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Interactive Teaching Mode of College English in Higher Vocational Colleges under the Smart Education Environment

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Abstract: Based on the case analysis of high-quality College English courses on public resource platforms such as "Vocational Education Cloud" and "Xueyin Online", this study establishes a classroom observation scale by drawing on the existing coding system for classroom teaching interaction behaviors. The MAXQDA (2022 version) analysis software is used to code the selected classroom samples. The study finds that the current interactive teaching in smart classrooms has the following problems: insufficient depth of cognitive interaction, marginalization of emotional interaction, and technical dependence in operational interaction. In response to these issues, countermeasures such as constructing a "three-dimensional integration" interactive teaching mode, developing intelligent interactive analysis tools, and strengthening teachers' digital literacy are proposed. This research provides theoretical references and practical paths for the construction of smart classrooms for College English in vocational colleges.

Keywords: Smart Education Environment; Higher Vocational Colleges; College English; Interactive Teaching Mode

1. Introduction

With the development of information technology, smart education has become an important trend in educational development. The Education Informatization 2.0 Action Plan (2018) emphasizes the need to carry out innovations in smart education and improve the application of information technology in teaching. Characterized by freedom, openness, and personalization, the smart education environment can promote teachers and students to jointly build a "learning community". As a compulsory public basic course for first-year students in higher vocational colleges, College English plays a crucial role in cultivating high-quality technical and skilled talents demanded by society. However, traditional College English teaching is plagued by monotonous teaching methods, low student participation, and unsatisfactory teaching effects. Under the smart education environment, how to innovate teaching modes, enhance teaching interactivity, and stimulate students' learning interest and initiative has become an urgent issue to be addressed in the reform of English teaching in higher vocational colleges. The development of public resource platforms provides abundant resources for teachers and students: teachers can design flexible and diverse teaching activities, while students can learn anytime and anywhere according to their personalized learning needs. As a teaching paradigm that emphasizes multi-directional interaction among "teachers, students, and technology", interactive teaching has great potential under the smart education environment. Therefore, taking the interactive teaching of College English courses on public resource platforms such as "Vocational Education Cloud" and "Xueyin Online" as typical cases to study the innovation of teaching modes under the smart education environment is of significant theoretical value and practical significance.

2. Literature Review

2.1 Smart Education Environment

Foreign research on the smart-education environment centers on two strands: theoretical explorations and empirical implementations. Theoretical studies argue that a smart environment can foster smart learning—for example, Elhoseny et al. (2017) propose a smart-learning model grounded in such an environment [1]. Kwet (2020) introduces “smart” technologies to delineate new rules and

technological paradigms for smart classrooms [2], whereas Kaur et al. (2022) contend that smart classrooms enable diverse educational actors to participate in depth[3]. Empirical efforts focus on actual construction and evaluation: Dooley (2011) builds smart classrooms within a smart-ecosystem framework [4]; Van Horne (2014) designs the TILE pedagogical mode supported by smart technology[5]; Kumara (2015) develops a teaching-evaluation system [6]; Unggyoung (2019) proposes a response system for smart classrooms [7]; and Petrović et al. (2022) experimentally demonstrate that communication and interaction in smart classrooms help educators optimize instructional arrangements and adjust teaching procedures[8]. In short, foreign research emphasizes practical exploration and exhibits increasing diversification.

Although Chinese scholars have yet to reach a consensus on the definition of "smart education", they converge on its technical features—openness, interactivity, and convergence—and on its pedagogical characteristics of intelligence and integration. Domestic studies can be grouped into four themes:

(1) Concepts and attributes: Zhu et al. (2023) argue that smart education is essentially characterized by "fourfold intelligence"—intelligent learning environments, smart pedagogies, adaptive learning services, and intelligent educational governance—underpinned by a closed data loop that realizes comprehensive perception, seamless connection and personalized diagnosis [9]. Huang et al. (2024) further define a smart-education environment as a "computable, evolvable and trustworthy" learning space whose core mission is to deliver precise, contextualized and ubiquitous educational services through trustworthy AI [10].

(2) Constituent elements: Liu et al. (2023) construct a structural model for smart classrooms from a "function–structure" perspective, identifying five core dimensions: blended physical–virtual environments, content-resource provision, teaching–learning interaction, evaluation–data governance, and ethical–risk control; the model's reliability and validity have been empirically verified [11]. Qi et al. (2024) propose a learner-centred, intelligently connected learning-environment framework that embeds ethical governance, trusted AI agents, multimodal perception and open services as requisite components, thereby achieving co-evolution between technological elements and the educational ecosystem [12].

(3) Design principles: Ye et al. (2023) advocate a "human–technology synergy" stance and set out four design principles for future smart-learning support systems: (i) learner-experience centrality, (ii) multimodal data-driven adaptation, (iii) algorithmic explainability and ethical auditability, and (iv) open sharing and continuous evolution [13].

(4) Practical applications: Wang & Yu (2024) develop and validate a multimodal-interaction observation tool for smart classrooms that simultaneously captures real-time evidence along three dimensions—facility operation, learning acquisition and content presentation—to provide teachers with just-in-time instructional decision-making support [14].

