into an organic whole. The graph-based knowledge structure is a complex network composed of various knowledge points and their relationships. Each knowledge point includes teaching content in various forms, such as text, charts, formulas, and videos, and is associated with other knowledge points. This design not only helps students quickly grasp the textbook knowledge system and plan their learning progress but also provides the optimal learning path for individual knowledge points, improving learning efficiency. Currently, most electronic textbooks and traditional text-based textbooks still adopt linear or tree-like knowledge structures. Although the main line is clear, it is difficult to reflect the complex connections between knowledge points. Even if electronic textbooks add multimedia resources, their knowledge structure remains consistent with traditional textbooks, failing to achieve true graph-based correlation.

3.2. Learning behavior portraits

During students' learning using digital textbooks, all generated learning data will be recorded by the digital textbooks, forming unique learning behavior portraits for each student. A learning behavior portrait refers to a virtual learning behavior model constructed by collecting data closely related to the learning process through multiple channels and methods, and using analytical mining technologies, which can be visually presented in forms such as word clouds and dashboards. This model is a collection of individual student tag systems that can describe students' characteristics, needs, preferences, and behaviors, providing data support for subsequent learning behavior analysis^[14]. As a typical application of learning analytics technology, the potential of learning behavior portraits is gradually being tapped, and their value is increasingly being verified. Learning behavior portraits can accurately judge students' learning status, reflect their behavioral performance and learning path

characteristics, and promote students' correct cognition and development of their own learning status^[15]. In the learning behavior portraits formed by digital textbooks, students' learning behaviors are classified and labeled through a tag system from three dimensions: personal characteristics, behavioral performance, and environmental factors. With the tags of each student's learning behavior portrait, teachers can also fully grasp students' learning status, thereby better adjusting teaching methods to improve students' learning effects.

Electronic textbooks lack the function of collecting and analyzing students' learning behavior data. In the process of students using electronic textbooks, they only serve as carriers of information and cannot record students' learning behaviors. In the process of students and teachers using electronic textbooks, their understanding of students' learning status and learning effects is often only subjective and perceptual, lacking specific information and data.

3.3. Intelligence

With the continuous development of a new generation of information technologies, digital textbooks have become intelligent teaching tools. By measuring, collecting, analyzing, and reporting students' learning data, digital textbooks can propose optimization plans for each student's learning process with the help of intelligent algorithms. For students, digital textbooks track each student's learning process, conduct full-process vertical evaluations of learning situations and horizontal evaluations of various knowledge point elements, helping students conduct personalized intelligent learning management. For teachers, using intelligent digital textbooks as carriers, aiming at the whole-process behavioral data of teaching, learning, assessment, and evaluation of class students, using in-depth data mining and analysis, and real-time visual intelligent feedback, a data-driven intelligent feedback chain and a teaching optimization and intelligent learning management mechanism based on digital textbooks are formed.

When using electronic textbooks, understanding students' learning situations can only be achieved through traditional tests and examinations, which have high requirements for test methods and question quality, and are time-consuming with poor instantaneity. There are also many accidental factors, making it difficult for teachers and students to effectively manage learning progress and quality.

3.4. Data interaction

A major feature of digital textbooks is the sharing and intercommunication of learning data between students and teachers, as well as among students. In the process of learning using digital textbooks, by recording and analyzing each student's learning behavior portrait, digital textbooks can integrate all students' learning data, analyze common problems existing in students' learning processes, present them visually, and open access permissions to all students and teachers using the digital textbook. For students, when encountering problems in the learning process, they can refer to other students' learning data and, if necessary, discuss with teachers and classmates through digital textbooks, that is, the interactivity of learning data among students. For teachers, by accessing the learning data analyzed and visually processed by digital textbooks, they can grasp the overall learning situation of the whole class and understand each student's learning progress in detail, making it easier to carry out targeted classroom teaching and improve students' mastery of the taught knowledge, that is, the interactivity of learning data between students and teachers.

3.5. Update methods

With the continuous development of scientific research and practical applications, textbooks should also be

continuously updated. Digital textbooks adopt a graph-based knowledge structure, which can easily add new knowledge to the knowledge graph. It is only necessary to design the content of the new knowledge itself and its relationships with existing knowledge to seamlessly connect the new knowledge with the existing knowledge graph and update all associated knowledge points simultaneously. Textbook updates include not only adding new content but also removing outdated content and correcting incorrect content. During use, digital textbooks collect a large amount of students' learning information and teachers' teaching information. With the help of intelligent data analysis and mining technologies, combined with teachers' guided updates, real-time updates keeping pace with the times can be achieved.

Electronic textbooks still belong to traditional publications. When updates are needed, they have to go through long processes such as revision, review, and release. Moreover, due to the lack of feedback data from textbook users, the design and update of electronic textbooks are often difficult to truly meet the needs of users, reducing the learning effects of textbook users.

4. Case analysis: Groundwater engineering knowledge micro-unit

The following takes the groundwater engineering knowledge micro-unit at Tongji University as an example to illustrate the differences between digital textbooks and electronic textbooks proposed in this paper. Groundwater Engineering is a core professional compulsory course for the major of Geological Resources and Geological Engineering at Tongji University, undertaking the core teaching task of the water research line in the integrated soil-water-rock three-line professional research system. The existing textbooks for Groundwater Engineering are "Groundwater Engineering (Second Edition)" and "Groundwater Engineering Second Edition" edited by Tang Yiqun, Zhou Jie, etc., both of which have complete electronic versions. However, groundwater is "invisible and intangible" with a wide range of impacts. Existing textbooks can only describe and analyze it through text and pictures, making it difficult for students to fully grasp the laws of groundwater movement. At the same time, the Groundwater Engineering course is based on engineering construction and is a practice-oriented course, which also requires textbooks to fully help students understand practical engineering and guide them to apply the learned knowledge to practice. Therefore, there is an urgent need for the development and construction of digital textbooks for Groundwater Engineering. Currently, the teaching team of the Groundwater Engineering course is actively carrying out the construction of digital textbooks, striving to construct a practical engineering-based teaching environment for students through digital textbooks, and the design concept fully reflects the differences between digital textbooks and electronic textbooks.

In terms of the content covered by textbooks, the content form of existing electronic textbooks is only text data and charts, while digital textbooks include various rich forms such as case videos, interactive virtual experiments, and VR internships on the basis of electronic textbooks.

In terms of knowledge structure, as shown in **Figure 1**, the existing electronic textbooks for Groundwater Engineering adopt the same traditional chapter-based structure as text-based textbooks to ensure consistency, while the digital textbook under construction is designed with a graph-based knowledge structure. It not only provides sufficient learning materials for each knowledge point but also clarifies the relationships between various knowledge points, establishing a clear knowledge framework of the Groundwater Engineering course for students. The graph-based knowledge structure also facilitates the update of new knowledge; it only needs to add the content of the knowledge point itself and the connections with related knowledge, which has extremely high expandability. However, when updating knowledge, electronic textbooks are prone to the separation of

new knowledge points from the overall knowledge system due to the lack of effective representation of the connections between knowledge points.

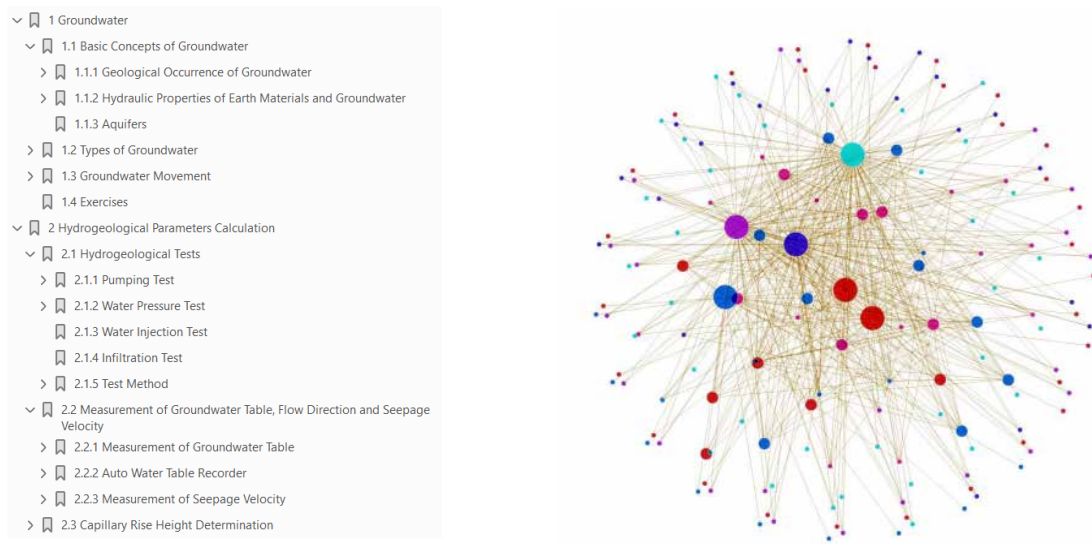


Figure 1. Differences in knowledge structure between electronic textbooks and digital textbooks.

The digital textbook for Groundwater Engineering will collect and analyze students' learning behavior data, construct students' personal learning portraits, and present the analysis results in a visual form. The system provides data query permissions for teachers and students, supporting student communication and teacher management. As shown in **Figure 2**, after the textbook analyzes students' in-class and after-class learning behavior data, a visual learning portrait with classification labels is generated. Based on this, the system can intelligently regulate the learning process, and teachers can also adjust teaching and update textbook content according to the portrait data, thereby improving learning effects and textbook quality.

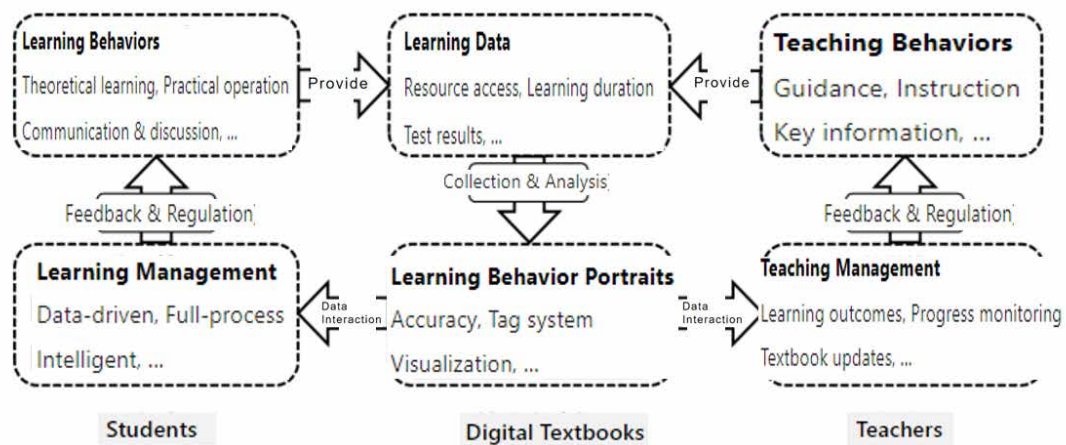


Figure 2. Usage mode of the digital textbook for groundwater engineering.

5. Conclusions

Digital textbooks are the key to the digital transformation of education. The fundamental difference between them and electronic textbooks is that the latter only provide static content, while digital textbooks, in addition to providing multimedia resources, can collect and analyze learning data, featuring personalization, interactivity, and intelligence. Integrating multimedia resources, learning evaluation, progress management, and data interaction, digital textbooks adopt a graph-based knowledge structure, realize the whole-process intelligent management and visual analysis through learning behavior portraits, thereby improving learning effects and supporting continuous optimization and updates based on data.

Taking the Groundwater Engineering course at Tongji University as an example, digital textbooks can construct virtual scenes of groundwater movement, helping students intuitively understand abstract laws and making up for the lack of practical perception in traditional electronic textbooks. Therefore, the construction of digital textbooks for Groundwater Engineering is of great significance. For similar engineering courses with complex knowledge systems, strong practicality, and rapid updates, it is necessary to actively integrate a new generation of information technologies in the future to build open and shared digital textbooks, making them an intelligent educational link connecting theory and practice.

Disclosure statement

The authors declare no conflict of interest.

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Differentiated Teaching Strategies in Senior High School Biology Integrating IB Concepts: Taking the Cultivation of Students' Scientific Thinking as an Example

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Abstract: Based on the IB curriculum concepts of “inquiry-based learning”, “interdisciplinary integration”, and “differentiated assessment”, this paper proposes differentiated teaching strategies centered on the cultivation of scientific thinking. By means of dynamic hierarchical grouping, contextualized case design, virtual simulation experiments, and a multi-evaluation system, a personalized learning path adapting to students with different cognitive levels is constructed. Research shows that this strategy can significantly improve students' experimental design ability and critical thinking.

Keywords: IB concepts; Differentiated teaching; Scientific thinking; Senior high school biology

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1. Introduction

The 2025 new curriculum standard for the college entrance examination biology clearly puts forward four core competencies: “life concepts, scientific thinking, scientific inquiry, and social responsibility”, with experimental inquiry questions accounting for a sharp increase to 35% ^[1], marking the transformation of teaching evaluation from knowledge memory to higher-order ability assessment. However, traditional senior high school biology classrooms still have problems such as “one-size-fits-all” teaching, a lack of experimental practice opportunities, and insufficient interdisciplinary integration, which cannot meet the new curriculum standard's requirements for “solving problems in real contexts”. In this context, the IB curriculum's concepts of “student-centered”, “focus on inquiry process”, and “emphasize interdisciplinary connections” provide strong support for teaching reform. Its differentiated assessment system and inquiry-based learning framework are highly consistent with the new curriculum standard's requirements of “teaching students in accordance with their aptitude” and “strengthening experimental inquiry”, offering a reference path to solve current teaching dilemmas.

2. Theoretical basis of IB concepts and differentiated teaching in senior high school biology

2.1. Analysis of core IB curriculum concepts

2.1.1. Connotation and characteristics of inquiry-based learning

Inquiry-based learning is student-centered, emphasizing the construction of knowledge systems through active questioning, experimental design, data collection, and result analysis. Its core characteristics include problem-driven (learning activities centered on real problems), process-oriented (focusing on thinking processes rather than single answers), collaborative (encouraging learners to improve cognition through interaction), and reflective (requiring critical analysis of the inquiry process). In biology teaching, students can understand variable control and causal relationships through designing experiments on “the impact of environmental factors on enzyme activity” instead of passively accepting textbook conclusions ^[1].

2.1.2. Construction principles of support systems for students at different levels

The IB curriculum support system follows the dual principles of “hierarchical progression” and “personalized adaptation”. Hierarchical progression enables students with different abilities to participate in inquiry activities through preset learning tasks of varying difficulty. In the “genetic laws” unit, students at the basic level can understand the law of segregation through a card simulation of Mendel’s experiments, while advanced students analyze complex cases of linked inheritance of multiple genes. Personalized adaptation emphasizes adjusting support strategies according to students’ interests and cognitive styles, providing concept map tools for visual learners and model-making tasks for kinesthetic learners ^[2].

2.2. Necessity of differentiated teaching in senior high school biology

2.2.1. Current situation and causes of individual differences among students

Senior high school students’ cognitive differences in biology manifest in: knowledge foundation (some have mastered junior high school genetics while others need to reconstruct cognition from the concept of genes); ability structure (students with strong spatial imagination quickly understand the DNA double helix structure ^[3], while those with outstanding logical reasoning are better at analyzing genetic maps); learning styles (field-independent students prefer independent inquiry, while field-dependent students rely on teacher guidance). Causes include innate genetic factors, differences in early educational environments, and non-intellectual factors such as differentiated learning motivation ^[4].

2.2.2 Challenges and limitations of traditional teaching models

A unified teaching rhythm fails to meet individual needs, leading to the phenomenon that “top students are not challenged enough and underachievers cannot keep up”. In teaching “mitosis”, if teachers only use static pictures, students with weak spatial imagination cannot understand the dynamic changes of chromosomes; supplementing 3D animations may cause information overload for basic-level students. The standardized evaluation system further exacerbates this contradiction, with score-oriented teaching forcing students to focus on memory-based knowledge while neglecting the development of scientific thinking.

3. Design of differentiated teaching strategies in senior high school biology integrating IB concepts

3.1. Differentiated teaching strategies based on students' multiple intelligences

3.1.1. Application of multiple intelligences theory in senior high school biology teaching

Gardner's Multiple Intelligences Theory classifies intelligence into eight types: linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, and naturalistic. Biology teaching can develop learning resources targeting different intelligence channels: linguistically intelligent students deepen understanding by writing popular science articles; spatially intelligent students observe organelle structures using VR technology; bodily-kinesthetic students master DNA replication through model making; naturalistically intelligent students participate in campus biodiversity surveys ^[5].

3.1.2. Design of differentiated teaching plans for students with different intelligence types

Taking the "energy flow in ecosystems" unit as an example: linguistic students design "popular science manuals on energy flow" to explain concepts in plain language; logical-mathematical students construct mathematical models to calculate energy transfer efficiency; spatial students visualize energy flow paths with flowcharts; bodily-kinesthetic students simulate energy transfer in food chains through role-playing; interpersonal students organize group debates on "the impact of human activities on energy flow"; intrapersonal students write reflection journals analyzing their ecological protection behaviors; naturalistic students conduct on-site investigations of campus energy flow ^[6].

3.2. Application strategies of inquiry-based learning in differentiated teaching

3.2.1. Hierarchical design and implementation of inquiry-based learning tasks

Task hierarchy balances cognitive complexity and openness. Taking the inquiry of "factors affecting enzyme activity" as an example: basic-level tasks involve "exploring enzyme activity changes by controlling a single variable (temperature)" with detailed experimental steps and data recording tables; advanced tasks add "designing comparative experiments to verify pH effects" ^[7] requiring independent selection of buffer concentrations; high-level tasks involve "proposing unvalidated factors affecting enzyme activity (e.g., surfactants) and designing inquiry plans" emphasizing innovation and feasibility assessment. Teachers present hierarchical requirements via "task cards", allowing students to choose initial levels based on self-assessment and challenge higher levels after completion.

3.2.2. Assignment and guidance of differentiated roles in group cooperation

Role assignment follows the principle of "complementary advantages", with each group including a recorder (good at organizing information), experimenter (strong practical ability), presenter (clear expression), and questioner (outstanding critical thinking). In "simulating Mendel's hybridization experiments", experimenters operate cards, recorders draw genetic maps, questioners analyze experimental error sources, and presenters summarize laws. Teachers rotate roles regularly to avoid ability solidification and record student performance through "role observation forms" ^[8].

4. Practice and challenges of differentiated teaching in senior high school biology integrating IB concepts

4.1. Differentiated teaching practice in large-class settings

4.1.1. Difficulties and breakthroughs in implementing differentiated strategies in large classes

Large classes (usually over 50 students) prevent teachers from focusing on individual needs, making differentiated tasks prone to formality. Breakthrough strategies include: dividing functional areas using the “learning center” model for students to rotate through activities by ability level; developing an “intelligent diagnosis system” for automatic grouping through pre-class tests^[9] and pushing adaptive learning resources; training student leaders as “little mentors” to assist teachers in guiding basic-level students. In the “immune regulation” unit, the system divides students into three groups to complete tasks: “drawing immune cell relationship diagrams”, “analyzing vaccine mechanisms”, and “designing new vaccine development plans”. Little mentors answer basic group questions while teachers focus on guiding advanced groups^[10].

4.1.2. Practical exploration of information technology-assisted differentiated teaching

Information technology enables “scalable personalization”. Intelligent teaching platforms record student operation trajectories, analyze cognitive patterns through machine learning algorithms, and support teachers in adjusting teaching strategies. In virtual experiments on “neural regulation”, the system pushes targeted micro-courses based on students’ error types; online discussion areas automatically cluster similar questions through keyword analysis, allowing teachers to answer common doubts in batches.

4.1.3. Case analysis: Successful practice of differentiated teaching in large-scale biology classes

In teaching “stability of ecosystems”, teachers adopted the “hierarchical tasks + intelligent platform” model: basic-level students watched micro-courses to learn the concept of “resistance stability” and completed basic question banks; advanced students participated in online collaborative tasks of “designing grassland ecological restoration plans” with the platform displaying group progress and contribution in real time; high-level students analyzed “the impact of alien species invasion on stability” and submitted literature review reports. The platform automatically generated “ability development radar charts” showing students’ growth in knowledge understanding, data analysis, and innovative thinking. Post-tests showed that the standard deviation of student scores in each level was reduced by 1.2 units compared with traditional teaching, proving that differentiated strategies effectively narrowed ability gaps^[11].

4.2. Adjustment of differentiated teaching under standardized examination backgrounds

4.2.1. Impact of standardized examinations on differentiated teaching and response strategies

Standardized examinations emphasize knowledge coverage and problem-solving skills, easily leading differentiated teaching to shift toward “examination-oriented training”. Response strategies include: decomposing examination requirements into differentiated goals (basic-level mastering “basic genetic map analysis methods”, advanced-level identifying “complex genetic patterns”, high-level designing “genetic disease screening plans”); developing “examination-oriented inquiry tasks”^[12] (e.g., training data collection and processing abilities through experiments on “exploring the impact of environmental factors on population quantity” to directly correspond to experimental design questions in examinations); establishing “examination literacy files” to record students’ performance in “question-reading speed”, “key information extraction”, and “answer standardization” for targeted strengthening of weak links^[13].

4.2.2. Balance between differentiated teaching and standardized examination goals

Balance requires grasping both “solid foundation” and “ability improvement”. In reviewing “cell metabolism”, teachers designed differentiated tasks: basic-level students completed fill-in-the-blank questions on “material changes in the three stages of aerobic respiration” to consolidate core concepts; advanced students analyzed “the biological significance of differences in anaerobic respiration products” to develop explanatory abilities; high-level students “compared respiratory differences among different tissue cells” to develop comprehensive application abilities. All tasks embedded high-frequency examination points (ATP production sites, energy calculation) to ensure differentiated teaching did not deviate from examination directions. Mock tests showed that the differentiated teaching group had an 18% higher score rate on “comprehension and application” questions than the traditional group, proving the effectiveness of the balance strategy.

5. Evaluation and improvement of differentiated teaching effects in senior high school biology integrating IB concepts

5.1. Construction of teaching effect evaluation index system

5.1.1. Quantitative evaluation indicators for scientific thinking cultivation effects

Quantitative indicators include critical thinking, creative thinking, and systematic thinking, scored using a Likert five-point scale. For example, the critical thinking scale includes three sub-dimensions: “problem identification”, “evidence evaluation”, and “conclusion derivation”, with 5 statements per dimension for students to rate from 1 point to 5 points ^[14].

