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Research on Teaching Resource Generation for the Theory-Practice Integrated Curriculum in Higher Vocational Education from the Perspective of Human-Machine Collaboration

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Abstract: In recent years, there have been several issues with the development of theory-practice integrated teaching resources in higher vocational education: slow updates, a lack of individualization, and a long cycle. Generative AI offers a new approach to human-machine collaborative development of resources. Based on the case of the "Firewall Technology" course, an all-encompassing chain intelligent resource generation framework has been established in this paper to cover the conversion of knowledge points into project tasks, the generation of theory-practice integrated assignments, the creation of practical training manuals, intelligent generation of test item banks, and support for students' self-assessment and peer assessment. Using a prompt engineering approach that integrates role empowerment, task decomposition, format constraints, and iterative optimization, we developed a reusable prompt template library. Based on the above practice, the human-machine collaboration model can reduce the initial draft generation time of a single resource from several hours to a few minutes, achieve a quality level of good to excellent according to peer review, and increase the efficiency of personalized exercise generation by more than 80%. The model for human-machine collaboration in resource generation for the theoretical-practical integrated courses at the higher vocational education level put forward in this paper is effective and transferable.

Keywords: Human-machine collaboration; Theory-practice integration; Intelligent generation of teaching resources; Prompt engineering; Large language model

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1. Introduction

The main way to train technical and skilled personnel at the higher vocational level is through theory-practice integrated courses, and the quality of the supporting teaching materials will directly affect teaching results. The three main problems that have arisen in the development of traditional resource models over the years are: First, the development cycle is long; it takes several hours or even days for teachers to create high-quality theory-practice integrated assignments and training materials. Second, the speed of content updates is slow; static resources cannot keep up with changes in the industry, especially in rapidly changing areas such as cybersecurity. Third, there is a lack of individualized support; standardized resources do not meet the various learning needs of all students [1–3].

With the development of generative AI, new types of human-machine collaboration and development have appeared. Large language models can understand the instructions given in natural language, generate organized text, and have multi-turn conversations. Although some previous studies have applied artificial intelligence in the areas of instructional design and test item generation, most of them have only reached the level of "tool use" and have not established a general method for covering the whole resource development process [4–6]. The difference is more pronounced in the area of theory-practice integrated courses, which are typical features of vocational education. Wang Yali and others have investigated the full-cycle construction of AI-enabled course resources; Cao Rui and others have developed a platform for generating personalized test items; Chen Lu has studied the effect of prompt engineering on the creation of course syllabi and exercises; Ou Zhigang and others have tested the usability of AIGC teaching materials.

"Firewall technology" is taken as the case study in this paper to demonstrate the whole framework of intelligent resource development, covering all links from "knowledge points → project task transformation → theory-practice integrated assignment generation → training manual generation → intelligent test bank creation → support for student self-assessment and peer assessment". Prompt Engineering based on "role empowerment - task decomposition - format constraints - iterative optimisation" is employed to build a practical human-machine collaboration model for the development of vocational education resources here.

2. Theoretical foundation and overall framework

2.1. Theoretical foundation of human-machine collaborative education

The foundation of the development of human-machine collaborative teaching resources is the Distributed Cognition Theory. Cognitive activities are distributed among people, tools and environments according to this theory, and technological tools can extend the cognitive abilities of people. Teachers have disciplinary knowledge, pedagogical experience, and the ability to judge the quality of teaching resources; AI is good at rapid generation, text processing, and pattern recognition. The collaboration between the two forms a complementary, mutually reinforcing closed-loop process of "teacher design—AI generation—teacher review—iterative optimization" [4,5].

This paper will also present the Human-Machine Collaborative Cognitive Load Theory and the Socio-technical Systems Theory. AI can be employed to organize the routine and repetitive tasks of creating templates for configuration commands and standardizing test items; thus, teachers' cognitive resources will be released for more demanding work, such as evaluating the suitability of the content and its alignment with teaching objectives. At the same time, to ensure the long-term development and wide application of this system, institutional support in the form of a three-level review mechanism, prompt template libraries, and anti-plagiarism regulations should be provided. According to Cognitive Load Theory, the main goal of human-machine collaboration is to reduce both the teachers' generative cognitive load and the students' comprehension cognitive load.