2.2 Interactive Teaching Mode

Foreign research on interactive teaching modes began in the 1980s. Palinscar(1983) proposes the interactive teaching method [15]. Rivers(1986) introduces the concept of "interaction" and elaborates the theory of interactive language teaching [16]. Brown(1994) proposes interactive testing theory from the perspective of second-language acquisition [17]. Gass(1997) argues that continuous input and interaction during second-language learning affect ultimate learning efficiency [18]. Kennewell(2005) explores how to use interactive teaching technologies to support and enhance classroom interaction[19]. Usmanova(2015) finds that interactive teaching improves students' communicative competence and satisfaction with teachers[20]. Karki(2018) adopts interactive teaching and learning methods to stimulate students' enthusiasm for English through varied classroom activitie [21]. Since the 1990s, Western research on interactive language teaching has become mature and has formed a systematic body of work.

Domestic research on interactive teaching started relatively late but entered a rapid-growth phase in recent years. Han (2025) uses narrative inquiry to document how an open-format interactive environment in a Chinese private university enables students to self-organise idea-generation, thereby raising

creative-performance levels [22]. Sun & Lee (2023) show that sustained peer-to-peer reasoning dialogues within an online STEAM collaborative writing environment significantly enhance Chinese primary students' creative ideation and language output[23]. Gong & Liu (2023) empirically compare design-task interactions in Chinese and overseas classrooms, concluding that local teachers' real-time, interactive mediation is the key predictor of students' creative-thinking gains [24]. Gu, Zhou & Fan (2023) reframe interactive teaching as a "tripartite creative-learning loop" (Asking–Doing–Evaluating) and demonstrate that when the loop is iterated within smart-classroom apps, students' fluency, flexibility and originality scores rise markedly [25]. Ministry of Education of China (2025) officially endorses AI-enhanced interactive pedagogies as the core mechanism for nationwide digital-education transformation, providing policy legitimacy and funding streams for future classroom-interaction research [26]. Against this backdrop, investigating interaction modes within smart-education environments is now more policy-relevant and research-urgent than ever.

3. Research Design

3.1 Research Questions

This study aims to explore the following specific questions:

By using the existing classroom interaction coding system, understand the current status of *College English* teaching interaction under the smart education environment from the classroom perspective;

Analyze the classroom teaching interaction of *College English* from three dimensions: cognitive interaction, emotional interaction, and operational interaction;

Propose a new interactive teaching mode for *College English* under the smart education environment to address the existing problems.

3.2 Data Collection and Analysis

3.2.1 Source of classroom cases

This study mainly selects representative excellent *College English* classroom cases from two platforms, namely "Vocational Education Cloud" and "Xueyin Online", as research samples. The classroom environments of these cases are equipped with rich intelligent teaching equipment, including interactive electronic whiteboards, mobile terminal tablets, and IRS (Interactive Response System) feedback devices. They also have flexible spatial layouts and support various teaching methods and modes by using media technology. Meanwhile, they support personalized resource recommendation, and teachers can manage teaching equipment, classrooms, and network control by using the Internet of Things technology. A total of 6 classroom videos are selected as cases, and the basic information of the case sources is shown in Table 1.

Table 1. Basic Information of Case Sources

No.	Case Name	Teacher	Teaching Duration	Source Platform
1	College English (Vocational Module)	Deng Xiaoya	64 class hours	Vocational Education Cloud
2	College English (Regular Class)	Xia Juan	64 class hours	Xueyin Online
3	College English	Guo Zhen	64 class hours	Xueyin Online
4	Higher Vocational English	Guo Zhanyan	64 class hours	Xueyin Online
5	Public English	Lin Shaorong	64 class hours	Xueyin Online
6	Practical English	Ren Ruina	64 class hours	Xueyin Online

3.2.2 Coding design

Based on "Human-Technology-Environment" interaction analysis coding proposed by Ye Xindong et al. (2011), the factors affecting teaching interaction behaviors are divided into teachers, students, technology, and environment, and the behaviors of teachers and students are classified into three levels: cognitive interaction, emotional interaction, and information interaction. Combined with the theme of this study, 18 specific indicators are set to formulate a coding system, and MAXQDA (2022 version) software is used for data analysis as shown in Table 2.

As shown in the Table 2, an average of 271.95 classroom teaching interaction behaviors occur in one class. Among them, the behaviors with a relatively high frequency (accounting for more than 5%) include the following types: "Teacher Instruction" (about 21 times, accounting for

8.49%), "Teacher Positive Feedback" (about 47.19 times, accounting for 16.15%), "Teacher Open-ended Questioning" (about 13.74 times, accounting for 5.21%), "Teacher Closed-ended Questioning" (about 29 times, accounting for 10.75%), "Teacher Technology Use" (about 37.12 times, accounting for 14.09%), "Student Active Participation" (about 27 times, accounting for 8.94%), "Student Active Answering" (about 24.79 times, accounting for 9.14%), and "Student Passive Answering" (about 28.15 times, accounting for 11.00%). However, some interaction behaviors occur less frequently, accounting for less than 1%, mainly including: "Teacher Criticism" (about 0.35 times, accounting for 0.13%), "Teacher Negative Feedback" (about 0.26 times, accounting for 0.19%), "Student Thinking" (about 1.63 times, accounting for 0.90%), "Student Negative Response" (about 0.77 times, accounting for 0.39%), and "Student Active Questioning" (about 0.23 times, accounting for 0.19%).