5.1.2. Qualitative evaluation indicators for differentiated teaching implementation process

Qualitative indicators focus on the adaptability and dynamic adjustment ability of teaching strategies, including the rationality of task hierarchy, effectiveness of support strategies, and timeliness of evaluation feedback. Data are collected through classroom observations, teacher reflection journals, and student interviews. Observation records detail how teachers respond to advanced-level students’ questions such as “whether epigenetics affects Mendel’s laws” to analyze whether guidance strategies promote in-depth learning ^[15].

5.2. Empirical analysis and feedback of teaching effects

5.2.1. Analysis of teaching effects based on empirical data

Empirical data include pre-test and post-test scores, classroom participation records, and work quality ratings. In the “gene expression” unit, the average pre-test score rate was 62%, increasing to 78% in the post-test (top students from 71% to 89%, basic-level students from 53% to 67%) (Table 1).

Table 1. Comparison of Classroom Behavior Observations Before and After Differentiated Teaching

| Behavioral Indicators | Before Implementation | After Implementation | Change Rate |
|--|-----------------------|----------------------|-------------|
| Number of student-initiated questions per class | 1.2 times | 3.9 times | +225% |
| Proportion of ineffective arguments in group discussions | 35% | 20.6% | -41% |

5.2.2 Feedback and application of teaching effect evaluation results

Evaluation results are fed back through “tripartite meetings”: school administrators adjust teacher training priorities based on comprehensive scores; teaching and research groups optimize task design for common

problems; teachers develop personalized guidance plans based on individual feedback. One teacher adjusted the high-level task of “energy flow in ecosystems” from “calculating energy transfer efficiency” to “designing plans to improve farmland energy utilization” and introduced agricultural expert lectures as scaffolding. Subsequent evaluations showed a 3-fold increase in students’ innovative proposals ^[16].

6. Conclusion

By integrating IB curriculum concepts, this paper constructs a system of differentiated teaching strategies in senior high school biology centered on scientific thinking cultivation. Research confirms that dynamic hierarchical grouping can accurately match students’ cognitive differences, virtual simulation experiments effectively improve experimental inquiry abilities, and interdisciplinary case design significantly enhances knowledge transfer and problem-solving skills. Under the background of the 2025 new curriculum standard strengthening core competency assessment, this strategy not only provides a practical paradigm for transforming from “knowledge-oriented” to “competency-oriented” teaching but also achieves the consistency of “teaching, learning, and evaluation” through a multi-evaluation system.

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Construction and Analysis of the Digital Textbook for “Engineering Geology”

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Abstract: Digital textbooks are a key focus for enriching the textbook system with Chinese characteristics and a driving force for advancing the digital transformation of higher education. Based on a brief introduction to the concept and characteristics of the digital textbook for “Engineering Geology,” this paper emphasizes the significance of constructing Tongji University’s “Engineering Geology” digital textbook and establishes its framework. It aims to comprehensively promote the in-depth integration of modern information technology with traditional textbooks and realize the all-round development of students.

Keywords: Digital textbook; Engineering geology; Paper textbook; Information technology

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1. Introduction

Textbooks are an essential guarantee for talent training. Targeting the development direction of textbooks and improving their construction quality are the top priorities of textbook development ^[1–3]. The Report to the 20th National Congress of the Communist Party of China clearly pointed out the need to strengthen textbook construction and management and promote educational digitalization, which undoubtedly points out the direction for textbook development—realizing the digital development of textbooks. Therefore, we should fully promote the construction and application of digital textbooks, which is of great practical significance for enriching the textbook system with Chinese characteristics, improving the quality of talent training, and building a talent-strong country ^[4,5].

As an important professional basic course for engineering majors such as Geological Engineering, Civil Engineering, Transportation Engineering, Surveying and Mapping Engineering, and Port, Waterway and Coastal Engineering, “Engineering Geology” is a necessary course for cultivating future geological engineers, geotechnical engineers and other talents ^[6]. The course of “Engineering Geology” is actually an organic combination of engineering and geology, featuring strong practicality and great abstraction. Specifically,

engineering focuses on practice, emphasizing drawing valuable technical experience from actual projects; while geology is more theoretical, containing many abstract concepts and complex geological phenomena that often require full use of imagination to understand. In recent years, with the continuous development of information technology, digital textbooks have been widely used in the field of education^[7,8]. With the help of technologies such as AI, AR (Augmented Reality), the Internet, and intelligent APPs, the construction of the digital textbook for “Engineering Geology” can be promoted, effectively solving the above-mentioned problems existing in the course.

As one of the first institutions of higher education in China to offer majors such as Geological Engineering, Tongji University has been adhering to innovating and developing the “Engineering Geology” course for many years. With the widespread application of digital textbooks, Tongji University keeps up with the times, emphasizes the significance of constructing the digital textbook for “Engineering Geology,” and establishes its framework, aiming to provide certain guidance for sibling universities in constructing their own digital textbooks for “Engineering Geology.”

2. Concept and characteristics of the digital textbook for “Engineering Geology”

The digital textbook for “Engineering Geology” is the digital transformation of traditional paper textbooks. Specifically, relying on excellent paper textbooks and high-level courses, it fully utilizes modern information technology to integrate various digital resources, learning tools and other elements according to actual teaching activities. Based on knowledge graphs and with the help of modern AI technology, it realizes that textbooks can be listened to, viewed, practiced, crossed, and optimally updated, forming a digital teaching content product that meets national standard requirements. Different from paper textbooks, electronic textbooks, and online courses (including learning resources such as MOOC teaching videos, PPT, and exercises), the characteristics of the digital textbook for “Engineering Geology” mainly include the following aspects:

2.1. Strong interactivity

Traditional paper textbooks for “Engineering Geology” are compiled based on the knowledge system of first-level disciplines such as Civil Engineering or Geological Resources and Geological Engineering. Understanding the content mostly relies on the explanation of teachers, and the teaching effect often depends on the teachers’ teaching level. The form of knowledge acquisition and course content transmission is relatively single. AR technology, tablet computers and other devices have strong human-computer interaction functions, which can enrich the form of course content transmission. Digital textbooks based on AR technology and tablet computers can provide a variety of interaction methods. For example, when explaining rocks in nature, students can further understand the classification, structure, texture, and identification methods of igneous rocks, sedimentary rocks, and metamorphic rocks by clicking on videos and animations, and can check their learning effects online by clicking interactive icons. The application of digital technology makes words no longer lie coldly in textbooks, but are active in interactive communication with people^[9].

2.2. Rich content

Traditional paper textbooks are limited by the number of pages, and the presented content is often limited to icons or text. However, the content carrier of digital textbooks is storage space^[10], whose storage capacity is unlimited. Therefore, it can store a variety of teaching resources, including actual engineering cases, teaching

videos, graphic animations, teaching reference materials, thinking questions and exercise sets, and question banks. The construction of digital textbooks can break through the graphic design of traditional textbooks and enliven the content. For example, designing 3D animations, enriching graphic color matching, and changing table styles to establish a relaxed visual space. For example, when explaining the impact of geological structures on engineering, specific topographic maps of horizontal structures, monoclinic structures, fold structures, fault structures, etc., in actual projects can be combined to clarify the characteristics of different structures and dynamically deduce the impact of the development of different structures on actual projects.

2.3. Real-time update

For the course of “Engineering Geology”, some paper textbooks are updated every 10 years, with a slow update speed. Many new technologies or construction methods are not supplemented in the textbooks in a timely manner, which is not conducive to students’ learning. However, digital textbooks can be based on knowledge graphs and updated in real time according to current domestic and foreign research progress. Especially relying on the Internet platform, it can realize unified release and synchronous update across the network, with fast update speed and low cost. For example, when explaining the prevention and control of landslide disasters, the governance principles proposed in traditional paper textbooks are prevention first and remediation supplemented, and the governance measures are mostly drainage, support, cutting and weight reduction, and improving the properties of sliding surfaces. But in existing projects, around the prevention and control of geological disasters such as landslides, an integrated air (Global Navigation Satellite System)-space (UAV)-ground (surface monitoring) method has been adopted to realize the identification and real-time early warning of landslide disasters ^[11].

3. Significance of constructing Tongji University’s digital textbook for “Engineering Geology”

“Engineering Geology” is a professional basic course for majors such as Geological Engineering, Civil Engineering, Intelligent Construction, and Port, Waterway and Coastal Engineering at Tongji University, with a wide range of applicable majors and flexible applicable objects; this course covers knowledge such as Soil Mechanics, Mineral and Rock Mechanics, Rock Mass Mechanics, Hydrogeology, and Engineering Geological Investigation, covering a wide range of knowledge. When adhering to and innovating the development of the “Engineering Geology” course, Tongji University should strive to promote the construction of its digital textbook in view of the characteristics and problems of this course. Its significance mainly includes the following points ^[12].

3.1. Conducive to accelerating the modernization of education

With the rapid development and strong penetration of modern information technology, the teaching methods and textbook forms in higher education are constantly changing. As an important support for talent training, digital textbooks are also constantly progressing and developing. Digital textbooks are not just a combination of boring text and digital technology, but a deep integration of course content, professional cutting-edge progress, and digital technology, striving to build an open, adaptive, and sustainable education system, so that modern higher education can continuously adapt to the new pace of modern technological development and become an important support for building an education-strong country. Tongji University offers many majors that include “Engineering Geology” as a course. Constructing a good digital textbook for “Engineering Geology”

is conducive to comprehensively cultivating innovative and compound talents in engineering, enriching the engineering textbook system of Chinese universities, and promoting the informatization development of higher education.

3.2. Conducive to giving play to the new function of collaborative education

The competition between countries and enterprises in the 21st century ultimately boils down to the competition for talent. As an important carrier of education, digital textbooks play an important role^[13]. For example, digital textbooks combine basic engineering geology content with engineering practice applications, and can further provide students with an interactive learning platform and practical application system. With the help of modern information technology, a large number of real-time updated actual engineering case libraries are established to enrich students' knowledge, making the "engineering flavor" of the "Engineering Geology" course stronger. In short, the construction of digital textbooks is not only conducive to enriching teaching content, but also can greatly improve students' professional identity, help students obtain and absorb new knowledge in real time, continuously improve the organic connection between professional practice and course content, and enhance students' practical engineering application abilities.

3.3. Conducive to consolidating students' professional foundation

When adhering to and innovating the development of the "Engineering Geology" course, Tongji University should pay attention to the characteristics and problems of this course, fully construct its digital textbook, and strive to present complex geological concepts or geological phenomena using emerging visual technologies (AR, VR) to deepen students' understanding, making the "geological flavor" of the "Engineering Geology" course stronger. For example, when explaining landslides, it is difficult to let students go to the field to understand the entire stages of landslide initiation, sliding, and gradual stability, and their respective characteristics. With the mature application of Virtual Reality (VR) technology, on-site visits can be completely introduced into indoor teaching. For existing landslide image data, an engineering case library can be established based on on-site collected data and 3D virtual technology, allowing students to wear VR headsets to experience the entire process of landslides in real time, deepen their understanding, and continuously consolidate professional knowledge.

4. Framework of Tongji University's digital textbook for "Engineering Geology"

The overall framework of Tongji University's digital textbook for "Engineering Geology" takes talent training objectives as the main line to promote the all-around development of students. The main line specifically includes two modules: the curriculum system and the evaluation system. Among them, the curriculum system mainly takes content directly related to "Engineering Geology" as compulsory content and other knowledge related to engineering geology as optional content, with the design focusing on teachers who teach the digital textbook; the evaluation system focuses on evaluating students' mastery of course knowledge. The framework of Tongji University's digital textbook system for "Engineering Geology" is shown in **Figure 1**.

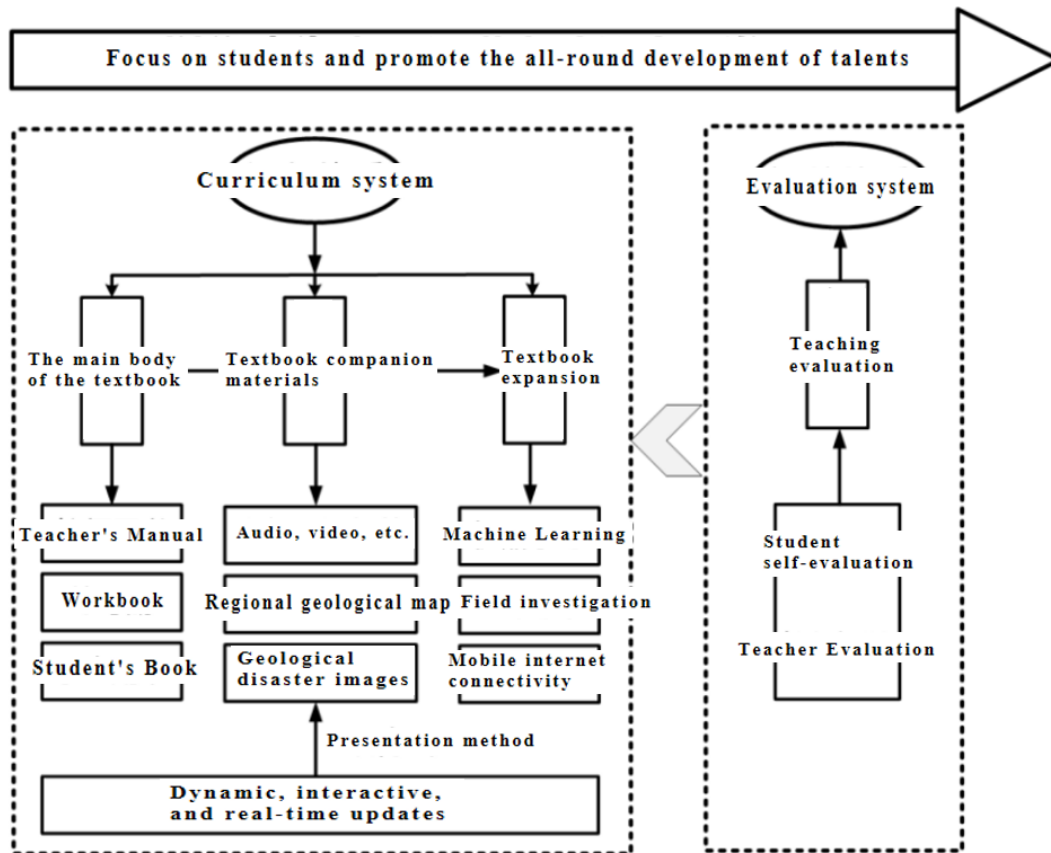


Figure 1. Construction System Diagram of the Digital Textbook for “Engineering Geology.”

4.1. Highlighting the core essence of digital textbook construction

Taking students as the foundation and promoting the all-round development of talents as the core main line of digital textbooks embodies the core essence of the development of the digital textbook system with Chinese characteristics. To highlight the core construction idea of student-centeredness, the digital textbook for “Engineering Geology” should form a horizontally cross-cutting and vertically divided system: horizontal cross-cutting means that the construction of digital textbooks requires the joint cooperation of multiple disciplines. By selecting disciplinary knowledge conducive to students’ development and using diversified information arrangement technologies ^[14], students’ practical skills and disciplinary literacy can be comprehensively improved; vertical division means that digital textbooks include elements such as the textbook main body, textbook supporting materials, and textbook expansion. Different elements have specific components, and textbook knowledge content should be presented in a multi-level, multi-element, and modular manner to promote talent training.

4.2. Highlighting the main body of the curriculum system construction

On the basis of constructing the core main line of the digital textbook system for “Engineering Geology”, the construction of digital textbooks should also highlight the importance of teachers and continuously improve their ability to integrate resources in content, such as the textbook main body, textbook supporting materials, and textbook expansion. Fully mobilize teachers to continuously collect a variety of geological structure pictures, improve course teaching videos, carefully make courseware combined with cutting-edge research progress of

the course, establish different levels of pass-through questions using interactive platforms, and adopt AR three-dimensional simulation models for obscure geological models to deepen students' understanding, with the help of Virtual Reality (VR)^[15], Augmented Reality (AR), 3D technology, the Internet, and big data. Thus, students' active learning can be continuously stimulated, the teaching quality of the "Engineering Geology" course can be improved, and a multi-mode teaching model can be realized.

4.3. Considering the application of the curriculum evaluation system

Whether the construction system of the digital textbook for "Engineering Geology" meets the actual needs of students needs to be further verified. On the one hand, as the fundamental basis for teachers' teaching, whether digital textbooks truly promote the all-round development of students needs to be dynamically adjusted in combination with curriculum evaluation; on the other hand, special attention should be paid to cultivating students' sense of participation. Allowing students to participate in the evaluation of the curriculum system is conducive to putting forward content that urgently needs to be improved in digital textbooks from the perspective of students, thereby continuously improving and strengthening the construction of digital textbooks to truly and effectively serve the long-term development of students.

5. Conclusion

In short, in view of the characteristics and existing problems of the "Engineering Geology" course, we should fully utilize modern information technology to promote the construction of its digital textbook, continuously enrich the digital textbook system with Chinese characteristics, realize the deep integration of digital technology with higher education teaching, continuously improve and update research progress, strengthen the interactivity, audibility, visibility, perceptibility, etc. between students and course knowledge, and continuously promote the all-round development of students. In the process of constructing the digital textbook for "Engineering Geology", Tongji University should take talent training objectives as the main line, fully reflect the student-centered construction concept, give full play to the significance of digital textbook construction, comprehensively improve students' practical application abilities, and make due contributions to accelerating the modernization of education and cultivating compound talents.

Disclosure statement

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Research on the Training Mechanism of Students' Study Tour Guidance Ability in Tourism Management Major from the Perspective of Industry-Education Integration

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Abstract: Based on the background of Industry-Education Integration, this paper focuses on the structural contradiction between talent training in higher vocational tourism management majors and the needs of the Study Tour industry, and explores the training mechanism of students' study tour guidance ability. The research constructs a G-SEEA analysis model consisting of five dimensions: Governance, System Construction, Ecology Cultivation, Evaluation Innovation, and Application Transformation. Through empirical analysis, it reveals the prominent problems existing in the current training process, and proposes improvement strategies such as establishing a multi-party collaborative governance framework, reconstructing the professional competence curriculum system, and improving the school-enterprise co-constructed practice platform. It provides theoretical basis and practical reference for deepening the teaching reform of tourism management majors.

Keywords: Industry-education integration; Study tour; Guidance ability; Training mechanism; G-SEEA analysis model; Curriculum reconstruction; Practical teaching platform

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1. Introduction

With the in-depth implementation of the “Vocational Education Quality Improvement and Excellence Plan (2020–2023)” and the rapid development of the study tour industry, deepening industry-education integration has become the core path to promote the high-quality development of modern vocational education ^[1]. According to the “China Study Tourism Report (2025)” released by the China Tourism Association, the current study tour market has evolved from a simple superposition of “tourism + education” to a core format carrying multiple values such as cultural communication, practical education, and digital innovation. The market scale has exceeded 100 billion yuan, with more than 80 million students participating annually ^[2]. However, after experiencing explosive growth, the industry is facing a critical transition period from scale expansion to quality

improvement, and the shortage of high-quality and professional talents has become the core bottleneck restricting the healthy development of the industry^[3].

Industry research data show that the demand structure for Study Tour talents has undergone significant changes, transforming from traditional “basic services” to “comprehensive capabilities”. There is an urgent need for compound talents with dual professional backgrounds in “education + tourism” and applied talents proficient in digital technologies^[4]. However, there is an obvious mismatch between the existing training system of tourism management majors and the actual needs of the industry, mainly reflected in: the curriculum content is seriously lagging behind the development of industry practice, failing to effectively integrate the curriculum design concept of “localization + education”; the teaching method is still dominated by theoretical lectures, which is seriously disconnected from the requirements of a complete curriculum closed loop advocated by the industry, such as “practical operation, project research, and achievement display”; the evaluation system has low alignment with professional standards, resulting in a long post-adaptation period for graduates, who are difficult to quickly meet the needs of employers.

Existing research mostly discusses the significance of industry-education integration from a macro perspective, or analyzes the reform practice of a single course from a micro perspective, lacking systematic deconstruction research on the training mechanism combined with the latest development trends of the industry^[5]. Based on the perspective of industry-education integration, this study innovatively constructs a “G-SEEA” five-dimensional analysis model, systematically integrating new requirements such as industrial digital transformation and cross-field collaborative ecosystem construction into the model framework^[6-8]. Through five dimensions—Governance mechanism, System construction, Ecology cultivation, Evaluation innovation, and Application transformation—it deeply analyzes the internal logic and interactive relationship of the training mechanism, providing a complete theoretical framework and practical path for innovating the training mechanism of students’ Study Tour guidance ability in tourism management majors^[9-11].

2. Core connotation and structural model of study tour guidance ability

2.1. Evolution and definition of ability connotation

Study Tour guidance ability is essentially a compound professional ability integrating tourism services, educational guidance, and interdisciplinary knowledge application^[12]. According to the “Study Tourism Service Requirements” (LB/T054-2025) issued by the Ministry of Culture and Tourism in 2025, their role has evolved from a mere travel service provider to that of an educational process guide, curriculum designer, safety guardian, and cross-cultural communication facilitator. Compared with traditional tour guide ability, the particularity of Study Tour guidance ability lies in its strong educational attribute. It not only requires practitioners to have proficient travel service operation skills but also needs them to master the basic principles and methods of education and psychology, and be able to transform travel experiences into structured learning processes. At the same time, with the in-depth advancement of industrial digital transformation, modern Study Tour instructors also need to have high digital literacy, and be able to proficiently use digital tools for curriculum design, scenario creation, and effect evaluation.

Based on the above analysis, this study defines Study Tour guidance ability as: in the whole process of Study Tour activities, based on clear educational goals, comprehensively applying multi-disciplinary knowledge and methods, designing and implementing educational courses, and effectively guiding learners to achieve all-around development through experience and inquiry.

2.2. Construction of the “Three-dimensional and nine-capabilities” structural model

To systematically analyze and cultivate this compound ability, this study constructs a “Three-Dimensional and Nine-Competence” structural model of Study Tour guidance ability by combining the latest 2025 industry standards and market demand characteristics^[13]. The model summarizes core competencies into three mutually supportive dimensions: basic guarantee, process implementation, and innovative development.

The basic guarantee dimension includes policy interpretation and compliance application ability, safety risk identification and response ability, and resource integration and coordination ability; the process implementation dimension includes curriculum design and research and development ability, inquiry learning guidance ability, and team organization and management ability; the innovative development dimension includes cultural understanding and inheritance ability, digital technology application ability, and reflective research and innovation ability.

By systematically sorting out the internal connections of ability elements, the model provides a clear target framework and practical basis for subsequent diagnosis of training system problems and construction of industry-education integration mechanisms.