The first division of labor in human-machine collaboration is that teachers act as "architects" to set learning goals, task structures, question types, quality requirements, anti-plagiarism measures, etc., and AI serves as the "implementer" to generate the first draft, provide solutions, and respond to revisions according to instructions. In this way, teachers can use their professional skills and AI will help increase the efficiency.

2.2. Principles for the development of theory-practice integrated course resources

In line with the Systematic Work Process Courses Theory and the philosophy of Action-Oriented Teaching, the construction of theory-practice integrated courses should be based on the following principles: contextualisation of tasks (integrating real-world enterprise project scenarios), transformation of knowledge points into project tasks (changing from a knowledge-based logic to an action-based logic), sufficiency of theory for practical application (limited to guiding the operation of practical training and aligned with operational sequences), and various types of questions with authentic assessments (such as fill-in-the-blank, tables, matching, short-answer and scenario analysis); training manuals should also have anti-plagiarism measures, such as personal identification screenshots and student ID directories [7–10].

2.3. General framework for intelligent generation of human-machine collaborative resources

The whole process of teaching resource development in this paper is shown through the framework of human-machine collaborative intelligent generation (**Figure 1**). Teachers need to be responsible for designing the overall courses, prompt engineering, quality assurance, and feedback on teaching materials; AI can help them create the first draft of courses and other materials, and then make several revisions based on feedback. Together, they will form project-based task systems, theory-practice integrated assignment banks, training manual libraries, dynamic question banks, personalized learning materials, and student learning profiles.

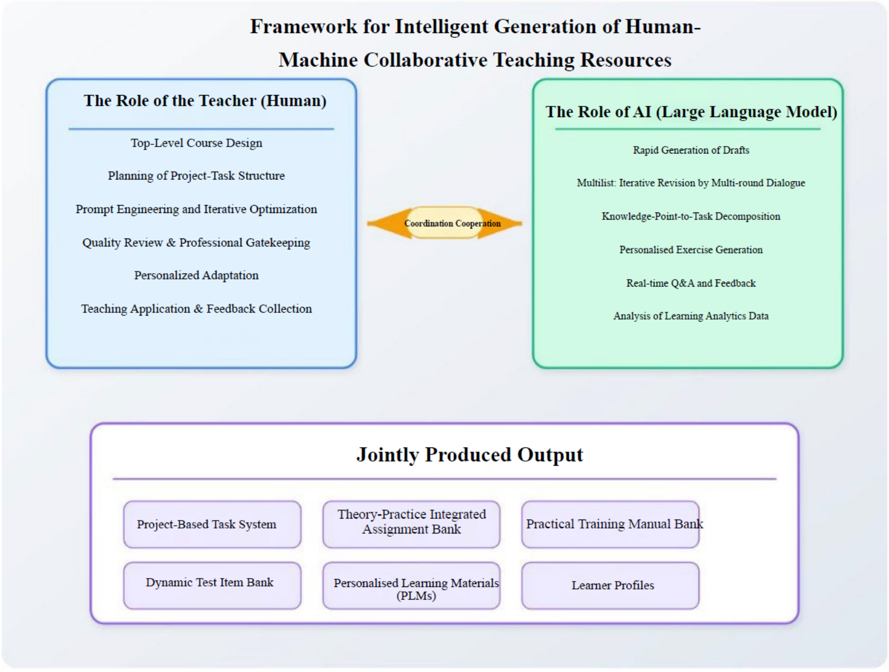

Figure 1. General Framework of Intelligent Generation of Human-Machine Collaborative Teaching Resources.

2.4. Prompt engineering and iterative optimization techniques

The four parts of the proposed prompt engineering method are: 1. Role Empowerment: Design the AI's role, such as a cybersecurity course teacher with 20 years of experience who is familiar with Huawei firewall configuration and has some knowledge of the cognitive patterns of higher vocational college students. 2. Task Decomposition: Break down a large development task into several small, manageable steps; for instance, in the creation of a practical manual, one can first have the AI set training goals, then present the network diagram, next write configuration steps, and finally list verification measures and discussion prompts. 3. Format Constraints: Specify the required structure of the output, such as "Display the results in a table", "Insert an empty line after each question", and "Precede all configuration commands with serial numbers". 4. Iterative Optimization: Repeatedly interact with and revise the prompt to improve the initial results. When teachers find that some parameters are missing or the difficulty of the AI-generated content is not suitable, they can issue targeted corrections, such as adding mode pat to the configuration command for Step 3; "Question 2 in the short-answer section is too difficult, please simplify it", etc. Generally, two or three rounds of revision can meet teaching requirements [4,6].