Table 2. "Human-Technology-Environment" Interaction Analysis Coding System

Category	Subcategory	Code	Description	Total Frequency	Average Frequency	Percentage (%)
Teacher	**Information Interaction**	1	Lecturing	72	15.31	4.63
		2	Instruction	132	21	8.49
		3	Criticism	2	0.35	0.13
	Emotional Interaction	1	Positive Feedback	251	47.19	16.15
		2	Negative Feedback	3	0.26	0.19
	Cognitive Interaction	1	Open-ended Questioning	81	13.74	5.21
		2	Closed-ended Questioning	167	29	10.75
	Operational Interaction	1	Technology Use	219	37.12	14.09
Student	**Information Interaction**	1	Peer Discussion	21	2.71	1.35
		2	Doing Exercises	26	4.37	1.67
		3	Thinking	14	1.63	0.90
	Emotional Interaction	1	Active Participation	139	27	8.94
		2	Negative Response	6	0.77	0.39
		3	Encouraging Peers	43	7.1	2.77
	Cognitive Interaction	1	Active Questioning	3	0.23	0.19
		2	Active Answering	142	24.79	9.14
		3	Passive Answering	171	28.15	11.00
	Operational Interaction	1	Student Technology Use	62	11.23	3.99
Total	Total	Total	Total	1554	271.95	100

According to the data in Table 3, the total average duration of classroom teaching interaction behaviors in one class is about 2644.02 seconds. Among them, the interaction behaviors with a relatively long duration (accounting for more than 5%) include: "Teacher Lecturing" (accounting for 10.68%), "Teacher Technology Use" (accounting for 14.65%), "Student Peer Discussion" (accounting for 13.45%), "Student Doing Exercises" (accounting for 7.56%), "Student Active Answering" (accounting for 12.28%), "Student Passive Answering" (accounting for 8.03%), and "Student Technology Use" (accounting for 12.00% in total).

However, some interaction behaviors take an extremely short time, accounting for less than 1%, mainly including: "Teacher Criticism" (average duration of 0.61 seconds, accounting for 0.02%), "Teacher Positive Feedback" (average duration of 0.29 seconds, accounting for 0.02%), "Teacher Negative Feedback" (average duration of 179.41 seconds, accounting for 6.33%), "Student Thinking" (average duration of 43.8 seconds, accounting for 1.53%), "Student Negative Response" (average duration of 3.78 seconds, accounting for 0.15%), "Student Encouraging Peers" (average duration of 26.07 seconds, accounting for 0.89%), and "Student Active Questioning" (average duration of 6.17 seconds, accounting for 0.24%).

Table 3. Summary of Duration of Classroom Teaching Interaction Behaviors

Category	Subcategory	Code	Description	Total Duration (seconds)	Average Duration (seconds/class)	Percentage (%)
Teacher	Information	1	Lecturing	1903.2	301.77	10.68

	Interaction	2	Instruction	853.1	151.9	4.79
		3	Criticism	4.2	0.61	0.02
	Emotional Interaction	1	Positive Feedback	3.1	0.29	0.02
		2	Negative Feedback	1127.8	179.41	6.33
	Cognitive Interaction	1	Open-ended Questioning	417.1	71.13	2.34
		2	Closed-ended Questioning	529.3	89.15	2.97
	Operational Interaction	1	Technology Use	2611.1	478.09	14.65
Student	Information Interaction	1	Peer Discussion	2397.3	391.18	13.45
		2	Doing Exercises	1347.2	229.30	7.56
		3	Thinking	271.9	43.8	1.53
	Emotional Interaction	1	Active Participation	371	60.21	2.08
		2	Negative Response	27.13	3.78	0.15
		3	Encouraging Peers	158.4	26.07	0.89
	Cognitive Interaction	1	Active Questioning	43.23	6.17	0.24
		2	Active Answering	2189.4	349.01	12.28
		3	Passive Answering	1432.2	257.12	8.03
	Operational Interaction	1	Student Technology Use	2139.8	5.03	12.00
Total	Total	Total	Total	17826.46	2644.02 seconds	100

3.2.3 In-depth analysis of classroom teaching interaction behaviors under the perspective of smart education

Through a brief analysis of the above data, a preliminary understanding of classroom teaching interaction behaviors is obtained. Next, a further analysis of the overall characteristics of classroom teaching interaction behaviors in these cases is conducted from the perspectives of cognitive interaction, emotional interaction, and operational interaction.

3.2.3.1 Analysis of classroom cognitive interaction

3.2.3.1.1 Analysis of teachers' questioning behaviors

Questioning is one of the most commonly used teaching strategies by teachers in classroom teaching and also a core link of classroom teaching. Good questioning can stimulate students' awareness of problems, enable them to independently explore and solve problems, inspire students to think at different levels, and thus promote the development of their higher-order thinking. Therefore, the current status of classroom cognitive interaction is obtained by analyzing teachers' questioning methods and the thinking levels involved in questioning.