3. Diagnosis and analysis of training status based on the G-SEEA model

To comprehensively evaluate the practical dilemmas in the training of Study Tour guidance ability in tourism management majors, this study conducted a systematic diagnosis of 5 higher vocational colleges offering Study Tour directions based on the five dimensions of the G-SEEA model. The research adopted methods such as questionnaire surveys and in-depth interviews, collecting 126 valid questionnaires and interviewing 12 professional teachers, industry experts, and enterprise representatives. The diagnosis results revealed in-depth problems in each dimension.

3.1. Governance mechanism dimension

The research found that the current governance mechanism has three prominent problems: a fragmented policy system and lagging implementation of industry standards; an inadequate interest distribution mechanism leading to insufficient depth of enterprise participation; a formalized organizational structure and a lack of regulatory closed loop. Data shows that 73% of enterprises believe that input and output are mismatched, and 62% of industry-education integration institutions have low activity frequency.

3.2. System construction dimension

The curriculum content is seriously disconnected from the requirements of new industry regulations, and only 25% of colleges and universities have systematically incorporated the 2025 new standards into their curriculum system; the practical teaching links have both insufficient authenticity and standardization; the innovation of teaching methods is weak, with project-based teaching conducted less than 3 times per semester on average.

3.3. Ecology cultivation dimension

Double-qualified teachers are in short supply both in quantity and quality, with an average of only 4.2 qualified teachers per school, accounting for 31% of the total number of professional teachers; the school-enterprise cooperation culture shows superficial characteristics; the construction of resource sharing platforms is lagging behind, and only 1 college has established a fully functional digital sharing platform.

3.4. Evaluation innovation dimension

The evaluation subject is single, with enterprises accounting for only 35% of participation in the evaluation; the evaluation method is traditional, with insufficient ability orientation; the feedback and improvement mechanism is lacking, and only 28% of colleges and universities have established systematic alumni career development files.

3.5. Application transformation dimension

The combination of employment orientation and regional characteristics is not close; the talent training program lacks strong social service capacity, and only 2 colleges independently undertake off-campus Study Tour projects; innovative and entrepreneurial achievements are scarce, and Study Tour-related innovation awards account for only 7% of tourism projects.

4. Optimization path of the training mechanism based on the G-SEEA model

In response to the problems in the five dimensions found in the diagnosis, this study proposes the following systematic optimization paths based on the G-SEEA model, combined with the latest 2025 industry standards and successful experiences of local practices.

4.1. Strengthening the governance mechanism

Construct a four-helix governance community involving government, industry, enterprises and schools to promote all stakeholders to jointly establish a substantive industry-education integration council ^[14]. Establish a dynamic docking mechanism between new industry norms and teaching standards, and set up a “standard monitoring and transformation post” in the professional teaching and research offices of colleges and universities to ensure that the latest industry requirements are promptly integrated into the entire talent training process.

4.2. Reconstructing system construction

Promote modular curriculum reconstruction based on the Guidelines, and build a curriculum system featuring “basic sharing, directional division and extended mutual selection” [15]. Fully implement the “Study Tour Project Workshop” practical teaching system, and introduce real projects based on high-quality regional study tour resources. Deepen the reform of digital teaching, build a virtual simulation training platform, and integrate intelligent management tools into the entire teaching process.

4.3. Nurturing ecology cultivation

Implement the “double appointment and double post” system and the “industry mentor special appointment plan”, establishing a two-way flow mechanism between teachers and enterprise technical backbones. Build a “digital sharing platform for Study Tour resources”, integrating real enterprise cases and college teaching resources. Cultivate an industry-education integration culture, promoting the formation of consensus on school-enterprise values through regular teaching and research activities.

4.4. Innovating the evaluation mechanism

Introduce “dual customer” satisfaction evaluation, taking the evaluation of cooperative enterprises and service objects as important indicators. Implement a “competence badge” micro-certification system to conduct special certification for core competencies. Construct a data-driven evaluation and feedback mechanism, using learning

behavior data analysis to improve teaching.

4.5. Expanding application transformation

Promote the “teaching factory” operation of training bases, encouraging on-campus training bases to undertake real Study Tour projects. Deepen the “school-family-community collaboration” service model, developing customized Study Tour courses for primary and secondary schools in the region. Create characteristic, innovative and entrepreneurial brands, guiding students to carry out entrepreneurial practices around local cultural resources.

5. Case verification: Practical application of the G-SEEA model in Maoming Polytechnic

The tourism management major of Maoming Polytechnic has carried out systematic reform practices based on the G-SEEA model. In terms of governance mechanism, it has constructed a “government-enterprise-school-village” four-party collaborative governance structure and established an industry-education integration alliance. In terms of system construction, it has built a modular curriculum system integrating “posts-courses-competitions-certifications” and fully implemented the “Study Tour workshop” system teaching. In terms of ecology cultivation, it has innovated a “four-dimensional space” integrated teaching model and built a digital resource sharing platform. In terms of evaluation innovation, it has implemented a “five-in-one” digital intelligence evaluation system. In terms of application transformation, it has undertaken real projects relying on “Study Tour workshops” to serve rural revitalization.

After two years of practice, the targeted employment rate of graduates of this major in 2024 has increased by 25 percentage points, and the satisfaction of cooperative enterprises and service objects with interns has reached more than 90%, verifying the effectiveness of the G-SEEA model.

6. Conclusion

By constructing the G-SEEA model, this study systematically analyzes the training mechanism of students’ Study Tour guidance ability in tourism management majors. The research shows that the current training problems stem from the collaborative failure of five dimensions, requiring systematic reform paths. In the future, focus should be placed on directions such as in-depth integration of digital transformation, refinement and standardization of ability evaluation, and regionalization and characterization of training models, continuously improving the industry-education integration mechanism to provide talent support for the high-quality development of the industry.

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Research on the Application of Artificial Intelligence in Network Engineering Course Teaching

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Abstract: This study explores the effective application of artificial intelligence (AI) in network engineering course teaching to address the limitations of traditional teaching methods, meet students' personalized learning needs, and promote the teaching reform of network engineering courses. The research sorts out relevant theories and progress of AI in the field of education, combines the actual teaching situation of network engineering majors, and explores specific methods of integrating AI into teaching. The study finds that AI plays an important role in optimizing teaching model innovation and improving teaching effects, providing new ideas and directions for network engineering course teaching.

Keywords: Artificial intelligence; Network engineering; Teaching application; Teaching model; Teaching effect

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1. Introduction

The main problems currently faced in network engineering course teaching focus on three aspects: teaching content, teaching methods, and students' personalized learning needs. First, due to the rapid update and iteration of network technology, existing textbooks and course content often lag behind industrial development, resulting in students' professional knowledge being outdated^[1-3]. Second, the traditional classroom teaching model is too single, making it difficult to fully mobilize students' learning enthusiasm and initiative, especially in practical operations, where students lack sufficient guidance and support. Finally, there are significant differences in knowledge foundation, learning interests, and learning abilities among different students, but traditional teaching methods struggle to provide targeted teaching services based on these differences^[4]. The application of AI technology is expected to solve the above problems.

This study aims to explore the effective application model of AI technology in network engineering course teaching, with the goal of improving teaching quality and students' practical abilities, and providing new ideas and methods for the teaching reform of network engineering courses^[5]. Specifically, the research will focus on the following aspects: first, constructing an AI-based intelligent teaching resource recommendation mechanism

to provide students with personalized learning resources by analyzing their learning behaviors and interest preferences; second, developing an intelligent tutoring and Q&A system to provide students with real-time and efficient learning support using technologies such as natural language processing; third, designing an intelligent teaching evaluation system to help teachers adjust teaching strategies in a timely manner and improve teaching effects through automated evaluation indicators and real-time feedback mechanisms. Ultimately, this study expects to promote the innovation of the teaching model of network engineering courses through the application of AI technology, cultivate more high-quality talents with innovative capabilities and practical skills, and provide strong talent support for the development of the network engineering field.

2. Theoretical basis of artificial intelligence in the field of education

As a comprehensive discipline, the core theories of AI include machine learning, knowledge representation, natural language processing, etc., which provide a solid technical support for its application in the field of education. Machine learning analyzes and predicts data through algorithm models, generating personalized learning paths based on students' learning behaviors. Knowledge representation abstracts educational content into a structured knowledge system, facilitating the understanding and application of intelligent systems. Natural language processing technology is particularly widely used in education; for example, the design of virtual teaching assistants relies on semantic analysis technology to achieve accurate Q&A services. In the field of education, AI not only optimizes the allocation of teaching resources but also improves the intelligence level of the teaching process, laying a theoretical foundation for the innovation of the teaching model of network engineering courses.

In recent years, with the rapid development of AI technology, its application in the field of education has gradually deepened. Machine learning algorithms can extract effective information from a large amount of teaching data, helping teachers better understand students' learning needs and behavioral patterns. At the same time, knowledge representation technology provides the necessary knowledge reserve for the development of intelligent tutoring systems by constructing domain knowledge bases. The combination of these technologies enables the education system to provide customized learning support according to students' personalized characteristics, thereby significantly improving teaching effects^[6]. However, although AI has shown great potential in the field of education, its theoretical framework still needs further improvement, especially in terms of adaptability and robustness in complex educational scenarios^[7].

3. Current application status of artificial intelligence in network engineering course teaching

Currently, the application of AI in network engineering course teaching is mainly reflected in intelligent tutoring, teaching resource recommendation, and teaching evaluation. Intelligent tutoring systems, by combining natural language processing and machine learning technologies, can provide students with real-time Q&A services and personalized learning suggestions. For example, an intelligent tutoring system based on knowledge graphs can quickly locate relevant knowledge points according to students' questions and generate detailed solutions. In addition, teaching resource recommendation systems use big data analysis technology to model students' learning behaviors and interest preferences, thereby pushing suitable learning resources for network engineering courses, such as video tutorials, case studies, and experimental guidelines.

However, the application of AI in network engineering course teaching also faces many challenges. First, technical issues such as data security and algorithm accuracy directly affect the reliability and user experience of the system. In intelligent tutoring systems, if the accuracy of natural language processing algorithms is insufficient, it may lead to incorrect answers or failure to meet students' actual needs. Second, teachers face difficulties in applying AI technology and changing their teaching concepts, which limits the promotion and effect of AI technology. In addition, students' adaptability to new teaching methods is also an important issue; some students may feel pressured due to the high technical threshold for use, thereby affecting their learning enthusiasm. Therefore, while promoting the application of AI technology, it is necessary to comprehensively consider factors related to AI technology, teachers, and students to maximize its benefits in network engineering course teaching.

4. Application models of artificial intelligence in the network engineering course teaching

4.1. Intelligent teaching resource recommendation

With the rapid development of AI technology, the application of big data technology in the field of education has provided new possibilities for the recommendation of teaching resources in network engineering courses. By conducting multi-dimensional analysis of students' learning behaviors, interest preferences, and knowledge mastery, an accurate student profile can be constructed, providing a scientific basis for teaching resource recommendation^[8,9]. Specifically, big data technology can collect students' operation records on online learning platforms, including data such as video watching duration, after-class exercise completion, and forum interaction frequency, and conduct in-depth processing of this information through data mining algorithms. Combined with the characteristics of network engineering courses, data analysis can also be carried out for specific links, such as experimental operations and project practice, to optimize the pertinence and effectiveness of resource allocation.

4.2. Intelligent tutoring and Q&A

As an important application of AI technology in the field of education, virtual teaching assistants provide students with real-time Q&A services using technologies such as natural language processing and knowledge graphs. In network engineering course teaching, virtual teaching assistants can quickly retrieve the knowledge base and generate accurate answers by parsing students' questions. When students ask about the working principle of routing protocols, the virtual teaching assistant can extract relevant information based on the built-in knowledge graph and explain it in clear and understandable language. In addition, virtual teaching assistants also have learning capabilities; they can gradually improve their own knowledge system by continuously accumulating common questions from students and their answers, thereby improving the accuracy and efficiency of Q&A. This intelligent Q&A method not only reduces the workload of teachers but also provides more convenient learning support for students^[10].

4.3. Intelligent teaching evaluation

In network engineering course teaching, constructing a scientific and reasonable automated evaluation indicator system is a key step in realizing intelligent teaching evaluation. This system includes multiple dimensions, such as knowledge mastery, practical ability, and comprehensive quality, to ensure the comprehensiveness and objectivity of evaluation results. For example, in terms of knowledge mastery, students' understanding

of theoretical knowledge is evaluated through data such as online tests and homework completion; in terms of practical ability, students' hands-on ability and problem-solving ability are measured through quantitative indicators such as experimental reports and project results ^[11]. In addition, combined with AI technology, machine learning algorithms are introduced to conduct in-depth analysis of evaluation data, identify students' weak links in learning, and provide them with targeted improvement suggestions. This multi-dimensional evaluation method not only improves the accuracy of evaluation but also provides important references for teaching improvement.

5. The impact of artificial intelligence application on network engineering course teaching

5.1. Impact on students' learning effects

The application of AI technology in network engineering course teaching has a significant impact on students' learning effects, specifically reflected in aspects such as knowledge mastery, practical operation ability, and learning interest. First, in terms of knowledge mastery, AI technology provides students with more accurate learning support through intelligent tutoring systems and personalized resource recommendation mechanisms. Studies have shown that student behavior modeling based on big data analysis can accurately identify students' learning difficulties and provide them with targeted learning resources, thereby helping students master complex knowledge points more efficiently ^[12].

Second, in terms of practical operation ability, virtual laboratories and simulation systems supported by AI technology provide students with rich practical opportunities. These tools can not only simulate real network environments but also provide real-time feedback based on students' operation performance, helping students identify and correct errors in a timely manner. Data comparison shows that students using AI-assisted teaching generally achieve higher scores in practical operation assessments than those in the traditional teaching group, indicating that AI technology has significant advantages in improving students' practical abilities.

5.2. Transformation of teachers' roles

The widespread application of AI technology has promoted the transformation of network engineering course teachers from traditional knowledge imparters to learning guides and course designers. In the traditional teaching model, teachers are responsible for explaining and imparting knowledge; however, in an AI-assisted teaching environment, teachers play more of the role of guides and coordinators in the students' learning process. Intelligent tutoring systems and automated evaluation tools can undertake some teaching tasks, such as answering questions and correcting homework, thereby reducing teachers' workload and allowing them to invest more energy in teaching design and personalized guidance. This role transformation not only improves teaching efficiency but also promotes the further development of teachers' professional abilities ^[13].

In addition, the application of AI technology also requires teachers to have stronger course design and resource integration capabilities. In network engineering course teaching, teachers need to design course content that meets the requirements of the times based on students' learning needs and technological development trends. For example, the construction of network space security courses combined with AI technology requires teachers to be proficient in relevant knowledge fields and integrate them into teaching design. At the same time, teachers also need to cooperate closely with technical personnel to develop intelligent teaching tools and platforms to support the smooth development of teaching activities. This interdisciplinary cooperation model not only expands teachers' teaching horizons but also provides them with more career development opportunities. Therefore,

the introduction of AI technology has not only changed the role positioning of teachers but also promoted the updating and upgrading of educational and teaching concepts.

6. Challenges and countermeasures of artificial intelligence application in the network engineering course teaching

6.1. Challenges at the teacher level

In the process of AI technology gradually integrating into network engineering course teaching, teachers face various challenges. First, the insufficient technical application capabilities of teachers have become one of the main obstacles. Many teachers have a limited understanding of AI technology and struggle to proficiently master the operation methods of intelligent teaching tools, which directly affects the effective implementation of AI technology in teaching. Second, changing teaching concepts is also a major difficulty. Under the traditional teaching model, teachers usually play the role of knowledge imparters; however, in AI-assisted teaching, teachers need to transform into learning guides and course designers. This transformation requires teachers to reposition their responsibilities and adjust teaching strategies^[14]. To help teachers overcome these difficulties, systematic training and development strategies should be adopted.

6.2. Challenges at the student level

Students also face a series of challenges when adapting to a network engineering course teaching supported by AI technology. First, the new teaching methods may make students feel uncomfortable. For example, the personalized learning paths and automated evaluation feedback mechanisms provided by intelligent teaching platforms can improve learning efficiency, but they also require students to have strong autonomous learning abilities. For students accustomed to traditional classroom teaching, this transformation may bring certain learning pressure. Second, the application of AI technology may lead some students to over-reliance on technology, neglecting the solid mastery of basic knowledge and the cultivation of practical abilities.

7. Conclusion

This study focuses on the application of AI in network engineering course teaching and explores its key role in optimizing teaching models and improving teaching effects^[15]. Through systematic analysis of models such as intelligent teaching resource recommendation, intelligent tutoring and Q&A, and intelligent teaching evaluation, the broad application potential of AI technology in the field of education is revealed. In terms of intelligent teaching resource recommendation, the student behavior analysis and personalized resource recommendation mechanism based on big data have significantly improved the adaptability and utilization efficiency of learning resources. The function realization of virtual teaching assistants and the planning of personalized learning paths provide more accurate support for students in network engineering courses, effectively meeting their diverse learning needs. In addition, the construction of automated evaluation indicators and real-time feedback mechanisms not only improves the scientificity of teaching evaluation but also provides an important basis for teachers to adjust teaching strategies. These research results show that the application of AI technology can significantly improve the shortcomings of traditional network engineering course teaching, thereby promoting the improvement of teaching quality.

Disclosure statement

The author declares no conflict of interest.

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Design and Practical Exploration of Curriculum Ideological and Political Education: Taking the Course “CNC Machining Technology and Programming” as an Example

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Abstract: Aiming at the course “CNC Machining Technology and Programming”, this paper conducts teaching reform and exploration based on ideological and political elements and virtual simulation practice. First, it analyzes the importance of introducing curriculum ideological and political education into this course. Second, it studies the organic integration of various ideological and political elements with professional knowledge points of CNC machining. Then, it designs teaching models including blended teaching, diverse teaching methods, innovative teaching content, and multi-dimensional curriculum resources based on curriculum ideological and political education. Furthermore, it continuously improves the practical simulation cases of integrating curriculum, ideological and political education with professional knowledge in each phase. Finally, it summarizes the course implementation effects.

Keywords: CNC machining technology and programming; Ideological and political elements; Virtual simulation practice

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1. The importance of implementing curriculum, ideological and political education

Curriculum ideological and political education is a beneficial exploration to realize “full-process education and all-round education”^[1]. Exploring ideological and political elements is a key link to promote the teaching practice of curriculum ideological and political education and deepen the integration of knowledge implementation and value guidance. In recent years, many scholars have conducted in-depth research on the exploration of ideological and political elements, providing rich theoretical and practical guidance for promoting the construction of curriculum ideological and political education. Document^[2] points out that ideological and political elements should be explored from aspects such as innovation-driven development, coordinated development, green development, and open development. Document^[3] combines the characteristics of mechanical majors to construct a four-level moral education element library covering spirit and feelings, technology and innovation,

history and culture, and mechanical artistic beauty. Document^[4] explores the integration of ideological and political elements into courses, forming a “trinity” education model involving schools, society, and families. Document^[5] constructs a curriculum ideological and political system under the background of “new normal education”. Document^[6] explores curriculum, ideological and political education in CNC manual programming under the blended teaching model. Documents^[7–9] explore ideological and political education in CNC training courses. Document^[10] discusses the production method of micro-courses integrating “curriculum ideological and political” elements. Documents^[11–14] conduct detailed exploration and research on ideological and political elements in CNC machining and CNC technology-related courses. The integration of ideological and political elements into classrooms is an important way to implement fostering virtue through education, all-round education, and correctly guide young people. It not only ensures that students learn professional knowledge but also cultivates comprehensive developers who can contribute to social progress. Therefore, as an important professional education course for mechanical majors, “CNC Machining Technology and Programming” is not only responsible for cultivating professionals with excellent skills for China’s intelligent manufacturing but also for nurturing individuals who can drive social development.

2. Ideological and political content of the course “CNC Machining Technology and Programming”

The course “CNC Machining Technology and Programming” is a professional course closely linking theory and practice for manufacturing majors. It mainly studies technical issues in the machining process and applied technologies of CNC programming, featuring a high integration of theoretical knowledge and practical skills^[15]. The course aims to improve students’ professional skills and quality, focusing on cultivating their comprehensive practical abilities. It takes the establishment of a knowledge system, the cultivation of quality, and the improvement of practical operation ability as the core, comprehensively cultivating students’ abilities to pursue truth, understand reality, and distinguish principles. The course covers a wide range of content and contains abundant exploitable ideological and political elements. The organic integration of professional knowledge and ideological and political elements is an urgent problem to be solved.

The course is generally taught to junior undergraduate students majoring in mechanical manufacturing. It plays an important enlightening role in helping young students who are about to enter society establish correct outlooks on life and values. In the teaching process, adhering to the teaching concept of fostering virtue through education, we organically combine professional knowledge with curriculum, ideological and political education. In the teaching of professional knowledge, we focus on ideals and beliefs, patriotic feelings, moral cultivation, knowledge breadth, craftsmanship spirit, and comprehensive quality, naturally integrating ideological and political elements, and integrating ideological and political work into the entire process of education and teaching. This stimulates students’ patriotic awareness and sense of responsibility, guides them to establish correct outlooks on life and values, and realizes the equal emphasis on teaching and education. The overall design of ideological and political elements in the course “CNC Machining Technology and Programming” is shown in **Figure 1**. Similar ideological and political elements can not only be applied to this course but also to other related courses in mechanical majors.

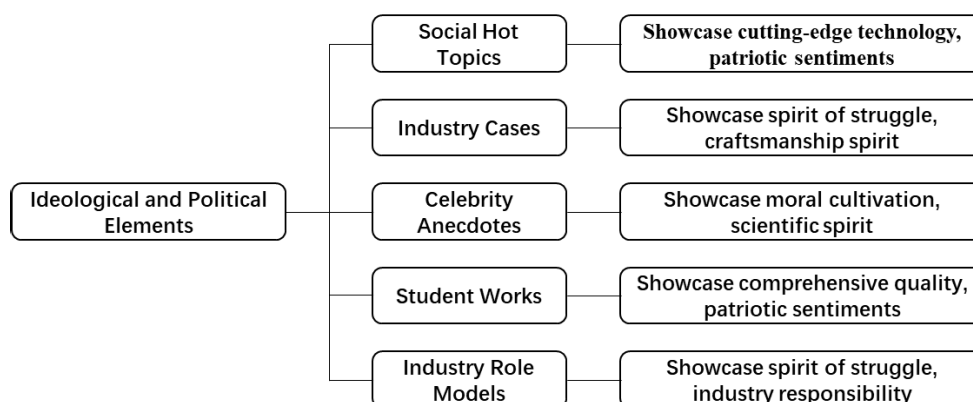


Figure 1. Ideological and political elements of the course “CNC Machining Technology and Programming.”