3. Principal use cases and prompt design

3.1. Conversion of knowledge points into project tasks

Traditional textbooks are organized according to the knowledge-based logic of "protocol principles → equipment configuration → comprehensive application", and theory-practice integrated courses need to be reformed based on the action-oriented logic of "project → task → knowledge points"—the two work together to achieve this goal [7].

Prompt Template: Based on the list of knowledge points above, design a Project-Based Task Structure for the "Firewall Technology" course. Requirements: 1. Cover the following knowledge points: Cybersecurity basics, Firewall Security Zones, Security Policies, NAT, Dual-Hot Standby, Encryption Technology, PKI, IPSec VPN, SSL VPN. 2. Organize the content according to the sequential workflow of enterprise network security construction and form five projects. 3. Each project should have 3–6 tasks, and the task names should describe what is done. 4. Output Format: A table with the project number, project name, task list, and related knowledge points.

The initial results of the AI were 5 projects and 24 tasks (**Table 1**), and then teachers reviewed and optimized them to create the final course structure.

Table 1. Structure of project-based courses generated with AI assistance (excerpt)

Project number	Project name	Core task	Knowledge points
P1	Introduction to Enterprise Network Security	Concept understanding, communication fundamentals, VRP operation, remote login	Definition of cybersecurity, TCP/IP protocol, VRP commands
P2	Building Enterprise Network Access Control Systems	Threat prevention, security zones, security policies, NAT, NAT Server	Attack types, security zones, policy configuration, NAT principles
P3	Ensuring Business Continuity	VRRP principles, hot standby, AAA authentication, user management	High availability, HRP, authentication & authorization, accounting
P4	Secure Remote Access	Encryption principles, PKI, IPSec VPN, SSL VPN	Symmetric/asymmetric encryption, digital certificates, VPN technologies
P5	Comprehensive Practical Training	Planning, deployment, testing	Comprehensive application

3.2. Intelligent generation of theory-practice integrated tasks

Theory-practice integrated assignments need to turn abstract theories into operational context problems, and the types of questions can be fill-in-the-blank, tables, matching, short-answer, scenario analysis, etc [1,10].

Prompt Template: You are a teacher of the "Firewall Technology" course at a vocational college. Design a theory-practice integrated assignment for the task of "[Task Name]" in accordance with the following requirements: 1. Create an actual enterprise introduction based on the scenario of a "Smart Agricultural Technology Company" (about 100 words). Add the following types of questions: 3 fill-in-the-blank questions, 1 table-filling exercise (3–4 rows), 2 short-answer questions, 1 matching exercise, and 1 scenario analysis question (describe a fault situation and have students analyze the cause). All the questions should be closely related to the practical training operations. Give the answer and a score. 5. Format Requirement: Leave a blank line between each question and use numbered labels for all items.

Take P1-T1 "Cybersecurity Concepts and Standards" as an example. In an AI-generated assignment, students need to map the three concerns mentioned by an employer in the AI's answer— "designs are being stolen", "the official website has been tampered with", and "business operations have been disrupted"—to the CIA triad and then explain each objective in a single sentence to the employer. Thus, the abstract knowledge will be applied in practice, and students will be able to learn by taking on the role of a security consultant.

3.3. Intelligent generation and anti-replication mechanism for training manuals

The training manual should present the operating steps clearly and have anti-copying measures to ensure the authenticity of the training [10].

Prompt Template: Please prepare a practical training manual for the "Firewall Technology" course on the "[Task Name]" (based on the eNSP simulator), and include the following sections: 1. Training goals (3-4 items); 2. Network Topology Diagram (Text Description Only); 3. Configuration Method (Step-by-step explanation); 4. CLI Configuration Commands (complete; add comments after important commands); 5. Web-based Configuration Method (short steps); 6. Verification Methods (at least two verification commands); 7. Anti-copy screenshot requirements: Open Notepad next to the eNSP window, show "Class + Name + Student ID", and take a screenshot that shows both in the same window; 8. Training Reflection Questions (2 questions); 9. Training Report Submission Requirements.

Anti-copying measure: Open a new Notepad window next to the eNSP window, display "class + name + student ID", take a full-screen screenshot of the whole window, and thus it is not possible to share screenshots for cheating.