First, the proportion of "teacher open-ended questioning" and "teacher closed-ended questioning" is counted. "Closed-ended questions" refer to questions with clear definitions, complete structures, and only one specific answer or conclusion. In contrast, “open-ended questions” have open structures, methods, and conclusions, requiring students to answer based on their personal experiences and ideas rather than simple memory and repetition. As shown in Table 4.

Table 4. Teachers' Questioning Methods

Content	Frequency	Proportion in Teachers' Questions (%)	Duration (seconds)	Proportion in Teachers' Question Duration (%)	Average Duration per Time (seconds)
Teacher Open-ended Questions	83	32.17	414.69	43.71	5.13
Teacher Closed-ended Questions	175	67.83	534.12	56.29	3.28
Total	258	100	948.81	100	8.41

As shown in Table 4, in the selected cases, teachers asked a total of 258 questions, with a total duration of about 948.81 seconds (approximately 15.8 minutes). Among them, "teacher open-ended questions" accounted for 83 times, accounting for 32.17% of the total number of teachers' questions, with a duration of about 414.69 seconds, accounting for 43.71% of the total duration of teachers' questions, and an average duration of about 5.13 seconds per time. "Teacher closed-ended questions" accounted for 175 times, accounting for 67.83% of the total

number of teachers' questions, with a duration of about 534.12 seconds, accounting for 56.29% of the total duration of teachers' questions, and an average duration of about 3.28 seconds per time.

The above data shows that teachers tend to use closed-ended questions to guide students' learning, and the frequency of using closed-ended questions is about twice that of open-ended questions. However, in terms of the duration per question, open-ended questions take a longer average time, indicating that teachers may pay more attention to guiding students to think in-depth when using open-ended questions and give more response time. On the whole, in the design of questions, teachers not only focus on the consolidation of basic knowledge but also pay attention to guiding students' thinking processes.

Second, based on Marzano's Taxonomy of Educational Objectives, the cognitive process is divided into three main systems and six levels, focusing on cultivating learners' higher-order thinking abilities and providing guidance for teachers on how to cultivate and develop students' thinking abilities in the teaching process. Through classroom video observation, the frequency of teachers' questions targeting different thinking levels in all cases is counted, and the specific data are shown in Table 5.

Table 5. Frequency Statistics of Teachers' Questions by Thinking Level

Question Thinking Level	Retrieval	Comprehension	Analysis	Knowledge Application	Metacognitive System	Self-System	Total
Total Frequency	29	26	22	9	6	7	99
Average Frequency	4.98	4.13	3.98	1.31	0.72	0.88	16
Percentage (%)	29.29	26.26	22.22	9.09	6.06	7.07	100

As shown in Table 5, the classroom questions raised by teachers cover all thinking levels involved in Marzano's Taxonomy of Educational Objectives. The total frequency of questions is 99, with an average of 16 questions per class. From the distribution of thinking levels, the questions mainly focus on the retrieval, comprehension, and analysis levels. Among them, the number of questions at the retrieval level is the largest (29 times, accounting for 29.29%), with an average of 4.98 times per class; the number of questions at the comprehension level is 26 times (accounting for 26.26%), with an average of 4.13 times per class; and the number of questions at the analysis level is 22 times (accounting for 22.22%), with an average of 3.98 times per class. In contrast, the number of questions at the knowledge application, metacognitive system, and self-system levels is relatively small, which are 9 times (accounting for 9.09%), 6 times (accounting for 6.06%), and 7 times (accounting for 7.07%) respectively, with an average of 1.31 times, 0.72 times, and 0.88 times per class.

This indicates that teachers' classroom questions focus more on basic cognitive levels (such as retrieval and comprehension), which helps students recall and master basic knowledge. At the same time, attention is also paid to questions at the analysis level to promote students' higher-order thinking. However, the frequency of questions targeting higher-level thinking skills (such as knowledge application, metacognition, and self-system) is relatively low, reflecting that teaching practice in this aspect needs to be further strengthened. In short, teachers take into account different thinking levels when designing questions, but the proportion of questions at each level still needs to be balanced to more comprehensively cultivate students' cognitive abilities.

3.2.3.1.2 Analysis of students' response and active speaking behaviors

Students' responses to teachers' questions can not only deepen their own understanding of knowledge but also help teachers understand students' mastery of knowledge points. The results of students' answers reflect whether they have achieved the teaching objectives, while students' active speaking behaviors are important manifestations of their participation in classroom teaching activities and can also reflect their thinking levels. Therefore, the current status of classroom cognitive interaction is understood by analyzing students' response and active speaking behaviors.

First, the proportion of "student active response", "student passive response", and "student active questioning" is counted and analyzed. "Student active response" refers to students actively expressing their own views on the questions raised by teachers. "Student active questioning" means that students take the initiative to ask teachers questions based on their existing knowledge structure. The specific statistical data are shown in Table 6.

Table 6. Students' Response and Active Speaking Behaviors

Content	Frequency	Percentage (%)	Total Duration (seconds)	Percentage of Total Duration (%)	Average Duration per Time (seconds)
Student Active Response	172	56.58	1551.2	50.84	9.02
Student Passive Response	126	41.45	1323.7	43.38	10.51
Student Active Questioning	6	1.97	176.3	5.78	29.38
Total	304	100	3051.2	100	48.91

According to the data analysis in Table 6, the number of student active response behaviors in the classroom is 172, accounting for 56.58% of students' response and active speaking behaviors, with a total duration of about 1551.2 seconds and an average duration of about 9.02 seconds per time. The number of student passive response behaviors is 126, accounting for 41.45% of students' response and active speaking behaviors, with a total duration of about 1323.7 seconds and an average duration of about 10.51 seconds per time. The number of student active questioning behaviors is 6, accounting for 1.97% of students' response and active speaking behaviors, with a total duration of about 176.3 seconds and an average duration of about 29.38 seconds per time.