Targeting junior undergraduate students majoring in mechanical manufacturing, this paper designs various ways to integrate ideological and political elements with course knowledge points, enabling students to receive ideological and political education while learning professional knowledge. The specific implementation methods are as follows.

2.1. Introduction of social hot topics

The course “CNC Machining Technology and Programming” includes content such as G-code programming, cavity machining technology and programming, and hole machining technology and programming. This knowledge is closely related to various machines and CNC-machined parts in the manufacturing industry. Introducing professional knowledge through social hot topics can not only help students care about current affairs but also show the strength of the motherland and stimulate their patriotic enthusiasm. For example, when explaining G-code programming, we introduce the hot news of the successful first flight of the Long March 5B carrier rocket, and link the 3D printer launched with it to the knowledge being explained. This not only increases students’ learning interest but also shows the vigorous development of China’s aerospace industry, enriches their knowledge, and stimulates their patriotic feelings.

2.2. Introduction of industry cases

The course “CNC Machining Technology and Programming” is closely linked to engineering practice, and knowledge related to CNC machining is used in various industries related to manufacturing. Introducing relevant industry cases into the course can not only arouse students’ interest in listening but also convey the spirit of self-improvement, unremitting struggle, and rigorous research craftsmanship. For example, when explaining thread machining on CNC lathes, we introduce the case of Peng Fangzhao, a post-90s engineer from Foshan. After more than 4 years of research, he developed a 7-axis 5-linkage machine tool to process high-precision screws for dental implants, filling the gap in the clinical application of domestic dental implants. This allows students to understand the wide application fields and technical frontiers of screws, and guides them to experience the spirit of struggle and craftsmanship.

2.3. Introduction of celebrity anecdotes

The course “CNC Machining Technology and Programming” includes basic knowledge, such as an overview of CNC programming and CNC machine tool coordinate systems. Behind this knowledge are stories of some

scientists, which can not only create a relaxed learning atmosphere but also enrich students' knowledge, convey the scientists' persistent exploration spirit and perseverance, and guide students to establish a scientific spirit of thinking and a tenacious will to overcome difficulties. For example, when explaining the coordinate system on CNC machine tools, we introduce the story of the great mathematician and philosopher Descartes discovering the coordinate system. He pondered hard even when he was ill in bed, which not only eliminates students' sense of strangeness in learning machine tool coordinate systems but also attracts their attention and guides them to develop a scientific spirit of thinking.

2.4. Introduction of student works

To better reflect the status of “student-centered” and “teacher-led” and cultivate students' comprehensive abilities, for content such as coordinate transformation function instructions, process analysis and programming of typical parts on CNC lathes, and process analysis and programming of typical parts in CNC milling, we introduce students' design works, which not only enhance their comprehensive quality but also cultivate their innovative thinking. For example, when explaining coordinate transformation function instructions, we start by displaying students' design works of anti-epidemic line diagrams using basic G-codes, and select works related to scaling, mirroring, and rotation to introduce the teaching theme. This not only cultivates students' design ability and innovative thinking but also enhances their patriotic feelings.

2.5. Introduction of industry models

Combining national craftsmen and industry models related to the knowledge points of CNC machining technology and programming with relevant course knowledge points, we use the deeds of typical figures to show the contemporary craftsmanship spirit, set examples for students, and thus cultivate their excellent qualities of fearlessness of difficulties, striving for progress, and pursuing excellence, guiding them to establish correct worldviews, outlooks on life, and values. For example, when explaining the machining technology and programming of holes, we introduce Yang Feng, a national craftsman specializing in drilling key components of aero-engines. This not only allows students to understand the application fields and importance of holes but also shows the contemporary craftsmanship spirit through the craftsman's experience of forgetting food and sleep and diligent research. At the same time, the application of holes in cutting-edge technology fields enhances students' interest in listening and national pride.

3. Teaching design of “CNC Machining Technology and Programming” based on curriculum ideological and political education

On the basis of introducing ideological and political elements, this course also conducts some explorations in teaching models, teaching methods, teaching content, and teaching resources.

3.1. Blended teaching model

Adopting an online-offline blended teaching model of “MOOC resources + Rain Classroom”, combining the characteristics of the course, following the guiding ideology of teachers leading the learning process and students participating as the main body, we use the method of “MOOC learning + Rain Classroom testing + group reporting” to guide learners' learning from shallow to deep towards in-depth learning.

3.2. Diverse teaching methods

In addition to traditional classroom teaching, this course adopts task-driven teaching, case-based teaching, Yulong CNC software simulation, and other methods to cultivate students' abilities to think, analyze, and solve problems; it guides and encourages students to acquire knowledge through practice, and increases teaching links such as discussion classes, Q&A, and questioning.

3.3. Innovative teaching content

Within the scope of the teaching syllabus, we introduce students' design works, comprehensive training physical works, and graduation design processing works as programming objects, analyze the CNC machining process of these parts, and compile programs to cultivate students' thinking of applying what they have learned. For example, when explaining the machining technology and programming of machining centers, we introduce students' comprehensive training parts as programming objects, which not only enhances students' interest but also lays the foundation for subsequent comprehensive training courses. At the same time, guiding students' learning for the purpose of application can improve their engineering awareness and guide them to pay attention to the connection between design and processing.

3.4. Multi-dimensional curriculum resources

Enrich the course with resources such as traditional textbooks, China University MOOCs, professional websites, relevant WeChat public accounts, and typical student assignments. For example, match the knowledge points of each chapter with resources on China University MOOCs and send them to students for preview before class; push WeChat public accounts such as CNC China Forum and Frontiers of Mechanical Automation to expand students' knowledge.

4. Practical simulation cases of integrating curriculum, ideological and political education with professional knowledge

Combining the current situation of national prosperity and patriotic education, we assign virtual simulation practice course designs of basic G-codes. The topics are updated according to current events each phase. The assignment content is gradually improved from design drawings at the beginning to adding editing programs and Yulong simulation video display later. The continuously improved assignment settings not only allow students to apply what they have learned but also stimulate their patriotic feelings and national pride.

4.1. Phase 1: Simulation practice course design

Design a line diagram showing national prosperity and strength using straight lines and arcs, and simulate it in Yulong simulation software. This not only tests students' mastery of basic programming instructions but also stimulates their sense of pride in the motherland's strength.

4.2. Phase 2: Simulation practice course design

Design a line diagram showing patriotic education using straight lines and arcs, and simulate it in Yulong simulation software. This not only tests students' mastery of professional knowledge but also stimulates their patriotic feelings.

4.3. Phase 3: Simulation practice course design

Design line diagrams that can show Guangdong characteristics, regional characteristics, aerospace, Winter Olympics, etc., using straight lines and arcs, and simulate them in Yulong simulation software. The open topic design allows students to use their imagination, and while mastering professional knowledge, guides them to care about national affairs, regional characteristics, cutting-edge technology, etc.

The continuously improved practical simulation design not only introduces ideological and political elements in an open way to guide students' innovation but also enables students to deeply master key knowledge points such as basic G-code programming, CNC program structure, and the application of Yulong simulation software, experience the fun of learning, and enhance knowledge visualization. Taking the second phase of patriotic education design as an example (**Figure 2**), the corresponding programs submitted by students are not only grammatically correct but also have detailed explanations for each program segment, truly understanding and mastering the essence of CNC programming.

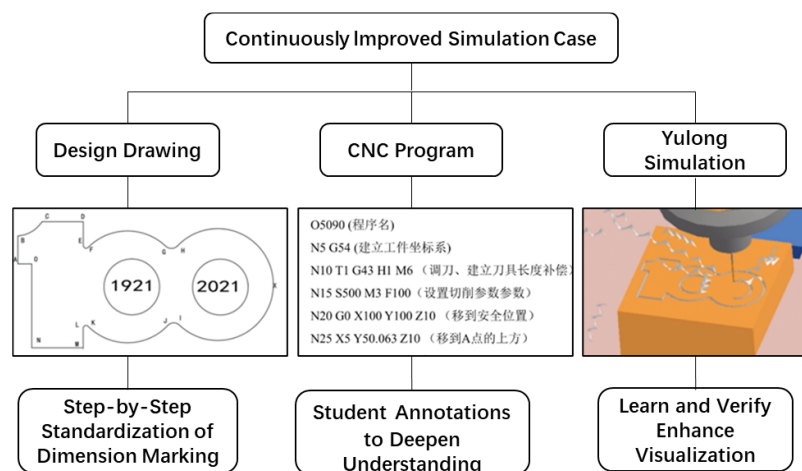


Figure 2. Virtual practice simulation design assignment integrating curriculum, ideological and political education with professional knowledge.

5. Conclusion

Integrating ideological and political elements into the online-offline blended classroom of "CNC Machining Technology and Programming" is an important way to realize full-process education and all-round education. Introducing professional knowledge through social hot topics can guide students to care about current affairs, enhance national self-confidence, and stimulate patriotic enthusiasm; through industry cases and industry models, it conveys to students the spirit of unrelenting struggle and rigorous research craftsmanship; through celebrity anecdotes, it encourages students to establish a scientific spirit of diligent thinking and daring to innovate; through student works, it trains students' comprehensive quality and innovative thinking. Ultimately, it promotes intelligent manufacturing, realizes China's transformation from a manufacturing power to a manufacturing powerhouse, and cultivates versatile talents with both moral integrity and professional competence in the new era.

In the practice of curriculum ideological and political education, integrating knowledge points in CNC machining technology and programming with ideological and political elements through various entry points in terms of teaching models, teaching methods, teaching content, and teaching resources not only enables students

to learn professional knowledge but also receives moral education, enlivens the classroom and increases interest, enriches teaching links and improves teaching effects.

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Research on the Cultivation Path of Innovative Talents in Jilin Universities Under the Background of New-Quality Productive Forces

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Abstract: New-quality productive forces are the new driving force for production in the digital economy era, and innovation is the key element for the development of new-quality productive forces. As an important position for cultivating innovative talents, universities are faced with the important task of vigorously cultivating talents adapted to new-quality productive forces, deepening the reform and development of higher education models, and serving regional economic development. Combined with the needs of emerging industries in Jilin Province, this paper analyzes the value logic of cultivating innovative talents in universities, and constructs and explores a “three-dimensional and five-chain” cultivation path for innovative talents around five dimensions: professional construction, curriculum setting, practice platforms, teaching staff, and evaluation mechanisms. It provides a reference for promoting the cultivation of innovative talents in Jilin and the high-quality economic development.

Keywords: New-quality productive forces; Universities; Innovative talents; Cultivation; Path

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1. Introduction

New-quality productive forces refer to the advanced productive forces in the contemporary era, driven by scientific and technological innovation, led by industrial innovation, and spawned by revolutionary technological breakthroughs, innovative allocation of production factors, and in-depth transformation and upgrading of industries. As an important part of the traditional industrial base in Northeast China, Jilin Province has a large proportion of traditional industries and relatively few emerging industries. The demand for talent in emerging industries is insufficient, while the demand for talent in traditional industries is overly concentrated, leading to an imbalance between talent supply and demand ^[1]. Under the background of new-quality productive forces, Jilin Province has ushered in an opportunity for comprehensive revitalization and high-quality development. Scientific and technological innovation is promoting the adjustment and transformation and upgrading of Jilin's industrial structure. The promotion and application of cutting-edge technologies have spawned new

industries, new models, and new driving forces, and the demand for high-quality innovative talents has increased accordingly. There is a serious shortage of high-end talent in fields such as high-tech industries and strategic emerging industries ^[2]. However, at present, the talent training in Jilin's universities is disconnected from the needs of industrial transformation. The setting of professional courses often lags behind the development of industrial transformation, lacking new technologies and processes. Curriculum teaching focuses on theoretical instruction, with insufficient connection to industrial post content, and insufficient attention to the cultivation of students' innovative ability and digital literacy, resulting in graduates being unable to meet the new requirements of provincial industrial posts ^[3].

2. Value logic of cultivating innovative talents in universities under the background of new-quality productive forces

2.1. Industry demand traction logic: rigid demand for talent structure in regional transformation

2.1.1. Core characteristics of new-quality productive forces determine talent demand orientation

New-quality productive forces are driven by scientific and technological innovation, showing the essential characteristics of high-tech integration, high-efficiency transformation, and high-quality output. This characteristic requires talents to have interdisciplinary knowledge integration capabilities and technological achievement transformation literacy, which can adapt to the dynamic needs of technological iteration and industrial upgrading ^[4]. In the process of digital and intelligent transformation of traditional industries and cultivation of emerging industries in Jilin, talent supply needs to leap from the traditional technical application level to the innovation-led level, break through the bottleneck of single skill-oriented talent training, and build a talent capability system in line with the development of new-quality productive forces.

2.1.2. Imbalance between supply and demand forces the reform of training models

There is a significant talent supply gap in the field of regional strategic emerging industries, and the contradiction between supply and demand for high-end R&D positions is prominent. The traditional professional talent training system is disconnected from the actual needs of the industry, making it difficult to meet the talent quality requirements for the development of new-quality productive forces ^[5]. The new occupational forms spawned by new-quality productive forces have broken traditional disciplinary boundaries, requiring universities to reconstruct the talent knowledge system, break disciplinary barriers, and establish a training framework that can cover multi-field knowledge and adapt to new occupational needs.

2.2. University mission undertaking logic: Core carrier of the integration of education, science and technology, and talents

2.2.1. Inevitable requirement for implementing national strategies

Practicing the strategic orientation of “science and technology are the primary productive forces, talents are the primary resource, and innovation is the primary driving force”, universities, as the main position for talent training, need to assume the responsibility of supplying talents needed for the development of new-quality productive forces, and build a talent training system compatible with national strategies ^[6]. Responding to the regional comprehensive revitalization strategy, solving the talent shortage in regional development through independent talent training, providing continuous talent support for the construction of a regional modern

industrial system, and promoting the formation of positive interaction between regional economic and social development and talent training.

2.2.2. Endogenous driving force for the development of universities themselves

New-quality productive forces provide a transformation opportunity for the discipline construction of universities, promoting traditional disciplines to extend to emerging interdisciplinary fields, promoting in-depth connection between discipline directions and regional industrial development needs, and realizing the iterative upgrading and characteristic development of discipline construction^[7]. By building a training model integrating “industrial chain-innovation chain-talent chain-education chain”, universities can achieve the same frequency resonance between talent training and regional development, strengthen their functional positioning of serving the region, and form differentiated school-running advantages.

2.3. Talent growth adaptation logic: Precise connection between competencies and era requirements

2.3.1. Adaptability of core competency dimensions

In terms of innovative ability, it is necessary to break through traditional thinking patterns, possess original research capabilities and disruptive technological research potential, and be able to carry out exploratory work in cutting-edge technological fields to provide innovative momentum for the development of new-quality productive forces^[8]. In terms of comprehensive literacy, it is necessary to integrate professional and technical knowledge, digital technology application capabilities, and industrial cognitive levels to form cross-field knowledge integration capabilities, adapting to the development scenarios of multi-technical integration and multi-format collaboration under new-quality productive forces. In terms of practical ability, it is necessary to master the whole-chain transformation skills from laboratory technology R&D to industrial practical application, adapt to the working model supported by projects and platforms, and realize the efficient landing of technological achievements.

2.3.2. Consistency with growth laws

The cultivation of talents for new-quality productive forces needs to follow the phased growth path of “laying a solid foundation - practical training - innovative breakthrough”, and build a phased and progressive training system to ensure that talent capabilities keep pace with the development needs of new-quality productive forces. As the core subject of innovative activities, young college students have a high degree of compatibility between their learning ability, adaptability, and innovative potential and the characteristics of rapid technological iteration of new-quality productive forces, and are the core talent reserve force for the development of new-quality productive forces.

3. “Three-dimensional and five-chain” cultivation path for innovative talents in Jilin Universities

3.1. Discipline and professional optimization: building an industrial-oriented discipline ecosystem

3.1.1. Key disciplines accurately connect to strategic industries

Facing the intelligent transformation needs of traditional advantageous industries in the region, adjust discipline

directions, strengthen knowledge modules and ability training content compatible with industrial upgrading; focus on the upgrading needs of modern agriculture, build characteristic disciplines serving agricultural modernization; layout future industrial fields, cultivate emerging disciplines facing technological frontiers and new industrial tracks, forming a discipline system covering traditional industrial transformation, emerging industrial cultivation, and future industrial layout^[9].

3.1.2. Interdisciplinary disciplines break through traditional barriers

Establish interdisciplinary colleges or research institutions across colleges, integrate resources from different disciplinary fields, break traditional disciplinary boundaries, and build a multi-disciplinary collaborative talent training platform; set up interdisciplinary degree programs, implement a system combining major-minor enrollment and micro-certificates, and cultivate compound talents with interdisciplinary knowledge backgrounds to adapt to the needs of multi-technical integration under new-quality productive forces.

3.1.3. Construction of dynamic adjustment mechanism

Establish a closed-loop feedback mechanism of “industrial demand - discipline setting - talent output”, conduct regular professional evaluations, and adjust discipline directions and professional settings according to the dynamic development of the industry; dynamically update professional training content with reference to the technical needs of innovative enterprises in the region to ensure that disciplines and professions keep pace with industrial development.

3.2. Curriculum system reconstruction: Consolidating the knowledge foundation for innovative capabilities

3.2.1. Modular design of core courses

- (1) Technical foundation module: Strengthen the teaching of general cutting-edge technologies such as digital technology and intelligent technology, and build a basic curriculum system covering the core technical fields of new-quality productive forces to lay the foundation for talents’ technical application capabilities.
- (2) Industrial application module: Embed cases and practical content of the development of key regional industries to help students understand actual industrial needs, improve technical application and industrial adaptation capabilities, and realize the connection between knowledge learning and industrial practice.
- (3) Innovative thinking module: Offer courses such as critical thinking, design thinking, and scientific and technological ethics to cultivate students’ innovative awareness and thinking abilities, and guide students to form an innovative cognitive framework in line with the development of new-quality productive forces.

3.2.2. Upgrading of practical curriculum system

- (1) Basic practice level: Build an integrated practice platform of “virtual simulation + basic experiments” to cover the training needs of core professional skills, and improve students’ basic operational capabilities and technical cognitive levels through simulated practice scenarios.
- (2) Comprehensive practice level: Implement project-based teaching models, transform actual industrial technical problems into curriculum practice projects, and guide students to solve complex problems in a

team collaboration manner to improve comprehensive application capabilities^[10].

- (3) Innovative practice level: Establish scientific research training programs to support students to participate in high-level scientific research projects, cultivate students' scientific research literacy and innovative practical capabilities, and accumulate experience for subsequent innovative activities.

3.2.3. Integration of innovation and entrepreneurship courses

Offer innovation and entrepreneurship courses compatible with the development of new-quality productive forces, connect with regional entrepreneurship support policies and resources, help students understand the entrepreneurial environment and policy orientation, and master basic innovation and entrepreneurship methods. Build a connection chain of “curriculum teaching - competition practice - project incubation”, take various innovation competitions as carriers to cultivate innovative projects with market potential, and promote the transformation of innovation and entrepreneurship capabilities into actual results.

3.3. Practice platform construction: Building a carrier for industry-university-research collaborative talent training

3.3.1. Open sharing of on-campus innovation platforms

Promote the full opening of high-level scientific research platforms in universities to students, set up independent practice spaces for students, provide opportunities to access cutting-edge technologies and scientific research resources, and support students to carry out independent innovative practice activities. Build innovative practice workshops adapted to the development of new-quality productive forces, equipped with cutting-edge technical equipment and tools, to provide hardware support for students' technical R&D and project practice, and create an independent innovative practice environment.

3.3.2. In-depth integration of school-enterprise cooperation

Co-build industrial colleges, implement a training model in which schools and enterprises jointly formulate training programs and participate in the teaching process, integrate enterprise resources and industrial needs into the entire talent training process, and realize the precise connection between talent training and enterprise needs. Build industry-education integration training bases, implement apprenticeship training models, allow students to deeply participate in enterprise production practice, and improve practical capabilities and professional literacy in real industrial scenarios. Implement a “demand-achievement-transformation” linkage mechanism, establish a docking channel for technical needs and scientific and technological achievements between universities and enterprises, promote the transformation of university scientific and technological achievements to the industry, and at the same time transform enterprise technical needs into practical content of talent training.

3.3.3. School-Local Collaborative Innovation Network

Participate in regional “government-enterprise-school” collaborative research projects, jointly carry out research on key industrial technologies, allow students to participate in actual scientific research and tackle processes, improve the ability to solve actual industrial problems, and promote the in-depth integration of talent training and regional innovative development^[11]. Co-build innovation and incubation bases with innovation parks and industrial demonstration zones in the region, provide venues, resources, and guidance support for students' innovative projects, promote the industrialization of students' innovative achievements, and form a school-local collaborative innovative talent training ecosystem.

3.4. Teaching staff construction: Cultivating a “Dual-qualified and dual-capable” teaching team

3.4.1. Teacher capacity improvement project

Implement the teacher industrial practice plan, requiring professional teachers to regularly carry out practical training in the industrial front line, accumulate industrial experience, integrate actual industrial cases and technical dynamics into the teaching process, and improve the industrial adaptability of teaching content^[12]. Carry out special training related to new-quality productive forces, covering cutting-edge technical knowledge, innovative teaching methods, etc., invite industry experts to participate in training and teaching, help teachers update their knowledge systems, and master teaching methods suitable for the cultivation of talents for new-quality productive forces.

3.4.2. Innovation of talent introduction and training mechanisms

Set up industrial professor positions, hire technical backbones and leading talents in the industry to teach part-time, introduce cutting-edge industrial technologies and practical experience into the classroom, and make up for the shortage of industrial practice capabilities of university teachers. Cultivate young teacher innovation teams, support young teachers to carry out scientific research projects jointly with enterprises through special plans, improve young teachers' scientific research and innovation capabilities and industrial service capabilities, and build a teaching team with a reasonable structure and outstanding capabilities.

3.4.3. Reform of evaluation and incentive systems

Establish a three-dimensional evaluation system of “teaching quality + scientific research achievements + industrial services”, incorporate school-enterprise cooperation achievements, talent training quality, and industrial service contributions into teacher assessment content, and guide teachers to focus on the cultivation of talents for new-quality productive forces and industrial services^[13]. Give preferential treatment in professional title evaluation and selection to teachers who have made outstanding contributions in regional industrial services and talent training, and set up special rewards to stimulate teachers' enthusiasm and initiative in participating in the cultivation of talents for new-quality productive forces.