3.4. Intelligent generation and multidimensional annotation of question banks

The question bank should have all sorts of difficulties, various kinds of questions, knowledge points, and supporting multi-dimensional tagging for convenient customization of test assembly [2,4].

Prompt Template: Design a post-class quiz for the course "Firewall Technology" based on the task "[Task Name]" (total of 15 questions) according to the following requirements: 1. 5 multiple-choice questions (3 basic questions and 2 application-oriented questions); 2. 5 multiple-choice questions (each has at least 4 options, and among them, 2 to 4 should be correct); 3. 5 true/false questions (including 2 common misconceptions); 4. Each question should have a difficulty level (easy/medium/difficult), the corresponding knowledge point, and a brief explanation (30–50 words); 5. All the essential knowledge points of this task should be covered in the content and linked to actual training.

Teachers review the questions generated by AI and, based on various reasons such as knowledge points, difficulty, question type, etc., add corresponding tags to build a dynamic question bank. Based on the data of incorrect answers, teachers can have the AI quickly create customized practice papers.

3.5. AI-assisted student self- and peer-assessment

After the students have finished writing their training reports, they can provide the information to the AI without any identifying information, and then the AI will give a score based on the reference grade and some suggestions for improvement in terms of the criteria. It should be pointed out that the AI does not grade the work; rather, it offers suggestions. This support reduces teachers' repetitive workload and promptly informs the students of any problems [5,10].

4. Implementation results and data analysis

Based on the above framework, 24 task resources have been added to the "Firewall Technology" course.

4.1. The development efficiency has risen

Table 2 shows the comparison of the efficiency of human-machine collaboration and traditional development models.

Table 2. Comparison of efficiency between human-machine collaboration and traditional development (average per task)

Resource type	Traditional development time(hour)	AI-generated draft time(minutes)	Teacher review iteration time (hours)	Total time savings rate
Theory-Practice Integrated Assignment	2.5	3–5	0.5	About 70%
Practical Training Manual	3	5–8	0.8	About 72%
Test Items (15 questions)	1.5	2–3	0.3	About 73%
Total for 24 Tasks	About 168 hours	—	About 38 hours	About 77%

Note: Savings Rate = (Traditional Development Time - Total AI-Assisted Time) / Traditional Development Time × 100%, where Total AI-Assisted Time = AI-Generated Draft Time (converted to hours) + Teacher Review and Iteration Time.

As shown in **Table 2**, the human-machine collaboration model reduced the development time of the 24 tasks from about 168 hours to around 38 hours and increased the efficiency by about 77%. The improvement is that AI has taken over the most time-consuming part—drafting—so teachers can focus on designing the framework and conducting high-quality reviews rather than writing word by word. Thus, the teachers' main responsibilities have shifted from "writing" to "reviewing and editing", and the amount of repetitive labor has been significantly reduced [3,4].

4.2. Quality validation via peer review

Five peer teachers were invited to anonymously review the 24 AI-generated resources, using a five-point rating scale (1 = poor, 5 = excellent). The review results are shown in **Table 3**.

Table 3. Peer review results for resource quality (average score)

Evaluation dimensions	Theory-practice integrated operations	Training manual	Test questions
Accuracy of knowledge points	4.7	4.8	4.8
Contextual Relevance	4.6	4.5	—
Appropriate difficulty level	4.5	4.4	4.6
Effectiveness of anti-copying mechanisms	—	4.9	—
Overall usability	4.6	4.7	4.7

The average rating of all resources is above 4.4, so they are considered "good to excellent". The score of the anti-copying mechanism in the training manual was relatively high, at 4.9; it was also mentioned that it had been "cleverly designed and was effective in preventing report plagiarism" [10]. The accuracy of the knowledge points was also relatively high, at 4.7–4.8, so it can be concluded that the professional content produced by AI is generally reliable. The main reasons for the minor deductions were "some questions are slightly too difficult" and "the scenarios could be more detailed"; these comments have been used to improve the system in the next iteration.

4.3. The effect of individualized learning support on students

According to the data on students' incorrect answers, teachers can have AI filter particular knowledge points and difficulty levels from the question bank and generate personalized practice sheets in minutes [2]. Out of the 86 students surveyed, 78 percent reported that "personalized exercises have helped me focus on my weaknesses effectively", so it can be seen that AI-assisted personalized resource generation can address the problem of "uniform exercises not being suitable for all individuals" in traditional classes. Resource Richness and Flexibility were given a satisfaction score of 4.5 out of 5. Given that there are frequent errors in the students' training reports, the AI will also generate specific troubleshooting exercises, such as "forgetting to enable port translation in NAT address pools" or "reversing the direction of IPSec interest flows", to address these common mistakes.