The above data shows that student active responses account for the largest proportion, followed by student passive responses, but the gap between the two proportions is small. This indicates that students have a relatively high level of participation in the classroom and can actively respond to teachers' questions, and the frequency of active responses still dominates, reflecting that students have a certain sense of independent participation. However, the proportion of student active questioning is very low, accounting for only 1.97%, and it only occurs 6 times in the selected cases (with a long duration per time). This indicates that the cognitive interaction in the classroom mainly relies on the mode of "teacher questioning and student answering", and students have a weak awareness of active questioning and lack the ability of questioning, criticism, and reflection. Smart education emphasizes the cultivation of students' higher-order thinking, such as critical and creative thinking. Therefore, in teaching, more attention should be paid to stimulating students' enthusiasm for active questioning, and students should be encouraged to bravely express their personal questions and views through the design of heuristic activities and the use of technical means, so as to improve the quality of classroom interaction and the depth of thinking.

3.2.3.2 Analysis of classroom emotional interaction

The status of teacher-student and student-student emotional interaction in the classroom can be summarized by counting five aspects in the cases: teachers' positive feedback and negative feedback to students, students' positive response and negative response to teachers, and students' encouragement and help to peers. Among them, teachers' positive feedback to students, students' positive response to teachers, and students' encouragement to peers reflect positive emotional interaction between teachers and students and among students. In classroom teaching, the positive emotional expressions of teachers and students are key factors to enhance the infectiousness of teaching and build a harmonious teacher-student relationship. The degree of emotional interaction between teachers and students determines whether they can generate emotional resonance. Secondly, human emotions and cognition influence and restrict each other: positive emotions help stimulate, maintain, and regulate people's learning activities, thereby promoting the mastery of knowledge and the exertion of intelligence. In contrast, negative emotional interaction will reduce the enthusiasm of teachers and students and is not conducive to the development of classroom teaching. The specific statistical data are shown in Table 7.

Table 7. Emotional Interaction Behaviors

Content	Frequency	Percentage (%)	Duration (seconds)	Percentage of Total Duration (%)	Average Duration per Time (seconds)
Teacher Positive Feedback	283	59.21	1185.8	66.22	4.19
Teacher Negative Feedback	5	1.05	17.5	0.98	3.50
Student Positive Response	141	29.50	380.7	21.26	2.70
Student Negative Response	3	0.63	29.5	1.65	9.83
Encouraging Peers	46	9.62	177.1	9.89	3.85

According to the data analysis in Table 7, the number of teacher positive feedback behaviors is 283, accounting for 59.21%, with an average duration of 4.19 seconds per time, accounting for the highest proportion in all emotional interaction behaviors. The second is student positive response to teachers, which occurs 141 times, accounting for 29.50%. However, the frequency of students' encouragement to peers is relatively low, with only 46 times, accounting for 9.62%. This proportion indicates that the interaction among students is relatively limited, and the feedback mainly relies on teachers. Through classroom observation, it is found that most of the behaviors of encouraging peers are carried out at the request of teachers, and there is a lack of spontaneous active feedback behaviors among students.

Occasionally, there are behaviors of teacher negative feedback and student negative response in the classroom. Teacher negative feedback mainly manifests as teachers ignoring students or briefly denying them and then continuing the class when students raise their hands to answer questions, which may dampen students' enthusiasm to a certain extent. In addition, student negative response to teachers only occurs 3 times, accounting for 0.63%. These responses are caused by students' inability to answer teachers' questions or difficulties in expression, indicating that teachers' questions have a certain degree of difficulty. However, teachers can provide timely feedback and adjustments to gradually guide students to answer. Therefore, the classroom atmosphere is relatively good, and the emotional communication between teachers and students and among students is relatively harmonious. However, it is still necessary to further encourage students' independent interaction and positive feedback to enhance the depth and breadth of emotional interaction.

3.2.3.3 Analysis of classroom operational interaction

Under the perspective of smart education, students are in a personalized classroom environment, and media equipment and modern technology play a crucial role in the construction of learning spaces. The smart education learning environment emphasizes interaction: teachers use information technology to carry out teaching activities, integrate curriculum knowledge with information technology, and promote teaching through technology rather than using technology for the sake of technology. In this study, operational interaction is divided into "teacher technology use" and "student technology use". Through coding the selected case videos, the data on technology use are obtained, as shown in Table 8.