3.5. Evaluation mechanism reform: Establishing an innovation-oriented evaluation benchmark

3.5.1. Optimization of student evaluation system

Break the “score-only” evaluation tendency, build a trinity evaluation system of “knowledge mastery + skill improvement + innovative achievements”, incorporate students' innovative achievements into the scope of credit recognition, and recognize students' innovative contributions in technical R&D and project practice. Establish a dynamic tracking mechanism for student growth, record the development process of students' innovative ability and practical ability through growth files, and realize the whole-process and personalized evaluation of students' training process. Introduce enterprise evaluation subjects, allow enterprises to participate in the assessment of students' internships and training and the evaluation of graduation achievements, ensure that the evaluation results are consistent with actual industrial needs, and improve the pertinence of talent training^[14].

3.5.2. Improvement of teaching evaluation mechanisms

Construct a professional teaching quality evaluation system with “industrial adaptability” and “innovation output

rate” as core indicators, regularly evaluate the adaptability of professional training programs and teaching content to the development of new-quality productive forces, and promote the continuous improvement of teaching quality. Implement third-party evaluation of teaching effects, entrust industry associations and professional evaluation institutions to conduct talent training quality research, objectively evaluate teaching effectiveness from a third-party perspective, and provide a reference for teaching reform^[15].

3.5.3. Adjustment of scientific research evaluation orientation

Encourage “organized scientific research”, guide university scientific research to focus on technical pain points and bottleneck problems in regional industrial development, carry out applied and transformative research, and promote scientific research achievements to serve regional industrial upgrading. Strengthen the evaluation of scientific research education effectiveness, incorporate teachers’ achievements in guiding students to carry out innovative practice and cultivating students’ scientific research capabilities into scientific research assessment, promote the in-depth integration of scientific research and talent training, and realize the value of scientific research education.

4. Conclusion

In summary, the cultivation of innovative talents in Jilin universities under the leadership of new-quality productive forces is essential to realize a positive cycle of “industrial demand traction - talent supply adaptation - innovation-driven development”. Through the construction of the internal logic of industrial demand orientation, clarify the core direction and value positioning of talent training; rely on the five implementation paths of “discipline optimization, curriculum reconstruction, platform construction, teacher team building, and evaluation reform” to form a comprehensive and systematic talent training system. Universities need to base themselves on the characteristics of regional industrial development, integrate the innovative genes of new-quality productive forces into the entire process of talent training, provide solid talent support for the comprehensive revitalization of the region, and at the same time provide a reference theoretical framework and practical paradigm for the talent training transformation of universities in similar regions.

Disclosure statement

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Exploration of Practical Teaching Reform for Marketing Training Course in the Digital Context

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Abstract: Taking the practical course Marketing Training for marketing majors as the research object, this paper explores how to reform practical teaching courses in the context of educational digitalization. Through analyzing the current situation of practical teaching, it identifies four key challenges: difficulties in integrating theory with practice, applying theoretical knowledge, expanding learning outcomes, and transforming professional knowledge into practical abilities. A teaching design is proposed from four dimensions, “learning theory, practicing skills, competing for achievements, and cultivating literacy,” along with corresponding solutions.

Keywords: Digitalization; Marketing training; Practical teaching

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1. Research status

Amid the wave of information technologies such as big data, the Internet of Things, artificial intelligence, and virtual reality, the development and evolution of large-scale, sustainable, and interactive virtual spaces have become a highlight of the informatization transformation of practical teaching in higher education. Li Hong from Chongqing Technology and Business University built an integrated teaching platform featuring “O2O collaboration + process simulation” using the Internet + cloud computing + big data, constructing an experimental teaching system of “core competency orientation + professional group-led entrepreneurial chain simulation” to expand the boundaries of “economic management virtual simulation experiments” and enrich the virtual simulation experimental teaching system for economic management^[1]. Cheng Peiyan from Shanxi University of Finance and Economics proposed a “practice-simulation-practice” approach for entrepreneurship simulation training, integrating entrepreneurial simulation training and practical training, which not only stimulates students’ learning interest but also cultivates the knowledge, abilities, and literacy required for entrepreneurial practice^[2]. Wang Na from Huaqiao University argued that virtual simulation experimental teaching for economics and management majors should aim to develop students’ sustainable comprehensive knowledge, thinking, and abilities, constructing an integrated teaching system for knowledge implementation and quality cultivation^[3].

Currently, universities are paying increasing attention to students' practical abilities, and training courses and practical sections within courses are widely offered. These training formats have stimulated students' enthusiasm and improved their practical abilities. However, these methods remain teacher-centered, lacking systematic training plans and incentive measures. Students cannot fully construct the knowledge they have learned; when facing real corporate environments and business types, they struggle to apply their knowledge to develop corresponding strategies. Many employers complain that graduate students lack practical experience and abilities. The root cause lies in the lack of an integrated and systematic framework in the professional education and teaching practice system, resulting in fragmented practical content, uncontrolled practical processes, and suboptimal practical effects due to the independent implementation of each training course^[4].

2. Current situation of practical teaching for the marketing training course

Taking the Marketing Training course as an example, based on teaching evaluation data over the past three years and feedback from teaching supervisors, peer evaluations, students, and enterprises, four key issues in the course were identified^[5].

2.1. Difficulty in integration

Practical operations cannot be integrated into the existing knowledge system. During training courses, students often focus solely on the operational skills of training software while neglecting an in-depth understanding of relevant theoretical knowledge. This "operation-focused, theory-neglected" learning model prevents students from truly grasping the internal operating mechanisms of the software, and practical operations without theoretical guidance fail to form a systematic knowledge system.

2.2. Difficulty in application

Theoretical knowledge struggles to guide practical operations. There is a disconnect between the abstract nature of marketing knowledge and the complexity of marketing environments, leading to a poor connection between theory and practice when students apply their knowledge. The lack of effective mechanisms to integrate theoretical knowledge with real market cases in teaching makes it difficult for students to establish an intuitive marketing thinking framework.

2.3. Difficulty in expansion

Learning outcomes lack effective promotion. The limited scope of marketing training results in insufficient competitiveness among students. Current simulation exercises are mostly confined to small-scale competitions within classes, restricting students' horizons and competitive scope^[6]. In the job market, students face fierce competition from graduates of universities across the country and other social candidates. This limited training model cannot effectively enhance students' competitiveness in the job market^[7].

2.4. Difficulty in transformation

The conversion rate of professional knowledge and abilities is low. Students' training operations mainly rely on virtual simulation systems, and there is a gap between training content and the actual needs of enterprises. Additionally, students have few opportunities to practice in enterprises, lacking experience in real work environments and hands-on operation. This gap makes it difficult to convert training effects into practical work abilities, resulting in an insignificant connection between training and practice^[8].

To address these four challenges in practical teaching, this course proposes a new practical teaching reform approach combining “learning, practicing, competing, and cultivating”. This approach introduces “corporate employment standards” into practical teaching to stimulate students’ learning enthusiasm, forming a practical teaching reform model of “learning theory, practicing skills, competing for achievements, and cultivating literacy”. It establishes a tripartite practical teaching operation mechanism involving teachers, students, and enterprises ^[9], helping students improve three core goals, knowledge, abilities, and literacy, and solving a series of issues such as practical teaching organization and management, practical content optimization, and practical transformation and application.

3. Reform goals

Based on the training objectives for marketing talents and to address the four key challenges in the training course, reform goals are set in terms of the teaching system, course modules, teaching models, and teaching paths (**Table 1**):

- (1) Construct a Teaching System Integrating Theoretical and Practical Courses
Integrate the Marketing course and Marketing Training course from separate courses into a unified system. Focus resources from the online Marketing course and the “MOOC Westward” project on marketing training simulations, providing multi-channel and comprehensive support for the Marketing Training course.
- (2) Expand Marketing Training Course Modules
Align training content with current market trends, develop interactive practice modules, and use virtual reality technology to create immersive marketing scenarios. This allows students to engage in marketing activities in a realistic environment, enhancing their practical abilities and learning effectiveness ^[10].
- (3) Create a New Teaching Model of “Promoting Training Through Competitions, Integrating Competitions and Training”
This model breaks the static and single training teaching model by adding competition links, enabling students to strengthen professional skills and enhance professional practical competitiveness through competitions. Its core concept is to stimulate students’ learning motivation through competitions, transforming static knowledge impartment into dynamic ability development, and improving students’ practical abilities, innovative abilities, and teamwork abilities.
- (4) Explore New Paths for Marketing Training Course Reform
Expand the Marketing Training course and provide marketing practice bases for students, enabling them to better apply professional knowledge to analyze and solve practical problems, enhance professional skills, and build core competitiveness.

Table 1. Transformation directions of marketing training course reform

| Transformation direction | | Description |
|--------------------------|------------------------------------|--|
| Study | From “Separation” to “Integration” | Transform from “single courses” to a teaching system combining “theoretical courses and training courses” |
| Practice | From “Weak” to “Strong” | Transform from “practical training only” to “practical exercises + practical training” to enhance training effects |
| Competition | From “Static” to “Dynamic” | Transform from “static knowledge impartment” to “dynamic ability development” |
| Training | From “Virtual” to “Practical” | Transform from “marketing training virtual simulation” to “marketing training virtual simulation + corporate practice” |

4. Reform ideas

4.1. Addressing the difficulty in integrating theory and practice

To help students supplement theoretical knowledge during training courses, two measures are adopted:

- (1) Offline Theoretical Course Design: Effectively review key theoretical knowledge in training courses, and respond to the Ministry of Education's "MOOC Westward" initiative by innovatively conducting cross-regional synchronous classroom teaching with universities in eastern China, achieving the sharing and complementary advantages of teaching resources.
- (2) Full Utilization of Online Learning Resources^[11]: Select online courses such as Marketing on the Smart Tree platform (on-campus resources) and high-quality online courses (off-campus resources), integrating internal and external resources through diversified channels to help students consolidate theoretical foundations.

4.2. Addressing the difficulty in applying theoretical knowledge to practice

To establish a bridge between theoretical knowledge and practical operations and improve training effects:

- (1) Set Up Simulation Practice Sessions^[12]: Fully consider students' actual needs in teaching preparation, and effectively help students familiarize themselves with operating procedures and task requirements by providing operation manuals, video tutorials, and multiple simulation exercises. This hierarchical teaching design significantly reduces the error rate of students during formal training.
- (2) Enhance the Interest of Teaching Activities: Design in-class knowledge competitions or skill contests to stimulate students' learning motivation through competition mechanisms. Appropriate rewards and public recognition are given to students with proficient operations and outstanding performance. This positive incentive not only encourages advanced students but also motivates underperforming students, helping to create a more positive learning atmosphere^[13].

4.3. Addressing insufficient student competitiveness due to limited training scope

To expand the breadth and depth of students' learning, organize marketing simulation competitions:

- (1) Increase In-school Competitions: On the basis of in-class marketing simulation competitions, further expand teaching formats by organizing inter-class in-school competitions to promote communication and learning among students from different classes, enhancing their teamwork abilities and competitive awareness.
- (2) Increase Inter-school Competitions: Build on in-school competitions and organize inter-school competitions with counterpart assistance universities in Xinjiang, breaking institutional barriers, strengthening communication and learning between students of the university and those from counterpart assistance universities, and helping students better enhance their market competitiveness^[14].

4.4. Addressing the gap between training content and corporate needs

To enable students to engage with enterprises and understand their real operations (**Figure 1**):

- (1) Invite Enterprises to Participate in Teaching: Invite corporate experts to the classroom to share the actual operation status of enterprises and industry talent needs, realizing the integration of theory and practice. Real case teaching not only stimulates students' learning interest but also helps them better understand the real business environment of enterprises, narrowing the gap between software simulation and corporate practice, and increasing the practicality and relevance of teaching content.

- (2) Arrange Student Visits to Enterprises: In the later stage of marketing training simulations, extend the training to off-campus practice bases through mobile classrooms. This teaching model effectively promotes the transformation of theoretical knowledge into practical skills. By moving classrooms to real business environments, abstract concepts are concretely presented, and simulation becomes closer to real scenarios, significantly improving students' practical application abilities^[15].

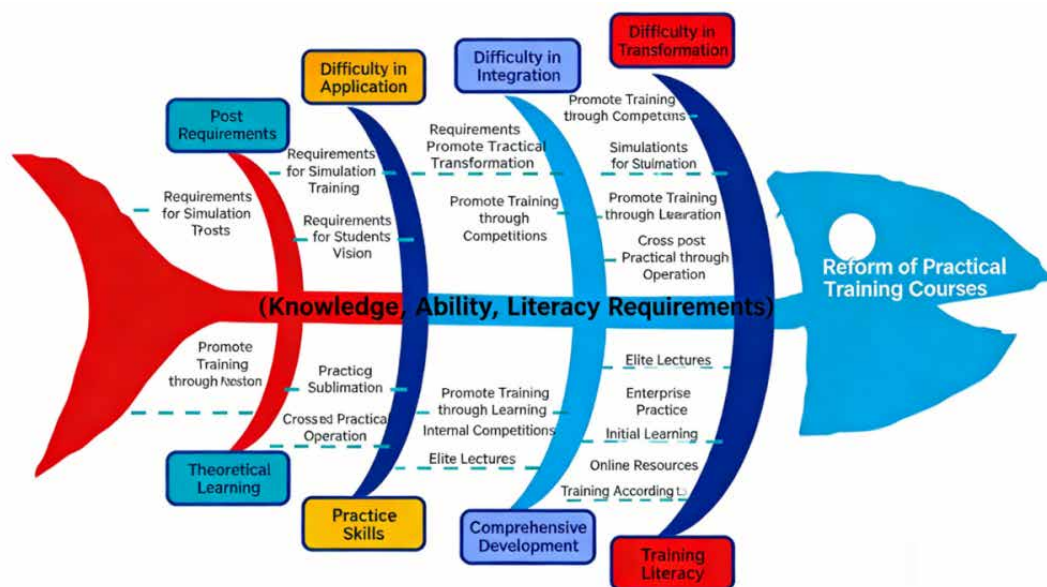


Figure 1. Fishbone diagram of marketing training course reform.

5. Reform methods

The course reform adheres to the “one core, two formats, three subjects” approach (Figure 2):

- (1) One Core: Centered on the industry-education collaborative education mechanism, closely integrating industry and education to improve the comprehensive quality and practical abilities of marketing professionals, promote educational reform and development, and cultivate talents who meet the needs of industrial development.
- (2) Two Formats: Including in-school training and off-campus practice. In-school training refers to practical teaching activities in a simulated work environment within the university, allowing students to apply their knowledge in a simulated setting to improve their hands-on abilities. Off-campus practice refers to practical teaching in enterprises, enabling students to apply their knowledge to solve marketing problems in real work, enhancing their professional literacy and comprehensive abilities^[16–18].
- (3) Three Subjects: Promoting close alignment between education and industry through three dimensions—students, enterprises, and teachers. This involves establishing training teaching bases, strengthening university-enterprise cooperation, improving teachers' teaching capabilities, enhancing the core competitiveness of the major, building a multi-dimensional collaborative education system, improving talent training quality, and adapting to social needs^[19,20].

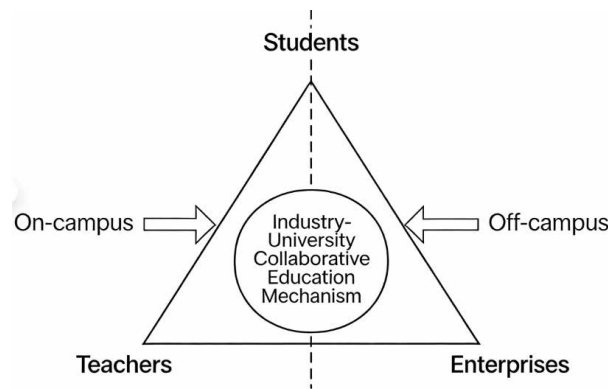


Figure 2. “One core, two formats, three subjects” implementation approach.

6. Specific implementation plan

Based on the problems and reform ideas of marketing training, the training course content is re-planned, with the following specific teaching arrangements (**Table 2**).

Table 2. Teaching plan for marketing training course

| Content Module | Class Hours | Teaching Plan |
|----------------------------|-------------|--|
| Learning Theory | 6 hours | “4+2” model: 4 hours of theory review, 2 hours of theoretical knowledge competition |
| Practicing Skills | 16 hours | “4+12” model: 4 hours of simulation exercises, 12 hours of practical operations |
| Competing for Achievements | 12 hours | “2×6” model: 6 rounds of in-school or off-campus competitions, 2 hours per round |
| Cultivating Literacy | 6 hours | “2+2+2” model: 2 hours of corporate expert lectures, 2 hours of enterprise visits, 2 hours of training reports |

6.1. Stage 1: Learning theory

Marketing training involves knowledge of marketing; mastering marketing theories helps students better understand how enterprises make marketing decisions during training operations. This stage is divided into two steps:

- (1) Step 1: Use 4 hours to review key theoretical knowledge used in marketing training, helping students reinforce their professional knowledge.
- (2) Step 2: Conduct a 2-hour theoretical knowledge competition to help teachers better understand students’ mastery of theoretical knowledge ^[21].

6.2. Stage 2: Practicing skills

Create a competitive and collaborative virtual marketing environment on the marketing training platform, allowing students to play different roles in corporate operations, understand and implement marketing decisions from multiple perspectives. Gaps in marketing strategies are reflected through market share, actual sales volume, profit margin, and total capital, with simulation performance measured by profit. This stage is carried out in two steps:

- (1) Step 1: Use 4 hours for two rounds of simulation exercises to help students familiarize themselves with software operation processes and rules.

- (2) Step 2: Conduct 6 rounds of practical operations over 12 hours, with rankings within the class ^[22].

6.3. Stage 3: Competing for achievements

Help students gain self-awareness and enhance their competitiveness through course competitions, conducted in two forms:

- (1) In-school competitions between different classes, allowing students to understand their competitive level within the university.
- (2) Inter-school competitions with counterpart assistance universities in Xinjiang, broadening students' horizons and helping them clarify their self-positioning.

6.4. Stage 4: Cultivating literacy

Improve students' literacy from three aspects:

- (1) Invite corporate experts to give in-depth professional lectures.
- (2) Organize off-campus learning visits to enterprises, integrating training simulations with real operations to enhance the conversion between simulation exercises and actual operations.
- (3) Conduct training course reports and summaries, with students sharing experiences and lessons learned ^[23].

7. Conclusion

In the digital era, new requirements are put forward for practical teaching reform. By constructing a “learning-practicing-competing-cultivating” teaching system, adhering to the industry-education collaborative education mechanism as the core, combining in-school training with off-campus practice, and closely aligning students, enterprises, and teachers, this reform improves students' comprehensive quality and implements the concept of building a powerful education country.

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Deep Dilemmas and Governance Paths of Industry-Education Integration in Preschool Education Practice Bases: A Practical Exploration Based on G University

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Abstract: The phenomenon of “superficial integration despite formal cooperation” in industry-education integration of preschool education practice bases in colleges and universities is a bottleneck restricting the quality of future preschool teacher training. Its deep-seated dilemmas can be attributed to the unbalanced structure of “rights, responsibilities, and interests” in the collaborative governance between “colleges and kindergartens”. Taking G University as a case, this study explores and practices a tripartite linkage governance path involving “colleges, kindergartens, and governments.” It clarifies rights and responsibilities through checklist management, balances interests with diversified incentives, and reconstructs the teaching core through competency-based phased practice and evaluation. This model effectively promotes the transformation of cooperation from formal coordination to substantive symbiosis, and the transformation of dual-mentor guidance from administrative supervision to professional leadership. It enhances students’ practical competence and professional identity, providing a reference practical paradigm for achieving in-depth industry-education integration that advances from resource exchange to value co-creation.

Keywords: Preschool education; Industry-education integration; Practice bases; Collaborative governance; Balance of rights, responsibilities, and interests; Dual-mentor system

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1. Introduction

Since the release of the “Guiding Opinions of the General Office of the State Council on Deepening Industry-Education Integration”, deepening industry-education integration has become a national strategic measure to promote the organic connection between the education chain, talent chain, industrial chain, and innovation chain^[1]. The “Opinions of the CPC Central Committee and the State Council on Comprehensively Deepening the Reform of the Construction of Teachers’ Teams in the New Era” also clearly proposes encouraging normal colleges and

universities to jointly establish kindergarten teacher training bases with kindergartens^[2]. Evidently, building high-level preschool education practice bases and advancing industry-education integration is an indispensable path to improving the quality of future preschool teacher training.

However, the current industry-education integration in preschool education practice bases generally suffers from “superficial integration”. Although colleges and universities have established formal cooperative relationships with kindergartens by signing cooperation agreements, they fail to achieve genuine industry-education integration in the core links of talent training, resulting in disconnection between curriculum content and frontline needs^[3]; practical teaching links are mostly fragmented, failing to form a systematic and progressive talent training system; there is also an imbalance in cooperative relationships, partly due to insufficient resource feedback from colleges to kindergartens, making it difficult to build a long-term mutually beneficial mechanism^[4]. This superficial cooperation restricts the cultivation of normal students’ practical abilities and the cognitive development of kindergartens, ultimately affecting the supply quality of preschool education teachers.

So, how to promote in-depth industry-education integration in preschool education practice bases? In fact, “inadequate collaboration and weak governance” are common dilemmas faced by application-oriented undergraduate colleges in advancing industry-education integration and professional cluster construction on a broader scale^[5]. Based on the practice of G University in the Guangdong-Hong Kong-Macao Greater Bay Area, this study, from the perspective of collaborative governance, attempts to reveal the deep-seated roots of the imbalance in “rights, responsibilities, and interests,” and further explore the construction of a sustainable and co-developing cooperation mechanism.

2. Dilemma manifestations and root cause analysis of industry-education integration in practice-based

Currently, driven by national and local government policies, the construction of preschool education practice bases has gradually advanced industry-education integration reforms. However, widespread practical dilemmas of “superficial integration” persist in institutional construction, teacher guidance, evaluation systems, and incentive mechanisms.

2.1. Multi-dimensional manifestations of dilemmas

2.1.1. Institutional void of collaborative organizations

Establishing a sound collaborative mechanism is the basic institutional guarantee for promoting industry-education integration in practice bases. For example, although G University has jointly established collaborative organizations such as a “Practice Base Management Committee” with cooperative kindergartens, these organizations often suffer from an institutional void in actual operation, lacking standardized and institutionalized workflows and responsibility implementation mechanisms. This reduces collaborative relationships to formalities, making it difficult to form a stable and effective institutionalized operation paradigm, which is not conducive to deepening industry-education integration in practice bases. An empirical study on industry-education integration in the Guangdong-Hong Kong-Macao Greater Bay Area by Shen et al. also indicates the weakness of guarantee mechanisms in current industry-education integration^[6].