4.4. Student self-assessment and peer assessment as support tools

Teachers use AI to help grade students and reduce the time it takes to do so. 82% of the students have been able to identify problems in their reports with the help of AI feedback, and 76% believe that an AI-generated standard for peer review can make the assessment more objective. Therefore, this system can reduce the burden on teachers in grading and enhance students' self-reflection skills and assessment literacy [5,10].

5. Conclusion and outlook

The course "Firewall Technology" is taken as the case study in this paper, and we elaborate on how teachers and artificial intelligence can jointly develop theoretical-practical teaching materials.

5.1. Research results

According to the above research, human-machine collaboration has increased the efficiency of teaching resource development; that is, it is now possible to create 24 task-based resources in about 38 hours instead of around 168 hours, an improvement of about 77% [3,4]; AI-generated resources meet the requirements of teaching in terms of quality, and the average peer-review score is 4.4 or higher [1,6]; it provides a fast way to create personalised learning materials, and 78% of the students found them helpful [2,5]; AI can assist students in self-assessment and peer assessment to reduce the workload of teachers [10].

This study contributes several innovations. It builds a full-chain intelligent resource generation framework that fills a systematic gap in human-machine collaborative resource generation within vocational education. It also proposes a teacher-led prompt engineering approach, creating a reusable prompt template library [4]. Additionally, it integrates an anti-plagiarism mechanism into the practical training manuals [10]. Finally, it explores a new model of AI-assisted self- and peer-assessment for students.

This study has several limitations. Only one course has been offered, and the sample size is relatively small. AI-generated content may have errors that need to be corrected by teachers, and good prompts are required for human-machine interaction [5]. The above method can be used in other computer networking courses and more general engineering practice courses; its main framework is discipline-independent, the way of prompt engineering is generalizable, and the anti-plagiarism mechanism can be applied to any subject that requires lab report submission. In the future, we could develop a semi-automated prompt-generation tool, explore AI-assisted automated review, and expand this model to more courses [2,5].

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References:

[1] Wang Y, Kan D, 2026, Research on the Construction of Teaching Resources for Graphic and Image Processing Courses Empowered by AI. Computer Knowledge and Technology, 22(12): 114–117.

[2] Cao R, Hu B, Guo K, et al., 2026, Design and Application of a Multimodal Large Model-Empowered Personalized Test Generation Platform. Computer Education, 2026(03): 277–282.

[3] Wang G, 2026, Application of DeepSeek Technology in Enhancing the Efficiency and Quality of Teachers' Lesson Preparation. Science and Technology and Innovation, 2026(02): 237–239.

[4] Chen L, 2025, Construction and Optimization Research on an Intelligent Content Generation Framework for Higher Vocational Computer Courses Based on Key LLM Technologies. Journal of Hunan Post and Telecommunication College, 24(04): 30–34.

[5] Li M, Wei J, 2024, Applications and Challenges of Generative Artificial Intelligence in Vocational College Education and School Governance. Journal of Guangdong Agriculture Industry Business Polytechnic, 40(04): 53–58.

[6] Ou Z, Liu Y, Qin K, et al., 2024, Generation and Evaluation of Artificial Intelligence Multimodal Teaching

Resources—Based on the Application of AIGC in International Chinese Language Education. Modern Educational Technology, 34(09): 37–47.
[7] Jiang D, 2017, Structural Logic of Work Process-Oriented Curriculum. Education and Vocation, 2017(13): 5–12.
[8] Zhang Z, Xu X, Yang W, et al., 2022, Action-Oriented Teaching: Understanding, Practice, and Strategies—A Survey of 650 Vocational School Teachers from Seven Provinces and Municipalities. China Vocational and Technical Education, 2022(35): 33–41.
[9] Yang Y, Lin X, 2021, The Integration of Four Dimensions: The Rational Logic of Action-Oriented Teaching Method. Education and Vocation, 2021(02): 80–87.
[10] Cao Q, 2017, A Study on the Flipped Classroom Teaching Mode of Theory-Practice Integration Courses in Higher Vocational Colleges. Higher Vocational Education (Journal of Tianjin Vocational Institute), 26(03): 74–77+83.

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