Table 8. Operational Interaction Behaviors

Content	Frequency	Percentage (%)	Duration (seconds)	Percentage of Total Duration (%)	Average Duration per Time (seconds)
Teacher Technology Use	216	77.42	2731.4	60.68	12.65
Student Technology Use	63	22.58	1769.3	39.32	28.08

As shown in Table 8, teachers use technology 216 times, accounting for 77.42%, while students use technology 63 times, accounting for 22.58%. Therefore, the frequency of teachers' technology use is significantly higher than that of students, and the interaction between teachers and technology is more frequent. This indicates that teachers can make full use of various functions in the smart teaching environment, are relatively proficient in the use of conventional teaching tools, and also have the awareness to let students use technology to participate in classroom activities. However, compared with the frequency of students' technology use, students' participation in technology is still insufficient, and technology application mainly focuses on supporting teacher-led teaching behaviors. It is necessary to further increase the frequency of students' technology use and enhance students' technical participation in the classroom.

In addition, teachers mostly use technology in teaching links such as presenting teaching content, providing positive feedback on students' performance, and pushing classroom exercises, while students mainly use technology in activities such as answering questions in a rush, completing answering tasks, and watching teaching resources. The in-depth operational interaction between teachers and students is still insufficient, and the innovation and diversity of technology application need to be improved.

4. Interactive Strategies for College English in Higher Vocational Colleges under the Smart Education Environment

4.1 Systematically Design Classroom

Questions for College English to Deepen Classroom Cognitive Interaction

4.1.1 Promote the transformation of classroom questioning subjects and highlight students' subjectivity in questioning

The classroom interaction under the perspective of smart education emphasizes equal dialogue among subjects, and this concept should be implemented through language practice in *College English* classrooms. With the "cultivation of language application ability" as the core, classroom interaction should be designed around text themes, grammar, and cross-cultural communication to realize two-way questioning. At the same time, students should be encouraged to actively ask questions from the perspectives of language details and cultural differences, so as to become the main body of questioning. Students' active questioning in *College English* classrooms can not only deepen their understanding of teaching content but also cultivate their awareness of problems in language output and promote the development of critical thinking and expression ability.

Therefore, teachers can reserve about 15% of "student questioning time" in teaching design to ensure students' right to ask questions. Secondly, smart technology should be used to stimulate students' enthusiasm for questioning: modules such as "anonymous questioning" can be set up on platforms like Rain Classroom and Xuexitong; online collaborative whiteboards can be used to organize group discussions to sort out ideas and form collective wisdom; AI voice evaluation tools can be used to provide real-time feedback on language errors in students' questions, so as to improve their language ability while questioning. Finally, question scenarios should be designed in combination with the characteristics of *College English*: scenarios should be adapted to students' majors and related to their interests, and "cognitive conflicts" should be used to stimulate students' awareness of questioning. For example, when explaining "cultural differences", teachers can guide students to find differences between their own cognition and the text, and then take the initiative to ask questions such as "How to avoid cultural offense?", so as to gradually improve students' consciousness and skills in questioning and realize the coordinated development of "questioning ability" and "comprehensive English application ability".

4.1.2 Reasonably arrange the proportion of question types and increase questions targeting higher-order thinking levels

The depth of classroom cognitive interaction depends on the quality of classroom questions, and the types of questions and the thinking levels involved in questions are crucial to the development of students' higher-order thinking. With the core of "serving professional learning and improving vocational English application ability", the design of questions for *College English* in higher vocational colleges should balance language training and the connection with vocational scenarios.

Firstly, the proportion of question types should be reasonably arranged to balance the openness of questioning. Question types include closed-ended questions and open-ended questions. Closed-ended questions are conducive to creating a relaxed and lively teaching atmosphere, have functions such as testing, regulation, and organization, and are suitable for basic language links in *College English* teaching in higher vocational colleges. In contrast, open-ended questions are more likely to stimulate students' higher-level thinking, expand the depth and breadth of their thinking, and can be designed in combination with the professional scenarios of higher vocational students.

Secondly, the proportion of questions targeting higher-order thinking levels should be increased, especially questions at the self-system level. In the introduction link of *College English* classes in higher vocational colleges, teachers can design question scenarios closely related to students' vocational lives to stimulate their desire for knowledge and enthusiasm for participation. At the same time, attention should be paid to the gradient of questioning levels: questions should be designed from easy to difficult and from shallow to deep. Basic knowledge can be consolidated through closed-ended questions first, and then in-depth thinking can be guided through open-ended questions, so as to help students solve problems step by step and develop higher-order thinking required in vocational scenarios while improving their language ability.

4.2 Create a Harmonious Classroom Atmosphere to Promote Classroom Emotional Interaction

4.2.1 Effectively use feedback strategies to promote teacher-student emotional interaction

The student-centered educational concept should highlight the integration of language

emotionality and vocational practicality in *College English* classrooms, so as to help students develop their careers and improve their English communication skills in workplaces. Emotional interaction can not only narrow the distance between teachers and students but also alleviate students' anxiety caused by "worrying about insufficient English application", thereby improving their classroom participation enthusiasm.

Teachers' feedback not only affects students' English academic performance (such as vocabulary mastery and sentence pattern application) but also serves as the leading force of emotional interaction in *College English* classrooms. Teachers' feedback is directly related to students' cognition of their own "vocational English ability". The feedback strategies adopted by teachers in the classroom not only affect students' cognitive depth of English grammar and vocational terms but also influence students' emotional attitudes (such as confidence and enthusiasm) towards English communication in future workplaces. Therefore, teachers should reasonably and effectively use feedback strategies in combination with the teaching objectives of *College English* in higher vocational colleges to promote teacher-student emotional interaction.