2.1.2. Suspended guidance of the dual-mentor system

The dual-mentor system (on-campus and off-campus mentors) serves as a bridge connecting theory and practice,

but in practice, it generally faces the problem of “formal existence without substantive function”^[7]. On-campus mentors, despite having solid theoretical knowledge and literacy, often lack frontline practical experience, leading to guidance that is divorced from real-world scenarios. In contrast, kindergarten-based mentors, while possessing rich practical experience, are burdened with heavy daily responsibilities and cannot incorporate intern guidance into their core duties, resulting in random and fragmented guidance. More critically, there is a lack of effective regular communication and collaboration mechanisms between the two types of mentors, making it difficult to form a joint effort in talent cultivation. This leads to the “suspension” of dual-mentor guidance in practice, failing to fulfill its intended role throughout the talent training process.

2.1.3. Disconnection of competency-oriented evaluation

In the evaluation of practical teaching, G University’s current assessment methods significantly focus on the completeness of textual materials such as internship reports and logbooks, failing to effectively conduct on-site assessments of students’ key practical abilities, such as organizing game activities, observing and interpreting children’s behaviors, and communicating with parents. Process-oriented evaluation is relatively weak. Chen points out that teachers’ practical knowledge is actionable, embodied, and tacit, and can only be “demonstrated through actions” when solving specific problems^[8]. Therefore, this evaluation orientation, prioritizing reports over practical performance, leads students to focus on written summaries rather than ability development and reflection during practice. It fails to give full play to the guiding role of evaluation in practical teaching, resulting in disconnection from the goal of cultivating high-quality application-oriented talents.

2.1.4. Diminished incentives for deepening cooperation

Building a talent training model with in-depth industry-education integration requires systematic collaboration between colleges and enterprises in training programs, curriculum systems, practice platforms, and faculty teams^[9]. However, for kindergartens, the increased management costs and safety pressures of accepting interns are often unbalanced with the rewards they receive, such as academic resources, support, and teacher professional development opportunities. This inevitably weakens kindergartens’ enthusiasm for deepening cooperation, making it difficult for collaboration to evolve from initial administrative promotion to a sustainable development stage driven by intrinsic interests.

2.2. Deep-seated roots of dilemmas

The causes of the aforementioned practical dilemmas are complex, but the systemic imbalance of “rights, responsibilities, and interests” in the collaborative governance structure between “colleges and kindergartens” is likely the deep-seated root. This institutional obstacle is also reflected in the “U-G-S” (University-Government-School) collaborative training of normal students, manifested as “unclear responsibilities and obligations among subjects”, leading to insufficient motivation of internship bases and random guidance^[10].

2.2.1. Unclear rights and responsibilities

During cooperation, the decision-making authority and responsibility attribution of colleges and kindergartens in key matters have long been ambiguous. For example, issues such as the distribution of discourse power in kindergarten-based curriculum development, the formulation of evaluation standards for students’ practical abilities, and the assessment weight of dual mentors lack clear definitions. This state of intertwined rights and responsibilities easily leads to mutual evasion or one-sided dominance in cooperation, hindering the advancement

of deep integration.

2.2.2. Void responsibilities

Accompanying ambiguous rights is the difficulty in implementing responsibilities. There is a lack of clear and operable division of responsibilities between the two parties in areas such as the content of mentor guidance, safety management during practice, and the ownership and subsequent development of cooperative achievements. The absence or overlap of responsible entities makes it difficult to effectively implement the dual-mentor system and affects the teaching efficiency and quality during cooperation.

2.2.3. Unbalanced interests

As a key subject in practical teaching, kindergartens often face a significant imbalance between the management costs and childcare pressures incurred by accepting interns, and the rewards they receive, such as academic resources, support from colleges, and teacher development opportunities. The lag and uncertainty of interest returns severely weaken kindergartens' intrinsic motivation for sustained deep participation in cooperation, making it difficult for industry-education integration and cooperative relationships to transform from external promotion to internal drive.

3. Practical exploration of constructing a collaborative governance mechanism

The construction of a collaborative governance mechanism must adhere to the methodologies of “systematic thinking” and “problem-oriented”^[11]. Studies have pointed out that constructing a “trinity” cooperation mechanism, building a “dual-qualified” teaching team, and developing high-quality practical teaching resources are key to deepening industry-education integration^[12]. To address the core contradiction of unbalanced “rights, responsibilities, and interests,” the key lies in promoting “institutional mechanism integration” and building a governance structure that responds to the core demands of all parties. G University's practice not only standardizes cooperation models but also stimulates the intrinsic motivation of all participating entities, aligning with the requirement to “deepen educational reform from the perspective of modernizing governance systems and governance capabilities to stimulate the vitality of educational development”^[13].

3.1. Constructing a tripartite linkage governance structure involving colleges, kindergartens, and governments

To resolve the dilemma of institutional void in collaborative organizations, G University strives to transform collaboration from looseness to substantiveness. Drawing on the path of “strengthening government governance responsibilities and establishing a tripartite collaborative leadership body” in the “U-G-S” collaboration model, with the active support and coordination of local education administrative departments, G University has jointly established a substantive “Industry-Education Integration Base for Teacher Education” with high-quality local kindergartens and education guidance centers. It has also formulated clear articles of association, a regular joint meeting system, and a special working group mechanism. This governance structure elevates cooperation to the level of formal governance based on rules and systems, providing solid organizational guarantees for in-depth cooperation.

3.2. Establishing checklist-based management systems to clarify rights and responsibilities

To address the common problems of random guidance and lax evaluation in the dual-mentor system, G University and cooperative kindergartens have jointly developed the “Detailed Standards for Practical Teaching of Preschool Education Majors” and the “Dual-Mentor Responsibility Manual.” The former clarifies the competency goals, content requirements, and process norms for each practical link (observation internships, teaching internships, and field visits), providing a unified quality standard for practical teaching; the latter defines the specific responsibilities and collaboration processes of on-campus and kindergarten-based mentors in terms of guidance frequency, content focus, reflection guidance, safety responsibilities, and assessment evaluation. In addition, the two parties have jointly established a “Kindergarten-College Curriculum Resource Development Group” and a “Joint Teaching and Research System” to conduct regular thematic discussions on common practical dilemmas and cutting-edge issues. By clearly defining and institutionalizing the rights and responsibilities of both parties, the collaborative guidance of dual mentors is supported by rules and evidence, improving the quality of industry-education integration in practice bases.

3.3. Building a diversified interest balance mechanism to stimulate motivation

To ensure the effectiveness of collaborative governance and respond to the core interest demands of all parties, G University has focused on building a balance mechanism aimed at achieving win-win outcomes for multiple parties. This mechanism aims to resolve the dilemma of “separation between industry and education, and alienation between colleges and enterprises” by establishing “flexible institutional mechanisms” to ensure the healthy development and sustainability of industry-education integration. For kindergartens, G University has provided professional development pathways, including “special educational research project cooperation” and “key teacher visiting and training”, and awarded the title of “Industry-Education Integration Practice Base for Teacher Education of G University” to deeply cooperative kindergartens, enhancing their sense of gain and honor. For college teachers, the university incorporates achievements from participating in base construction, industry-education integration, joint teaching and research, and cooperative development of teaching cases into the evaluation indicators for professional title promotion, position appointment, and annual assessment, opening up effective paths for their industry-academia-research transformation and professional development. For students, a process-oriented evaluation and incentive system centered on professional competency portfolios has been established. The portfolio, which records typical practical works, activity design plans, and child observation records, not only serves as an important basis for awards and evaluations but also becomes a strong credential for their employment competitiveness.

3.4. Reforming phased practical teaching and evaluation focused on competencies

The reform of industry-education integration evaluation oriented by competencies aims to foster students’ wisdom and high-level abilities^[14]. Drawing on the core concept of the workshop model in industry-education integration, G University has reconstructed its practical teaching system with a competency-oriented approach, organizing practical content and evaluation around key skills required in real industry scenarios (such as child behavior observation, parent-kindergarten communication, and safety emergency response)^[15]. In terms of practical content, a phased practical system of “observation and perception - assisted participation - partial leadership - independent post assumption” has been constructed to ensure that students’ practical experience matches their professional cognition and ability development. In terms of practical models, multi-course linked projects have been innovatively implemented. For example, courses such as “Kindergarten Environment Creation,” “Preschool

Children's Science Education," and "Preschool Education Brand Management" are integrated, and students are organized to go to base kindergartens to complete tasks such as thematic environment creation and science activity guidance over several weeks, enabling them to comprehensively apply their knowledge in real and complex educational scenarios. In terms of evaluation reform, the weight of practical ability evaluation in the total score has been significantly increased, with the proportion of evaluation by kindergarten-based mentors based on students' on-site performance significantly raised. Supplementary multi-dimensional assessment methods, such as competency portfolio review, simulated teaching, and case analysis defense, have been adopted, shifting the evaluation focus from "what students know" to "what students can do", and guiding teaching and learning toward the cultivation of application-oriented, competency-based talents.

4. Practical effects and reflections

Based on the systematic construction of a collaborative governance mechanism, the industry-education integration model of G University's preschool education practice bases has achieved the transformation from formal coordination to substantive symbiosis.

4.1. Analysis of governance effects

4.1.1. Enhanced collaboration between colleges and kindergartens

The optimization of the governance structure and the implementation of the interest balance mechanism have effectively stimulated the intrinsic motivation for cooperation between the two parties. Kindergartens have transformed from passive providers of practice venues for interns to co-designers and collaborative researchers in talent cultivation. They proactively take real problems encountered in frontline childcare and education, such as "optimization of children's emotional management strategies" and "in-depth guidance of outdoor free play," as core topics for joint teaching and research and as research topics for normal students' practical research or graduation theses. This in-depth interaction, based on shared goals and professional aspirations, enables "college-kindergarten" collaboration to transcend simple resource exchange and evolve into an academic community that jointly explores solutions to specific educational problems, achieving mutual empowerment between college talent cultivation and frontline education quality improvement.

4.1.2. Strengthened guidance capability of dual mentors

By clarifying the responsibilities of both parties through checklist-based management and adopting diversified incentives, the guidance effectiveness and professional investment of the dual-mentor team have been effectively enhanced. Through regular participation in joint teaching and research and activity observation in kindergartens, on-campus mentors' guidance is no longer limited to the elaboration of theoretical principles but can combine vivid educational scenarios to provide students with more contextual and operational reflection frameworks. Kindergarten-based mentors, whose guidance work has received institutional recognition and rewards, have transformed their role from administrative supervisors focused on discipline and safety management to developmental mentors concerned with students' practical reflection, teaching method experimentation, and professional identity formation. Based on the norms of the "Dual-Mentor Responsibility Manual", the two types of mentors have formed a relatively stable collaborative guidance model, jointly observing and evaluating students' practice, and enhancing the systematicness and professionalism of guidance.

4.1.3. Improved comprehensive practical abilities and professional identity of students

Although practical knowledge originates from experience, it can be refined into beliefs that guide future actions. The competency-oriented phased practice and evaluation reform have promoted the substantive development of students' professional literacy. Process-oriented competency portfolios show significant progress in students' core practical abilities, such as activity design, child behavior observation and analysis, and parent-kindergarten communication. For example, in the "Spring Arrives" thematic environment creation project jointly carried out by G University and the First Kindergarten of the local street, the student team's abilities in environment planning, material application, and guidance for children's interaction were highly praised by the kindergarten. The interview pass rate and overall evaluation ranking of the past two batches of graduates in regional teacher recruitment exams have steadily improved. Feedback from employers also indicates that their post adaptation period has been significantly shortened, demonstrating good professional competence. More importantly, the experience of successfully solving problems in real projects is crucial for the emergence and consolidation of such beliefs and professional identity.

4.2. Reflections and ongoing challenges in practice

First, the long-term mechanism needs further consolidation. The smooth operation of the current collaborative governance model still relies to a certain extent on the promotion of core members and support from phased projects. Its institutionalized and normalized operational resilience needs further testing through time and practice. How to fully integrate it into the core teaching systems of both parties is a key issue to be addressed in the future. Second, the depth and breadth of interest sharing need to be expanded. Although the existing interest balance mechanism has achieved initial results, exploration in deeper interest linkages—such as co-creation and sharing of research achievements, joint development of brand courses, and order-based talent cultivation—remains insufficient, failing to fully unleash the innovative value of industry-education integration. Third, the integration and application of new technologies need to be strengthened. Facing the disruptive impact of information technologies such as artificial intelligence and big data on the educational ecosystem, how to effectively integrate them into practical teaching environment creation, student ability diagnosis, and personalized guidance, and build a new form of industry-education integration in the context of smart education, is the direction for future practice base construction.

5. Conclusion

In summary, the crux of "superficial integration" in preschool education industry-education integration lies mainly in the imbalance of "rights, responsibilities, and interests". G University's practice shows to a certain extent that constructing a governance path centered on collaborative governance—by clarifying the rights and responsibilities of both parties through "college-kindergarten-government" linkage, stimulating the motivation for deepening cooperation with diversified interests, and reconstructing the teaching evaluation system for industry-education integration based on competencies—can effectively promote cooperation from formal coordination to substantive symbiosis, achieving mutual empowerment between college talent cultivation and frontline needs. This experience of resolving industry-education integration dilemmas through governance innovation provides a reference practical plan for "accelerating the implementation of preschool education action plans" and "improving the public service level of preschool education". In the future, efforts should be focused on deeply solidifying long-term mechanisms, expanding in-depth interest linkages such as co-creation of research achievements, and

actively exploring the empowerment of smart education. Only in this way can a new ecosystem for high-quality preschool education normal student training be systematically constructed, laying a solid foundation for the construction of a contingent of preschool teachers in the new era.

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The Exploratory Practice Research of Integrating “Book Fragrance” Into the Cultural Construction of Secondary Vocational Classes

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Abstract: Class collective culture is the common behavior norms, values and cognition formed by class members in long-term interaction, and is the core of class collective construction. The purpose of building a collective culture in the class is to promote the development of students’ personalities, improve their comprehensive abilities and core literacy, and adapt to the diverse needs of society. This paper, from the perspective of secondary vocational school students, emphasizes the importance of integrating learning style into class collective culture, and explores how to create a class with rich learning atmosphere in secondary vocational school according to the psychological and behavioral characteristics of secondary vocational school students, and proposes corresponding strategies.

Keywords: Class culture; Class culture construction; Book fragrance; Secondary vocational school

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1. Introduction

Class culture construction is the shaping of the class culture atmosphere, which subtly influences and purifies the minds of the learners, so that students can cultivate their sentiments and enhance the collective happiness of the class ^[1]. Integrating the fragrance of books into class culture construction and building a bookish class is an important part of campus culture. Building a bookish class, spreading the fragrance of excellent Chinese culture to the class, allowing students to experience the endless charm of Chinese culture, and forming common core values in their studies ^[2].

2. The importance of class culture construction

Building a class with a strong fragrance of books is conducive to the establishment of self-confidence among secondary vocational students, as well as the cultivation of their learning quality and willpower. In an excellent class environment, students strive to learn, explore more, and seek truth from knowledge. Over time, a good learning environment is naturally formed ^[2].

According to Dewey's research, students in secondary vocational schools generally lack self-confidence and have a severe sense of inferiority. The poor academic performance in junior high school leads to a lack of sufficient internal motivation in secondary vocational schools, and is prone to self-abandonment behavior, lack of interest in learning, and unfavorable learning results ^[3].

The construction of a bookish class is conducive to the establishment of self-confidence and the cultivation of learning quality and spiritual will of secondary vocational students. According to the survey, vocational school students generally lack self-confidence and have a serious sense of inferiority. Due to poor academic performance in junior high school, there is a lack of a spirit of hard work and a positive learning state, leading to self-abandonment, resulting in a lack of strong interest in learning and unclear learning effects. In addition, most secondary vocational students have poor foundations, and it is not easy to improve after forming bad study habits in junior high school. This directly leads to the poor ability of secondary vocational students to be frustrated, and they are prone to retreat when encountering difficulties, and a general aversion to learning. In addition, vocational school students are in the rebellious period of youth, and the generation of rebellious emotions can easily lead to students' behavior in the process of learning, which is not conducive to class management and the orderly development of various subject teaching work. Class culture construction with the fragrance of books can be purified by high-quality culture (such as famous quotes, mottos, etc. ^[4])

3. The practice of Bandura's theory of social learning

According to the social learning theory proposed by American psychologist Albert Bandura in 1977, most human learning takes place in a social environment by observing the behavior of others and their consequences. It influences people's behavior through cognition, motivation, emotions, and beliefs ^[5]. In a class full of learning atmosphere, students discuss and learn from each other. In the subtle influence, students' living and learning habits will gradually improve, internalizing them into their own behavioral habits and consciously abiding by the school's rules and regulations.

In the new era, with the continuous progress of science and technology and the continuous reform of education, vocational education has received more and more attention. With the continuous expansion of the scale of secondary vocational schools, the healthy development of secondary vocational schools and the coordinated operation of society play an important role. Therefore, in the management of secondary vocational school classes, it is particularly important to discover students' shining points and give full play to the exemplary role of peers, parents, and teachers. In this way, students can be guided to develop in a positive direction, enter a virtuous cycle, and spread the academic atmosphere to every corner of the class ^[6].

4. Strategy analysis of class culture construction

According to Li Ruxia, "The construction of class culture in schools has shifted from pursuing material environment creation to spiritual and cultural construction." Therefore, in order to achieve the goal of class culture construction, the most important thing should be how to gradually infiltrate the "bookish atmosphere" into the class. By definition, it is first necessary to create a "bookish atmosphere" in the class. Through the construction of class culture, the material environment of the class and the values of the whole class will be affected. At the same time, knowledge, skills and ideas related to the teaching method can be communicated to students ^[7,8].

4.1. Creating a “book fragrance”

According to Newton and Greviner, “academic atmosphere” refers to elements that include teaching practice skills, evidence-based methods, and effective change management, which are aimed at improving educational atmosphere and outcomes. These factors together create an environment that supports and promotes academic and academic pursuits. Therefore, in the classroom, a learning atmosphere can be created by establishing a class book corner, posting inspirational couplets, and using class black newspapers to decorate the class culture wall, so that students can immerse themselves in excellent culture. In addition, a student in the class can be designated as the person in charge of the book corner. The student in charge of the book corner also needs the class’s opinion. In this way, students participate in the cultural construction of the class with a sense of belonging^[9].

4.2. Integrating “book fragrance” into the class

In the process of creating a bookish class, students are encouraged to absorb excellent traditional culture, such as literary literacy (poetry, prose, songs, extracurricular knowledge) and scientific knowledge. Through the edification of knowledge, students can avoid impatience and impatience in their daily learning activities, and calmly appreciate the joy brought by various knowledge. At the same time, it cultivates students’ interests and hobbies, expands their horizons, and helps students further think about their own life goals and strive for their ideals^[10–12].

In addition, students should persist in reading excellent Chinese traditional culture courses. To this end, class teachers can establish “Class Reading Stars” and share excellent works through themed class meetings. For example, based on the class’s reading progress, a monthly book club is organized to encourage students to showcase the character features, storylines, and themes in the book through PPT, videos, or speeches, as well as their insights, comments, and even gains after reading. Through sharing, each student’s different viewpoints will collide with each other in the classroom, generating new thinking and enlightenment. At the same time, teachers should also participate in students’ reading activities and play a demonstrative role.

4.3. Maintaining the “book fragrance”

The construction of “book fragrance” is a long-term and stable process. In order to prevent students from feeling bored and slack in reading activities, teachers can start from the students’ individual perspectives and carry out diversified activities. The competition topics can cleverly integrate various aspects of class culture construction, such as examining class themes, class slogans, class mottos, and class styles, in order to give full play to students’ strengths and encourage them to participate in various activities related to class culture construction. In addition, students with special talents can be encouraged to participate in class culture construction. For example, students who are good at drawing can be encouraged to draw the class bulletin board, while students who are good at writing can be responsible for writing the class culture couplets. At the same time, students can also participate in competitions, such as school, district, and city-level essay, Chinese, and English speech competitions. In these activities, students can unleash their potential, discover their strengths and shining points, ensure their comprehensive development, and allow students who have been immersed in the “scent of books” for a long time to undergo a qualitative change^[13–15].

In addition, teachers should also consider the different professional attributes of secondary vocational students and recommend extracurricular cultural knowledge related to their majors, so that students can understand the development trend of their own major through reading extracurricular knowledge and improve their recognition of their major. It not only maintains students’ curiosity about their major but also subtly

enhances their spiritual quality, strengthens their perseverance, enriches their knowledge base, and further enhances their confidence. Based on the characteristics of the individualized needs of secondary vocational students, the individualized reading list is set and selected, and the quality weaknesses of individual secondary vocational students are targeted and improved, so that they can make up for the deficiencies in the process of improving their character. At the same time, discover your own shining points, play to your own strengths, and regain confidence.

5. Conclusion

The construction of bookish classes is the overall trend of educational reform and development. Its creation is particularly important for the development of secondary vocational students. At the same time, it is also a bridge for the growth of teachers and the promotion of harmonious teacher-student relationships. The construction of a class culture full of “book fragrance” is an important way to improve the quality of secondary vocational education and promote the transformation of the secondary vocational education model. The construction of bookish classes is diverse and requires the attention of vocational teachers, pooling collective wisdom, and combining the characteristics of vocational students, to explore and practice together until “bookish” permeates every corner of the classroom, and the fruits of bookish classes are shared.

Disclosure statement

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Research On the Construction Mode and Development Path of University Innovation Club

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Abstract: As student-initiated and student-led organizations, university innovation clubs are profoundly reshaping the patterns and directions of higher education, with their construction models and development pathways directly influencing student competency development. Based on the fundamental concept of university innovation clubs, this paper analyzes prevalent challenges such as inefficient resource integration, inadequate institutional mechanisms, and superficial industry-education collaboration. Through case studies of innovation club development across multiple universities, it proposes an innovative tripartite construction model of on-campus resource integration, off-campus industry linkage, and interdisciplinary collaboration. Furthermore, we formulate a corresponding developmental pathway emphasizing institutional standardization, industry-academia-research integration, and the cultivation of an innovation culture. This study offers both theoretical and practical implications for reforming university student organizations and practice-based educational platforms.

Keywords: University innovation clubs; Construction model; Development pathway; Interdisciplinary collaboration; Resource integration

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1. Introduction

Against the backdrop of the rapidly developing knowledge economy and continuous breakthroughs in scientific and technological innovation, university innovation clubs have become key platforms for cultivating students' innovative thinking and practical abilities. Through interdisciplinary collaboration, systematic resource integration, and deep cooperation with industry, university innovation clubs function not only as student organizations but also as vital hubs that link higher education talent cultivation with broader social innovation development ^[1].