Firstly, targeted positive verbal feedback and responses should be given in a timely manner to students' performance in vocational English practice. For example, if students accurately use expressions such as "refund policy" and "after-sales service" in the simulation of "e-commerce English customer service dialogue", teachers can give feedback like "You've mastered key expressions for e-commerce customer service, which will help you handle foreign clients' needs in future work!". Even if students have expression deviations, teachers should first affirm their efforts (e.g., "It's great that you tried to describe the patient's condition in English!") and then guide them to correct, so as to build a good teacher-student relationship through positive feedback and enhance students' confidence in vocational English learning.

Secondly, targeted feedback language should be used to provide detailed feedback based on students' specific performance and professional needs. For example, when e-commerce major students simulate "cross-border live streaming with goods in English", if their body language is natural but the description of product selling points is not clear, teachers can give feedback like "You interacted with the 'audience' very vividly! Next, you can add more professional expressions like 'fast shipping' or 'quality guarantee' to make your introduction more attractive to foreign customers." For tourism major students' "English interpretation of scenic spots", if their pronunciation is standard but the introduction of cultural background is insufficient, teachers can feedback like "Your pronunciation is clear and easy to understand! If you can add a short introduction about the history of this scenic spot in simple English, foreign tourists will be more interested." Through detailed feedback adapted to professional scenarios, students can feel emotional support while clarifying the direction for improving their vocational English ability.

4.2.2 Attach importance to cooperative learning to promote student-student emotional interaction

Emotion is a fundamental element of cooperative learning. The emotional attribute is not only an important feature of cooperative learning but also an inherent requirement of English practice. Cooperative learning of *College English* should take emotion as the link to promote the coordinated development of vocational ability and comprehensive literacy.

Firstly, return to the essence of education and establish a cooperative learning concept of "language practice + vocational collaboration". The cooperative learning of *College English* should break away from the limitation of "simple grammar and vocabulary practice" and design tasks around vocational scenarios (such as "joint creation of English interpretation plans for scenic spots" and "collaborative writing of English diagnostic reports on automobile equipment failures"). This makes cooperative learning not only a carrier for improving students' English communication ability but also an effective way to cultivate team collaboration and professional literacy, enabling students to feel the value of "English serving the profession" in cooperation and strengthen their learning motivation.

Secondly, strengthen teachers' guidance and organization functions to build a professional-adapted cooperative group and emotional atmosphere. Teachers should form structurally reasonable cooperative groups based on students' professional directions and English proficiency (e.g., "cross-border e-commerce

groups" can be composed of students who "have a good command of English + are good at communication" and students who "are familiar with product knowledge + have weak expression ability"), so as to ensure that students can participate in vocational English communication equally. At the same time, "English ice-breaking tasks in groups" (such as sharing "the most desired problem to be solved with English in future careers") can be carried out to create an open and inclusive interaction atmosphere, avoid uneven participation caused by "differences in English proficiency", and enable every student to dare to speak and be willing to cooperate.

Thirdly, respect individual differences among students and design "hierarchical and progressive + vocationally related" cooperative tasks to promote emotional interaction. Teachers should take into account students' differences in English foundation (such as vocabulary size and oral fluency) and professional cognition (such as mastery of vocational terms in e-commerce, nursing, and automobile repair), and design tasks reasonably: basic-level tasks can be set as "group collaboration in translating vocational scenario dialogues (such as nursing English expressions for comforting patients)", while advanced tasks can be set as "simulating group plans for handling English customer complaints in cross-border e-commerce". This enables students of different levels to give full play to their advantages in cooperation, and deepen the emotional connection among students through interactions such as "helping classmates correct English expression deviations" and "sharing skills for memorizing vocational terms", so as to build a stable and mutually supportive cooperative learning community.

Fourthly, improve the multi-dimensional evaluation mechanism covering "cognition + emotion + profession". The evaluation content should cover three aspects: the cognitive dimension (focusing on "the quality of completing English tasks, such as the accuracy and logic of group English reports"), the emotional dimension (focusing on "the degree of tolerance and mutual assistance in group interaction, such as whether students take the initiative to encourage classmates with weak expression ability and listen to different opinions patiently"), and the professional dimension (focusing on "the embodiment of professional literacy, such as whether students complete English cooperative tasks in accordance with post standards"). The evaluation method can adopt "teacher evaluation + group mutual evaluation + self-evaluation", and the results should be fed back in a timely manner (e.g., "In the ‘cooperative response to English consulting of e-commerce customers’, your group not only accurately used terms such as ‘refund policy’ but also took the initiative to help group members sort out the logic of expression, with sufficient emotional interaction. It will be more perfect if you can add ‘consideration of cultural differences of customers’"). Evaluation should be used to guide the continuous optimization of cooperative learning.

4.3 Efficiently Apply Intelligent Technology to Empower Classroom Operational Interaction

4.3.1 Empower with the coordination of feedback and evaluation to realize precision teaching and motivation stimulation

In the smart teaching of *College English* in higher vocational colleges, the functions of real-time feedback and online evaluation should work together: on the one hand, technology should be used to break the traditional teaching model of "teacher-centered lecturing and student-centered listening" and strengthen the interaction in vocational English scenarios; on the other hand, multi-dimensional evaluation should be relied on to stimulate students' learning motivation, so as to achieve the dual goals of "precision teaching" and "active learning".