In the context of a new round of scientific and technological revolution and industrial transformation, innovation clubs play an irreplaceable role in fostering students' adaptive innovation abilities and competence in solving complex problems. Interdisciplinary collaboration and resource integration are situated within the broader frameworks of "new engineering education" and "future technology institutes," further highlighting the value of these clubs as experimental fields for educational reform ^[2].

2. Definition and function of university innovation club

2.1. Definition of University innovation clubs

University innovation clubs are student-initiated and student-operated organizations within higher education institutions, dedicated to cultivating students' innovative spirit and enhancing their practical abilities through a wide variety of activities and projects while promoting interdisciplinary collaboration. Rather than merely serving as informal groups centered around shared interests, innovation clubs function as platforms that integrate academic research with hands-on practice, enabling students to unlock and develop their innovative potential ^[3].

Such clubs frequently organize innovation competitions, entrepreneurship planning activities, academic seminars, and innovation workshops, all of which help students strengthen their problem-solving skills and deepen their understanding of innovation. Within these environments, students can experience the entire process—from generating initial ideas to implementing feasible solutions—thus improving their capacity for practical application and elevating their innovative thinking ^[4].

In addition to enhancing students' innovative abilities, innovation clubs also provide valuable conditions for interdisciplinary communication. By collaborating with peers from diverse academic backgrounds, students can approach problems from multiple perspectives, break away from traditional thinking patterns, and produce more groundbreaking ideas and solutions. Innovation clubs, therefore, serve not only as platforms for academic exchange but also as important spaces for students to develop teamwork skills and organizational management capabilities.

2.2. Functions of university innovation clubs

The functions of university innovation clubs extend far beyond fostering students' innovative abilities. They play crucial roles in academic exchange, the promotion of technology transfer, and participation in social practice. Innovation clubs regularly host academic lectures, expert workshops, and technical exchange activities, offering students opportunities to communicate with experts from academia and industry ^[5]. Through such engagement, students can stay informed about the latest trends in technological development, gain intellectual inspiration in a vibrant academic atmosphere, and broaden their scholarly horizons.

Innovation clubs also contribute to the transformation of scientific and technological achievements. By organizing a variety of innovation projects and competitions, students can apply their creative ideas to real-world contexts. Throughout project implementation, students not only learn how to translate theoretical knowledge into practical solutions but also advance technology transfer and industrialization through collaboration with external enterprises or relevant institutions. This function of innovation clubs enhances students' ability to adapt to societal demands and simultaneously provides the broader community with innovative result of real practical value ^[6].

University innovation clubs also place strong emphasis on fulfilling their functions in social practice. Through volunteer services, social research activities, and innovation and entrepreneurship projects, students are able to participate directly in addressing real-world social issues. These experiences allow them to accumulate practical knowledge, broaden their horizons, and strengthen their sense of social responsibility and practical competence. Such practice-oriented activities enable students to gain a deeper understanding of societal needs and market trends, thereby laying a solid foundation for their future career development ^[7].

3. Construction models of university innovation clubs

3.1. Integration of on-campus resources

The construction of university innovation clubs relies heavily on the support of various internal resources within higher education institutions. Academic resources serve as the foundation for the development of innovation clubs. Universities possess abundant disciplinary resources and professional faculty teams capable of providing students with in-depth academic guidance and research support. By collaborating with relevant academic departments, innovation clubs can integrate knowledge from different disciplines and organize interdisciplinary innovation activities. This model not only broadens students' academic horizons but also enhances their comprehensive abilities in addressing complex problems ^[8].

In addition, university laboratories and research facilities provide essential technical support. The availability of on-campus laboratory equipment and facilities offers students practical spaces for project development and technical validation. During the construction and advancement of innovation clubs, universities may also provide financial support, helping student teams acquire the necessary technical equipment or materials required for project implementation, thereby ensuring their feasibility ^[9]. Through effective integration of on-campus resources, innovation clubs can offer students more diverse opportunities for innovation practice and facilitate the smooth progress of their projects.

3.2. Off-campus collaboration and industry linkage model

Beyond internal resources, the construction of university innovation clubs requires establishing long-term cooperation mechanisms with external society and industry sectors. By collaborating with enterprises, industry associations, and government agencies, innovation clubs can secure additional practical opportunities and resource support for students. The establishment of "industry mentor databases" enables clubs to receive technical, financial, and advisory assistance while also gaining updated information on industry trends and market demands, making student-led innovation projects more aligned with real-world conditions ^[10].

Building strong connections with industry sectors also provides students with valuable internship and employment opportunities. Many enterprises are willing to engage with students through innovation clubs, offering internship positions and project collaboration opportunities. Through this university–industry cooperation model, students can accumulate practical experience and enter the workforce more smoothly after graduation, enhancing their overall employability. Furthermore, collaboration between universities and enterprises promotes the transformation of technological achievements, closely integrating academic research with practical applications and achieving mutual benefits in both academic innovation and industrial development ^[11].

3.3. Interdisciplinary collaboration model

Interdisciplinary collaboration is one of the distinctive advantages of university innovation clubs. Within this model, students from diverse academic backgrounds work together to tackle complex challenges. This collaborative approach breaks down traditional disciplinary boundaries, integrates knowledge from different fields, and stimulates the generation of innovative ideas and outcomes ^[12].

Such interdisciplinary collaboration goes beyond mere knowledge sharing; it also fosters students' overall abilities in teamwork. During the development of innovation projects, students must not only apply their own professional expertise but also learn to communicate and collaborate with team members from other disciplines. This multifaceted cooperation model increases the intellectual and practical value of the club's innovative while providing students with comprehensive opportunities for skill development. It greatly contributes to enhancing

their teamwork capabilities and problem-solving skills.

4. Pathways for the sustainable development of university innovation clubs

4.1. Enhancing institutionalization and standardization

To ensure the long-term and stable development of university innovation clubs, universities must establish comprehensive management mechanisms and regulatory frameworks. This includes clearly defining the organizational structure of the club, specifying the responsibilities of key leaders, and ensuring that all activities and projects can be carried out efficiently. At the same time, a scientific and well-regulated financial management system is essential for the stable operation of the club. Universities should allocate dedicated funding to support the development and operation of innovation projects while ensuring transparency in the use of funds. Moreover, activity planning should follow well-defined procedures and standards, with each event organized and executed based on clear guidelines. Incorporating the concept of a “closed-loop management system,” the club can implement refined management throughout the entire process—from project initiation and progress tracking to transformation ^[13].

Through standardized management approaches, innovation clubs can significantly improve their operational efficiency and strengthen their ability to sustain long-term growth. Institutionalized management helps clarify the club’s positioning and development direction, providing a stable participation platform and attracting more students to engage actively. Within a well-structured regulatory system, various innovation projects and activities can proceed in a more orderly manner, thereby better cultivating students’ innovative capacities and teamwork spirit while supporting the club’s long-term development.

4.2. Strengthening university–enterprise cooperation and integrating industry, academia, and research

The sustainable development of innovation clubs depends largely on deepened collaboration between universities and enterprises, as well as the integration of industry, academia, and research. By establishing partnerships with enterprises and research institutions, universities can offer innovation clubs the technical support and financial resources they need. Cooperation between enterprises and innovation clubs enables companies to access new ideas and technological while providing students with practical project opportunities that bridge theoretical knowledge and real-world application. Innovation clubs may collaborate with enterprises to jointly develop new technologies, create new products, or design innovative solutions, ensuring precise alignment between academic research and industry demands ^[14].

University–enterprise cooperation also provides students with more internship and employment opportunities, enabling them to connect their innovative skills directly to career pathways. Through participation in enterprise research, development, and market-related activities, students gain valuable experience and enhance their competitiveness in the job market. By establishing a strong collaborative relationship among industry, academia, and research, innovation clubs not only receive stronger external support but also help students further strengthen their innovative abilities through hands-on practice, facilitating high-efficiency integration between academic pursuits and industrial development ^[15].

4.3. Fostering a campus atmosphere that promotes innovation culture

The development of university innovation clubs requires the cultivation of a strong innovation culture within the

campus environment. Universities should provide policy guidance to encourage students to actively participate in innovation club activities and stimulate students' innovative potential through resource support and incentive mechanisms. Schools may organize entrepreneurship competitions, creative workshops, and similar activities each semester, offering platforms for students to showcase their ideas while enhancing their creative thinking and practical skills ^[16].

In addition, universities may invite entrepreneurial mentors and industry experts to deliver lectures and host seminars, helping students broaden their horizons and keep pace with current industry trends and technological frontiers. These activities not only inspire students' innovative thinking but also equip them with practical experience and methodological insights necessary for innovation and entrepreneurship. Through comprehensive support and encouragement, universities can create a more favorable environment for the development of innovation clubs, strengthen the presence of innovation culture on campus, and further enhance students' overall competencies.

5. Conclusion:

As a vital platform for nurturing students' innovative spirit and practical skills, university innovation clubs are playing an increasingly crucial role. By integrating campus and external resources, fostering interdisciplinary collaboration, and strengthening deep industry partnerships, these clubs not only enhance students' innovation capabilities but also facilitate the transformation of academic achievements into practical applications that serve society. Moving forward, as innovation clubs further refine their institutional frameworks and embrace emerging technologies like generative artificial intelligence, they will provide robust support for cultivating strategic national talents with social responsibility and innovative capabilities.

Disclosure statement

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Path Exploration of Integrating Localization and Industrialization of International Chinese Education Empowered by China-Central Asia Cooperation Spirit

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Abstract: Against the backdrop of the deepening of the Belt and Road Initiative and the construction of the China-Central Asia community with a shared future, international Chinese language education has become a core carrier of cross-cultural communication. This paper, based on the connotation and core of the China-Central Asia spirit, focuses on the practical predicaments of the integration of localization and industrialization of international Chinese language education. By analyzing the value logic of spiritual empowerment, it explores the integrated paths that combine the depth of cultural dissemination with the vitality of industrial development from the dimensions of curriculum system reconstruction, industrial ecosystem construction, and cooperation mechanism innovation. This provides theoretical references and practical models for enhancing the quality and efficiency of language education cooperation between China and Central Asia and building a two-way mutual learning cultural exchange pattern.

Keywords: China-Central Asia spirit; International Chinese education; Localization; Industrialization; Integrated development

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1. Introduction

With the implementation of the achievements of the China-Central Asia Summit, interactions between the two sides in economic and trade cooperation, cultural and people-to-people exchanges have become increasingly frequent. As a “bridge project” for connectivity, international Chinese education has become more strategically valuable^[1]. The core essence of the China-Central Asia spirit, “mutual respect, good-neighborliness and friendship, mutual assistance in times of need, and win-win cooperation,” not only lays an ideological foundation for bilateral cooperation but also provides spiritual guidance for international Chinese education to break through development bottlenecks. Currently, Chinese education in the China-Central Asia region has initially formed a large-scale development trend, but it still faces problems such as insufficient localization adaptation, low

industrialization level, and weak resource integration, which restrict the full release of educational effectiveness. How to take the China-Central Asia spirit as the guide, promote the in-depth integration of Chinese education with the local cultural context and industrial needs, and realize the transformation from “knowledge output” to “value co-construction” has become an important issue to be solved urgently. Based on this, combined with the realistic background of China-Central Asia cooperation, this paper systematically explores the development path of integrating localization and industrialization of Chinese education under spiritual empowerment, providing new ideas for building a sustainable development ecology of Chinese education^[2].

2. Connotation core and empowerment value of the China-Central Asia spirit

2.1. Core connotation of the China-Central Asia spirit

The China-Central Asia spirit is a consensus formed in long-term bilateral exchanges, and its core connotation can be summarized into four dimensions: first, mutual respect, respecting the differences in historical cultures, social systems, and development paths of various countries, and adhering to the principle of equal treatment; second, good-neighborliness and friendship, building a mutually supportive partnership based on the natural advantages of geographical proximity and cultural affinity; third, mutual assistance in times of need, joining hands to address risks and share development opportunities in the face of regional development challenges and global changes; fourth, win-win cooperation, promoting the coordinated improvement of the interests of both sides through pragmatic cooperation-oriented efforts. This spiritual core is highly consistent with the core goal of international Chinese education of “promoting cross-cultural understanding and building communication bridges”, providing valuable guidance for educational practice^[3].

2.2. Core value of spiritual empowerment

(1) Consolidating cooperation, consensus and strengthening internal educational motivation

The China-Central Asia spirit provides an ideological link for bilateral Chinese education cooperation, enabling educational subjects to break through single teaching thinking, establish a development concept of “symbiosis and common prosperity”, and promote the coordinated investment of resources from governments, universities, enterprises, and other parties, laying a cooperation foundation for the integration of localization and industrialization.

(2) Guiding value orientation and improving educational adaptation capacity

Guided by the principle of “mutual respect”, Chinese education can break away from the “standardized output” model, focus on adaptation to local cultures, customs, and educational systems, and enhance the local recognition of Chinese education; guided by the orientation of “win-win cooperation”, Chinese education can be guided to connect with local industrial needs, realizing the two-way transformation of educational value and economic value.

(3) Solving development bottlenecks and expanding educational development space

Faced with problems such as insufficient localized resources and imperfect industrialization mechanisms in Chinese education, the concept of “mutual assistance in times of need” advocated by the China-Central Asia spirit can promote the joint construction and sharing of educational resources and joint research of cooperation projects between the two sides, forming a development pattern of complementary advantages and injecting new momentum into the sustainable development of Chinese education.

3. Practical dilemmas in the integration of localization and industrialization of international Chinese education between China and Central Asia

3.1. Insufficient localization adaptation and restricted educational effectiveness

(1) Lack of localized transformation of the curriculum system

Currently, most Chinese education courses in Central Asia adopt domestic textbook systems, with content focusing on Chinese language and cultural knowledge, and insufficient integration of the historical traditions, cultural customs, and social realities of various Central Asian countries. This leads to a disconnect between teaching content and the cognitive context and actual needs of local learners, making it difficult to fully mobilize their learning enthusiasm^[4].

(2) Low localization level of the teaching staff

Most Chinese teachers in Central Asia are either dispatched from China or local primary teachers. The former lack an in-depth understanding of local educational models and cultural contexts, while the latter need to improve their professional competence and teaching level. It is difficult to realize the organic integration of Chinese teaching and local culture, affecting the stability of teaching quality.

(3) Simplified teaching evaluation system

Existing evaluations mainly focus on the mastery of linguistic knowledge, ignoring the assessment of cross-cultural communication skills and practical application abilities. Moreover, evaluation standards are not set in combination with local workplace needs and cultural scenarios, making it difficult to adapt to localized talent training goals^[5].

3.2. Lagging industrialization development and weak resource integration

(1) Fragmented industrial layout

The Chinese education industry in Central Asia is mostly concentrated in basic language training, with insufficient development of extended industrial chains such as high-end translation services, “Chinese + vocational skills” training, and cultural creativity. The industrial structure is single, and it is difficult to form a scale effect.

(2) Imperfect market connection mechanism

There is a disconnect between Chinese education and local industrial needs. Talent training in universities is disconnected from enterprise job requirements, and there is a lack of customized Chinese training programs for advantageous industries in Central Asia, such as energy, agriculture, and logistics, resulting in a low conversion rate of educational achievements.

(3) Incomplete industrial support system

The Chinese education industry in Central Asia faces problems such as insufficient capital investment, weak technical support, and limited brand influence. It lacks professional educational service platforms and market-oriented operation mechanisms, making it difficult to achieve sustainable development.

3.3. Lack of integrated development mechanism and insufficient synergistic effect

The integration of localization and industrialization lacks systematic institutional design. The division of responsibilities among governments, universities, enterprises, and other subjects is unclear, and there is a lack of effective communication and coordination mechanisms and interest-sharing mechanisms. On the one hand, localized reforms do not fully consider industrial needs, leading to a disconnect between educational content and the market; on the other hand, industrialization development ignores localization adaptation, making it difficult to

gain widespread recognition from local society. The two are separated from each other, failing to form a virtuous cycle of “education adapting to the local area and industry feeding back education”^[6].

4. Integrated development paths empowered by the China-Central Asia spirit

4.1. Promoting the quality improvement of Chinese education localization based on the principle of “mutual respect”

(1) Building a localized curriculum system

Based on the cultural context and development needs of various Central Asian countries, carry out curriculum reconstruction of “Chinese + local culture + vocational needs”. Integrate the historical cultures and traditional customs of various Central Asian countries into language teaching, develop characteristic textbooks such as “Central Asian Culture and Chinese Expression” and “Application of Chinese in Central Asian Workplaces”; set directional courses such as Energy Chinese, Agricultural Chinese, and Cross-border E-commerce Chinese for the industrial advantages of different countries, realizing the precise connection between teaching content and local needs^[7]. At the same time, respect the differences in educational systems among Central Asian countries, and adopt a “modular teaching” model to adapt to local credit systems and teaching rhythms^[8].

(2) Cultivating a localized teaching staff

Implement a “dual-teacher co-cultivation” plan: on the one hand, strengthen localized training for Chinese dispatched teachers, offer courses related to Central Asian culture and local educational models, and improve their cross-cultural teaching capabilities; on the other hand, cooperate with Central Asian universities to carry out academic education and on-the-job training for Chinese teachers, invite experts from Chinese universities to give online and offline lectures, and cultivate a team of localized teachers who “understand Chinese, are familiar with the local area, and are good at teaching”. Establish a bilateral teacher exchange mechanism, promote mutual visits and research between Chinese teachers and local Central Asian teachers, and share teaching experience^[9].

(3) Establishing a localized evaluation system

Construct a three-dimensional evaluation model of “language competence + cross-cultural literacy + practical ability”, set up practical assessment content such as oral communication, business negotiation, and cross-cultural communication in combination with the workplace needs and cultural scenarios of the Central Asian region; introduce local enterprises and social organizations to participate in the evaluation process, and incorporate the job adaptation and social recognition of learners into evaluation indicators, forming a diversified and localized evaluation closed loop.

4.2. Promoting the industrialization upgrade of Chinese education guided by the orientation of “win-win cooperation”

(1) Building a diversified industrial ecology

Relying on the industrial advantages of the Central Asian region, expand the dimensions of the Chinese education industry: first, deepen the basic language training market, develop personalized courses for different groups, such as Chinese enlightenment for teenagers, workplace Chinese for adults, and Business Chinese; second, develop “Chinese + vocational skills” training, focus on key fields such as energy, agriculture, logistics, and cross-border e-commerce, and carry out customized training in

cooperation with local enterprises to cultivate compound language talents; third, extend the industrial chain, develop related industries such as Chinese translation services, cultural creativity, and cross-border educational tourism, forming an integrated industrial pattern of “teaching - training - services - cultural and creative products”^[10].

(2) Improving the market connection mechanism

Establish a coordinated mechanism of “government guidance, university leadership, and enterprise participation”, and build a China-Central Asia Chinese education industry cooperation platform. Through holding school-enterprise docking meetings, job fairs, and other activities, promote universities to sign cooperation agreements with local enterprises, build internship and training bases, and realize the seamless connection between talent training and job needs; carry out “order-based training” for advantageous industries in Central Asia such as energy, agriculture, and logistics, set courses and organize teaching according to enterprise needs, and improve the conversion rate of educational achievements. At the same time, build an online education platform with digital technology, integrate high-quality Chinese education resources, and expand the coverage of industrial services^[11].

(3) Strengthening industrial support guarantees

Increase capital investment in the Chinese education industry, encourage social capital to participate in industrial development, and establish a China-Central Asia Chinese education industry development fund; strengthen technical empowerment, promote the in-depth integration of artificial intelligence, big data, and other technologies with Chinese education, develop digital products such as intelligent teaching systems and Chinese learning APPs, and improve teaching efficiency and industrial competitiveness; build a regional Chinese education brand, enhance the influence and reputation of Chinese education through holding Chinese speech contests, cultural festivals, and other activities, and enhance industrial attractiveness^[12-14].

4.3. Building a long-term mechanism for integrated development based on the concept of “mutual assistance in times of need”

(1) Establishing a coordinated governance mechanism

Set up a China-Central Asia Chinese Education Cooperation Committee, composed of representatives from government departments, universities, and enterprises of both sides, to overall plan educational cooperation matters and clarify the division of responsibilities of all parties; establish a regular communication and consultation mechanism, promptly solve problems arising in the integration of localization and industrialization through holding cooperation meetings and conducting joint research, forming a governance pattern of “government coordination, university implementation, enterprise participation, and social support”.

(2) Building a resource-sharing platform

Integrate educational resources of both sides, build a China-Central Asia Chinese education resource library, covering textbooks, courseware, teacher training materials, industrial demand information, etc., to realize resource interconnection and sharing; promote cooperation such as credit recognition, course sharing, and joint school-running between universities, encourage Central Asian students to study in China or pursue Chinese-related majors through online platforms, and cultivate high-level bilingual talents; share industrial development resources, promote cooperation between Chinese education institutions and local enterprises and industry associations, build industrial colleges and R&D centers,

and realize the in-depth integration of the education chain and industrial chain.

(3) Strengthening cultural exchange empowerment

Centered on the China-Central Asia spirit, carry out various cultural exchange activities, such as “Chinese + culture” experience camps, Central Asian cultural exhibitions, and China-Central Asia military-civilian get-togethers, to enhance cultural identity and emotional resonance between the people of both sides; integrate cultural exchanges into Chinese teaching, allowing learners to understand the connotation of different cultures while mastering language knowledge and improving cross-cultural communication capabilities through situational teaching and cultural practice; encourage Chinese education institutions to cooperate with local cultural institutions to develop cultural and creative products with both Chinese characteristics and Central Asian cultural elements, promoting the coordinated development of cultural communication and industrial development^[15-17].

5. Conclusions

The China-Central Asia spirit provides value guidance and an action plan for the integrated development of localization and industrialization of international Chinese education. Its core connotation is highly consistent with the development goals of Chinese education, and can effectively solve the current problems of insufficient adaptation, backward industry, and weak integration faced by Chinese education. By promoting the quality improvement of localization with “mutual respect”, leading the industrialization upgrade with “win-win cooperation”, and building a long-term mechanism with “mutual assistance in times of need”, it is possible to build an integrated development ecology of “education adapting to the local area, industry developing in the market, and both sides advancing in coordination”, realizing the transformation of Chinese education from “scale expansion” to “quality improvement”, and injecting new vitality into China-Central Asia cultural and people-to-people exchanges.

Looking forward to the future, with the continuous deepening of the construction of the China-Central Asia Community with a Shared Future, bilateral Chinese education cooperation will usher in a broader development space. In the next step, we should further strengthen the leading role of the China-Central Asia spirit, continuously optimize the integrated development path, strengthen the application of digital and intelligent technologies, and promote the in-depth integration of Chinese education with regional industrial development and cultural construction; at the same time, pay attention to experience summary and model promotion, form a replicable and referable China-Central Asia Chinese education cooperation paradigm, and make greater contributions to promoting the high-quality development of global Chinese education and facilitating the exchange and mutual learning of different civilizations. It is worth noting that in the process of integrated development, full respect should be paid to the sovereignty and development demands of various Central Asian countries, and homogeneous promotion should be avoided. Precise adaptation of “one country, one policy” should be realized through differentiated strategies. At the same time, the prediction and response to cultural conflicts and market risks in the integration process should be strengthened to ensure the stable and long-term progress of cooperation.

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Exploration on the Construction of Smart Classroom of Mental Health Educational Curriculum of University in Big Data Era

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Abstract: The mental health educational curriculum in universities emphasizes the organic combination of theoretical knowledge and practice of the subject. In order to cultivate students' abilities such as independent thinking, experimental design and self-learning, it is crucial to actively apply Smart Classroom to the teaching of mental health educational curriculum in universities. Based on the requirements of Big Data Era, it is necessary to carry out a scientific review of the current teaching situation of mental health educational curriculum in universities. Besides, the teaching should fully take the characteristics of Big Data background into consideration, and actively carry out the practice and exploration of Smart Classroom teaching mode, in order to promote the personalized, in-depth, accurate and intelligent development of the curriculum.

Keywords: Big data; Smart classroom; Mental health education

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1. Introduction

At present, China makes great efforts to promote the reform of higher education system and the innovation of teaching methods, and focuses on the full integration of the Big Data in "Internet+" era and artificial intelligence into the teaching activities of higher education. This has become the mainstream trend of higher education reform promoted by the development of the times. In the Action Plan for the revitalization of teacher education (2018–2022) issued by the Ministry of Education, it is clearly stated that the education should actively promote the transformation of teaching methods characterized by autonomy, cooperation and inquiry, and make full use of different new technologies such as Cloud Computing, Big Data, Virtual Reality and Artificial Intelligence, aiming to promote the construction and application of teaching service platform for teachers' education information. Based on technologies and platforms such as Big Data, cloud computing, smart devices and the internet, Smart Classroom is a kind of teaching mode that subject knowledge will be vividly displayed to students with the help

of efficient and intuitive multimedia teaching system^[1]. It is important to fully rely on the Age of Big Data, try to closely combine the advanced artificial intelligence with the teaching of the curriculum, explore the construction path of Smart Classroom, and fully realize the individuation, deepening, precision and intelligentization of the curriculum. This is not only a strong call of the times but also inevitable trend of the innovation of the teaching of psychological health educational curriculum in China.

2. Review of the current teaching situation of mental health education in university based on the requirement of Big Data era

Literally, Big Data refers to the collection of massive data. According to the existing research, it should have basic characteristics as follows: firstly, the number of information data is extremely huge since Big Data is a collection of all kinds of information; secondly, the type of information data is various because Big Data is a kind of information resource produced by the integration and concentration of many kinds of information; thirdly, the transmission speed of information data is extremely fast due to the development of information technology; fourthly, the content of information data is changing rapidly; fifthly, the processing and filtering of information data is more complicated. Due to the large number of data sources and types, it is necessary to collate useful data through specific technologies in order to make effective use of it.

The curriculum of mental health is a compulsory and important basic for current college students. On the whole, in recent years during the teaching there are the following problems: firstly, the curriculum mainly focuses on the basic theoretical knowledge of mental health in the class, which lacks the training of practical abilities like students' self-design of psychological experiment and scientifically-solving of psychological problems and crisis intervention; secondly, its content is out of line with the theoretical courses and cannot keep up with the rhythm of the frontier research of psychology, which will do a harm to the students' systematic mastery of the more advanced theoretical knowledge, experimental practice and scientific research methods; thirdly, its teaching evaluation overemphasizes the academic examination results of the subject, neglecting the evaluation and examination of students' independent design of psychological experiments and practical operation skills, as well as their ability of scientific research. The curriculum should not only emphasize the basic theory, but also the ability to design experiments and practice independently. In other words, teachers should pay attention to both the theory and practice of to carry out teaching activities.

Based on this, it is very necessary to carry on the practical exploration of Smart Classroom teaching mode in the teaching practice. Smart Classroom is characterized by the digitalization of teaching decision-making, the immediacy of evaluation feedback, the three-dimensional interaction between teachers and students and the intelligentization of resource push, which will effectively stimulate students' self-learning awareness and enhance their self-learning ability^[2]. The comprehensive application of "Smart Classroom" in both theoretical and practical situations can not only promote the transformation from "knowledge classroom" to "Smart Classroom" but also help to liberate students from passive knowledge acquisition in the offline classroom, making students' learning change from knowledge acquisition to problem solving. In addition, during the process, teachers constantly put the standard of scientific research and spirit through every teaching stage, which enables students to solidify the norms and spirit of scientific research in wisdom, internalize it in heart and externalize it in practice^[3]. This is very important to improve the students' ability of independent study, independent thinking, independent experiment design, experimental-program making and experiment carrying out.

3. The necessity and feasibility of smart classroom construction of university mental health education in Big Data era

3.1. The construction of mental health education Smart Classroom in colleges is an urgent call for classroom teaching in the Big Data era

3.1.1 Mental health education Smart Classroom is more open and interactive

Compared with the traditional one of mental health education course, the teaching mode based on Big Data Technology and Internet Information Technology is more open and interactive. For one thing, the interaction between teachers and students in universities is greatly enhanced under this model, which can fully realize real-time communication. Because it is not too limited by time and space, teachers can use a variety of media to carry out teaching, and students can use micro-class, network platform, micro-blog, Wechat and other ways to learn. And for another, this model is more open. Traditional education pays more attention to the study of book knowledge, while under the mode of smart classroom teaching, teachers can provide students with abundant knowledge and information of mental health education at any time, and besides students can also consult all kinds of relevant knowledge independently, fully meet students' individual learning needs, and effectively improve the overall teaching quality of mental health education ^[4].

3.1.2 The construction of a mental health education Smart Classroom can effectively promote the continuous deepening of classroom teaching reform

After its appearance, the mental health education Smart Classroom is gradually favored by more and more teachers and students. It can help teachers to constantly sum up the teaching experience in the teaching process and constantly improve the theoretical basis, so as to better carry out the teaching reform. For example, when doing the course, we can show some classic cases to the students through multimedia equipment, and guide them to learn to carry out self-psychological adjustment in time when there is psychological pressure, or take the initiative to contact the teacher to talk about their psychological confusion. With the help of this teaching mode, we can better create a space for two-way communication and interaction between teachers and students, especially by building a diversified online teaching platform, which can promote effective interaction between both sides and make the development of teaching activities smoother and efficient. At the same time, with the help of Big Data to carry out accurate analysis of teaching data, teachers can understand students' psychological needs and state of mind in time, effectively formulate personalized solutions ^[5]. As a result, students' psychological needs can be fully met, and students are ensured to face the present with an optimistic and cheerful attitude to meet the challenges of the future society.

3.1.3 The construction of mental health education Smart Classroom can promote the teaching evaluation system to be more scientific and perfect

With this mode, the teacher can carry on not only the careful design to the teaching details, but also the supervision and the record to the entire teaching process, analysis and statistics of the whole teaching process of the data indicators. After each stage of teaching, the recorded teaching data can reflect the whole teaching process truthfully, comprehensively and objectively. According to these data, teachers can analyze their own strengths and weaknesses. Therefore, the teaching model can promote the teaching process evaluation system to be more scientific and integrated.

3.2 The necessity of Smart Classroom construction of university mental health education curriculum in Big Data era

The Smart Classroom is a new teaching model that has emerged in the early 21st century with the active advancement of new curriculum reform and liberal education. It makes full use of the communication network, computer technology and scientific management concepts in schools, highly integrated with in-class information resources related to learning, life services and management, and systematically combines with various digital teaching resources, in order to achieve unified access control, resource management and user management.

Professor Zhu Zhiting believes that the Smart Classroom includes the basic frame systems such as environment, teaching methods, and personnel training^[6]. Its basic aim is to implement the teaching and learning of wisdom and promote the development of learners' wisdom based on the intelligent teaching environment. As a new teaching mode based on modern information technology, this mode attaches great importance to the expansion of various teaching resources and learning facilities, greatly expands the teaching resources of the subject, and makes the whole teaching process more targeted and effectively helping students to complete personalized learning. Besides, teachers can also carry on an online comprehensive understanding to students' study conditions. Compared with traditional classroom teaching, this mode is more interesting and open, and can further integrate the teaching content and resources. Education is filled with wisdom through intelligent means, so as to stimulate the enthusiasm of students to participate in the study of the courses. At the same time, with the help of a scientific design rich in personalized, intelligent, and situational mental health education learning environment, teachers can transfer the focus from the knowledge to the development of wisdom and skills, which is helpful to improve students' learning efficiency and quality and effectively realize the individualized development of students. In addition, this mode can make the teaching evaluation timelier and more scientific, and make students and teachers discover their own defects in time, so as to realize the optimization of relevant teaching activities^[7]. The introduction of an AR interactive psychological sand table in smart classrooms combines the advantages of AR technology and psychological sand table. Through AR technology, students can simulate real-life scenarios in the virtual world, better understand human behavior and psychological activities; the psychological sand table can help students explore their inner world, enhance-confidence and self-awareness. For example, the system projects a virtual mountain and sea scene, students can push the mountains and seas, create freely, interact with birds, marine life, move mountains to fill the sea, trigger volcanoes, etc., to achieve inner relaxation in fun interaction, and teachers can also develop personalized plans according to student performance and needs.

The introduction of AR interactive psychological sand table in smart classrooms combines the advantages of AR technology and psychological sand table. Through AR technology, students can simulate real-life scenarios in the virtual world, better understand human behavior and psychological activities; the psychological sand table can help students explore their inner world, enhance-confidence and self-awareness. For example, the system projects a virtual mountain and sea scene, students can push the mountains and seas, create freely, interact with birds, marine life, move mountains to fill the sea, trigger volcanoes, etc., to achieve inner relaxation in fun interaction, and teachers can also develop personalized plans according to student performance and needs. In addition, the mode can provide timely data feedback on learning after the objective evaluation of teachers and students, which is beneficial for teachers to know the actual situation of themselves and students in a timely manner. Besides, it can also provide a reference for the further development of relevant teaching activities. The advantages of the mode are shown in **Figure 1**.

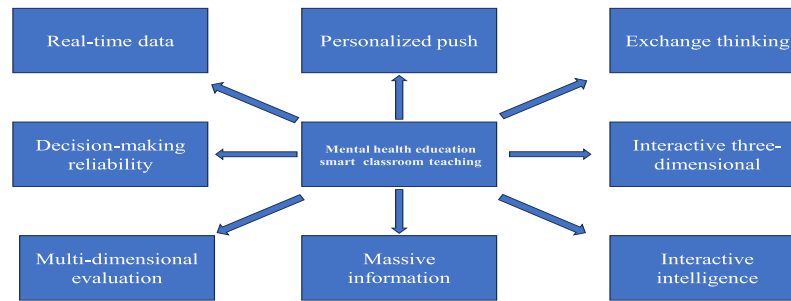


Figure 1. Advantages of mental health education Smart Classroom.

4. The practice and exploration of smart classroom teaching in university mental health education course in Big Data era

At present, as for the development of higher education, it has become an important direction to reform the teaching by means of internet information and Big Data technology. With the help of Big Data analysis technology, during the design process, teachers should fully consider the teaching needs of three stages of mental health education before class, during class and after class, it includes pre-class preparation and research, self-study guidance, resource sharing and interaction among students during class, and online testing and communication after class, do well in the detailed design such as learner analysis, teaching goal setting, teaching strategy adjustment, teaching evaluation and judgment, fully stimulate students' learning initiative and highlight students' main status, and to achieve truly innovative development. Combined with the practice and exploration of the mode in our university, there are the following five aspects for universities to construct the mode. The basic links of the mode is shown in **Table 1**.

Table 1. The basic links of Smart Classroom teaching

| Basic links | Teaching tasks |
|----------------------------------|---|
| Preparation before class | Analysis of learning situation Pre-teaching tests Teaching design Resource Push |
| Implementation Link in the class | Situation Creation Cooperative inquiry Display and share Assessment feedback Multiple evaluations |
| After-school promotion | Post-teaching tests Knowledge push Reflect on learning Expand and upgrade |

4.1. Reasonable selection of smart classroom teaching platform to do a good job before the introduction of preparatory work

In order to give full play to the advantages of the mode, teachers should first choose the cloud teaching platform more suitable for students to study, which can effectively improve the teaching efficiency. With the help of the current popular cloud teaching platform, teachers and students can use mobile phones, tablets and other tools for communication and interaction, fully realize the online communication and online teaching of high

integration. Besides, teachers can upload and download the course materials and information and carry out the daily teaching management. At the same time, each link for students to understand knowledge needs teachers to carry on scientific guidance. Under this mode, teachers should do a good job of leading preparation before class according to the needs of teaching objectives. In practice, teachers can use Big Data to analyze students' basic characteristics, teaching objectives and other contents, and push relevant learning contents to students before class^[8]. After that, teachers can use the school's smart classroom platform, smart phones, computers and so on to preview the lessons before class. Teachers can also make PowerPoint slides or short videos of teaching contents and send them to students to watch and learn before class, in order to help them fully understand the learning content before class. Teachers can also design a number of issues about the course, and let students study and communicate through the platform, thus contributing to more professional knowledge accumulation. Through their own careful access to relevant information, students can preview and understand the knowledge to be learned, which can lay a solid foundation for later learning.

4.2. Do a good design of smart classroom cultivation objectives and teaching models for mental health education curriculum

It should be said that the main training goal of mental health education course is to train students' ability of thinking, putting forward research problems and solving practical problems. Therefore, teachers should be good at guiding students to systematically study and master the contents of mental health education curriculum from both theoretical knowledge and practical operation, according to the relevant content, scientific and effective psychological experiments to design or solve practical psychological problems. At the same time, teachers should also be based on the overall needs of the society for the training of psychology professionals, the training objectives of mental health education courses and the actual learning situation of students, the knowledge goal, ability goal and quality goal of each unit are clear. According to the actual situation of mental health education course, teachers can change some of the theoretical and experimental classes into online self-learning. In the teaching process, the teacher can let the student study the related theory and the practice operation knowledge independently through the on-line video resource, guides the student to use the psychology related theory knowledge to raise the research question, under the guidance of the teacher, the students can independently complete the psychological experiment design, the psychological experiment programming and the concrete implementation of the relevant operating procedures. In the course of teaching practice, especially in the initial stage of teaching the theory course of mental health education, the teachers can introduce or design a large number of educational practice cases in combination with case teaching, to help students really understand and master the basic theoretical content.

At the same time, teachers should introduce or design cases to deepen students' understanding and mastery of mental health education theory, which will help students in the next stage of online learning, independently acquire the relevant theoretical knowledge in the field of practice and operation of mental health education. For example, in the special content of "Self-awareness", we help students systematically understand the relevant knowledge of self-awareness, such as MBTI personality test by combining online teaching resources. At the same time, we design activities such as "My Self-portrait", "Guess Who TA Is", "Growth Steering", "Wearing a Tall Hat" to help students fully and objectively understand themselves. We also follow up and urge students to start with small things in their daily life through such as "How to Break Through Self" to help students learn to persist in self-breakthrough and improve their self-awareness level. In the evaluation of teaching effect, the construction of mental health education smart classroom can track the whole process of students' learning, the data of real-

time test, after-class test and follow-up feedback in online classroom are integrated into the evaluation system of mental health education curriculum to realize real-time and dynamic feedback of evaluation information, reconstruct the formative curriculum evaluation system of mental health education. The design of the training objectives of the smart classroom for mental health education courses can be carried out from the following four aspects, as shown in **Table 2**.

Table 2. Design of teaching objectives for mental health education courses

| Cognitive objectives | Emotional attitude objectives | Behavioral objectives | Technology fusion objectives |
|---|--|---|--|
| Self-awareness expansion Cognition of psychological laws Technical tool cognition | Emotional regulation ability Cooperation and empathy consciousness Growth mindset shaping | Problem-solving skills Social interaction skills Self-help and help-seeking behavior | Technological empowerment Immersive experience Resource link |

4.3. To do a good job in the design of smart classroom teaching plan and teaching in the course of mental health education

Teaching in class is the main content of teachers' teaching work. After entering the stage of classroom learning, teachers can change the traditional teaching mode, make use of mental health education Smart Classroom and have good interactions with students, so as to further enhance the efficiency of classroom teaching ^[9]. Students have become the main body of study under the mode of Smart Classroom. Teachers can use various advanced techniques based on mental health education to provide professional guidance for students. For example, the content of the current lecture can be transmitted to the student's terminal and three-dimensional display, in order to help students understand the learning content. At the same time, to reduce the difficulty of learning, teachers can create an immersive situation, and guide students into the situation through teaching equipment and methods. Teachers can discuss the learning content or set up the application scene of the relevant professional courses, and then lead the students to apply the professional knowledge to solve the problems by role-playing. Generally speaking, the teaching content system of mental health education includes the basic theory and the practice. The content of the theory course, including the general principle, basic thought, basic method, and psychological experiment design of mental health education, can be arranged offline. The practical application, including the practical operation and specific application of mental health education, can be carried out online and offline in two ways. In practice, we mainly let students discuss various concrete problems in the field of mental health education, guide students to put forward problems, solve problems, and come up with corresponding suggestions. We should pay attention to combining the current research hot spots of mental health education and keep up with the pace of mental health education research. For example, in smart classroom education practice, we can try to write the corresponding psychological experimental program on E-Prime software, which is very operable and implementable. The main purpose of the offline experiment course is to let students work out the corresponding experiment program and implement the experiment operation according to the experiment design plan. In this way, students can master the professional knowledge of mental health education systematically, improve their practical application ability, and enhance innovative thinking. Combined with the characteristics of the mental health education curriculum, a three-segment mental health education curriculum smart classroom teaching design method can be used to carry out ^[10]. The basic elements of the model are shown in **Table 3**.

Table 3. Three-part mental health education course teaching design in smart classrooms

| Before class | In-class | After class |
|-------------------|------------------------|---------------------|
| Precise research | Interactive experience | Follow-up tutoring |
| Resource guidance | Data driven | Home-school synergy |

4.4. Do a good job of mental health education smart classroom courses online learning resources database design to consolidate the relevant knowledge

The online learning resource database of mental health education course should include three parts: teaching videos, course questions database and other learning materials. Teachers can record some micro-lessons about mental health education whose contents should focus on the content of teaching materials and expand on this basis. At the same time, teachers should set up questions database according to the teaching content, so as to supervise students' study and monitor their effect. In addition, teachers should widely collect and upload e-books, video resources, relevant research literature and cutting-edge information related to mental health education courses to the learning resource bank, so that students can supplement or expand their own learning content ^[11]. Smart classrooms can use sensors, cameras and other equipment to monitor and analyze students' expressions, behaviors and movements in real time. For example, students abnormal performance in class, such as looking down for a long time, staring vacantly, frequent small movements, etc., may indicate their poor psychological state. The can mark and warn these abnormal behaviors according to the predefined rules, and discover the possible psychological crisis of students in time.

After-class consolidation is the continuation and supplement of mental health education smart classroom teaching, because it can help students effectively strengthen the understanding and memory of mental health education classroom teaching knowledge. In the context of Big Data, teachers can effectively use Apps or cloud teaching platforms to consolidate students' psychological knowledge. For one thing, teachers can release the key knowledge content on cloud teaching platforms so that students can learn more emphatically after class. After class, teachers can use Smart Classroom to push students to review resources related to the major of mental health education. These resources should follow the development trend of the major at present, so that students can be guided through social surveys or social practice to complete. After completion of the wisdom evaluation of the classroom platform, teachers can give students special guidance based on the evaluation. In this way, students can continue to get opportunities to improve themselves after class. For another thing, teachers can arrange relevant homework topics on the cloud platform, so that students can finish them in their spare time. Through the platform, teachers can track and analyze the students' problem-solving cases, find out the deficiencies in the learning process and provide the basis for the next teaching activities.

4.5 We should attach importance to the integration of ideological and political elements in the smart classroom teaching of mental health education in order to cultivate students' humanistic spirit

According to the integration of ideological and political elements in the smart classroom teaching of mental health education, Big Data technology can make up for the lack of pertinence and effectiveness in the ideological and political education to a certain extent. With the help of the technology, we can effectively record students' learning trajectory, scientific analysis of students' mastery of knowledge, provide students with accurate personalized portraits, and dynamically study the students' ideological trends and their acceptance

of the ideological and political course, so as to realize individualized ideological and political guidance. This is beneficial to solve the problem that students' individual differences cannot be taken into account in large or combined classes of mental health education courses and improve the effect of ideological and political education. In the practice of education, we should conscientiously design the construction of ideological and political education in mental health education courses, and the specific content is shown in **Table 4**.

Table 4. Ideological and political teaching content of mental health courses

| Three classrooms | Three permeations | Three main threads |
|--------------------|-------------------|-----------------------|
| Classroom teaching | learning | cultural confidence |
| School activities | life | professional ethics |
| Social practice | work | spirit of cooperation |

In the course of mental health education, teachers should emphasize the ethical problems in order to cultivate students' humanistic spirit, emphasize rigorous experimental designs and strict experimental control in order to train students' rational spirit, positive spirit and realistic spirit; guide students to think about the problems and shortcomings of mental health education cases in order to train students' critical and skeptical spirit, guide students to put forward practical and social significance of mental health education research in order to enhance students' sense of social responsibility, cultivate students' spirit of innovation and exploration. At the same time, some smart platforms are installed with a psychological cognitive ability training system. We take the course of "letting eliminate the psychology of jealousy" as an example, teachers can use this system to evaluate and analyze students, fully understand the situation of students' jealousy, and students in a targeted way according to the detailed report obtained, so that students can gradually eliminate the psychology of jealousy and become more open-minded. In addition, in the practice of smart classroom teaching, teachers have more opportunities to adopt interesting and novel ways to make students accept the culture and values without psychological defenses, and to make subtle spiritual changes in the level of ideals and beliefs. Compared with the traditional explicit teaching method, it can more effectively eliminate the students' conflicted psychology in the process of cognitive learning and enhance the effect of ideological and political education in the course of mental health education.

5. Conclusion

To sum up, it is imperative to innovate the mode in the context of the Big Data era. With the help of Big Data and Smart Classroom, students' subjective initiative can be stimulated comprehensively, the benign interaction between teachers and students can be promoted, and the teaching quality and the overall quality of personnel training can be effectively improved, thus promoting the common development of both students and schools and sending more high-quality psychology professionals to the country.

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