For example, with the help of intelligent tools such as Rain Classroom and Xuexitong, teachers can capture students' learning dynamics in vocational English in real time and provide real-time feedback: in the practice of "English product description in cross-border e-commerce", the real-time answering function can be used to check students' mastery of vocational terms such as "MOQ (Minimum Order Quantity)" and "shipping terms"; in the simulation of "nursing English doctor-patient dialogue", the real-time hand-raising function can be used to capture students' confusion about the application of sentence patterns for "symptom description".

This real-time and accurate grasp of students' learning situation can not only enhance the classroom vitality through "one-to-one Q&A" (such as guiding students to correct the expression deviation of "Please tell me your pain level" individually) but also stimulate students'

intrinsic motivation to participate in vocational English practice. Teachers can adjust teaching in real time based on feedback results: if most students have insufficient mastery of "English expressions for automobile equipment failures", group discussion tasks can be added temporarily; if students have a clear understanding of "the logic of English introduction to scenic spots", the advanced "simulation of English tour guiding" can be carried out. At the same time, by using the learning situation data generated by the system (such as the accuracy rate of vocational terms and the frequency of sentence pattern application), teachers can analyze students' learning shortcomings, identify the growth points of teaching (such as focusing on strengthening the training of "business English negotiation skills"), and realize the goal of "needs-oriented teaching" for *College English* in higher vocational colleges.

On this basis, a "vocational English practice + multi-dimensional interaction" online evaluation system should be built relying on technology: on the one hand, accurate feedback should be given to students' performance in vocational English based on the real-time feedback function of technology; on the other hand, student-student mutual evaluation should be strengthened through technology to enhance students' subject status. For example, in the task of "English case report of nursing", the online collaborative platform (such as Tencent Docs) can be used to set up "mutual evaluation dimensions" (including the accuracy of terms, logical coherence, and the embodiment of professional literacy), so that students can discuss the "rigor of English description of patients' conditions" and "clarity of English expression of nursing suggestions"; in the assignment of "English product poster design for cross-border e-commerce", the class voting function can be used to select the "most attractive English copy", so as to promote emotional communication (such as supplementing "your copy adds 'fast shipping', which is in line with the needs of foreign buyers" during mutual evaluation) and cognitive collision (such as discussing "how to highlight product selling points with more concise English") among students. Evaluation should be made an important carrier to stimulate students' intrinsic motivation for vocational English learning.

4.3.2 Reasonably use digital resources to optimize the presentation of knowledge content

Digital resources are the key support for the "vocational scenario-based teaching" of *College English* in higher vocational colleges. Their multi-modal characteristics can transform abstract vocational English knowledge into concrete practical scenarios, stimulating students' ability of independent cooperation and creation. For example, in the teaching of "business English correspondence", short video resources can be used to present the "real scene of English email communication in foreign trade companies", and dynamic PPT can be used to analyze the structural logic of "inquiry and offer" correspondence; in the teaching of "catering service English", VR resources can be used to enable students to "immerse themselves" in the "English ordering process in Western restaurants", mobilizing visual and auditory senses to promote the emotional expression of knowledge content (such as feeling the warmth of the polite expression "May I take your order?" in real scenarios).

At the same time, intelligent terminals (such as tablets and mobile phones) can make digital resources more accessible: students can review the video of "English explanation of automobile equipment disassembly" through the learning platform after class to consolidate terms such as "engine" and "brake system" repeatedly. However, the boundary of technology application should be grasped: excessive use of animation resources in the teaching of "basic English grammar in higher vocational colleges" should be avoided, so as to prevent students' attention from deviating from the core of "sentence pattern application"; in the teaching of "English resume writing", excessive template resources should not be piled up, but students should be guided to select suitable templates according to their own majors (such as "logistics management" and "early childhood education") to avoid information overload. Only by using digital resources reasonably and moderately can "technology for good" be realized, enabling students to think actively in vocational English learning (such as "how to adjust the content of English resumes according to post requirements") while paying attention to their emotional experience (such as enhancing learning confidence through "success cases of workplace English" videos).

4.3.3 Fully consider the disciplinary characteristics of english and strengthen the application of disciplinary functions

The disciplinary characteristic of *College English* in higher vocational colleges lies in the "combination of language instrumentality and vocational practicality". Therefore, disciplinary tools should be selected in a targeted manner to provide scaffolding for students' inquiry-based learning of English.

In the "vocational terminology and context teaching", the visual semantic tool XMind can be used to guide students to build a thematic vocabulary network around their professional directions. For example, students majoring in tourism can build a vocabulary network of "scenic spot English interpretation", associating sub-topics such as "attraction introduction", "cultural background", and "tourist service", and marking the collocation logic and pragmatic context of terms such as "UNESCO World Heritage Site" and "peak season" (e.g., "'peak season' is often used to remind tourists to book tickets in advance, and can be collocated with 'It's advisable to book tickets in advance during the peak season'"). This transforms "isolated vocabulary memorization" into "scenario-based meaning exploration" combined with vocational scenarios, laying a foundation for the subsequent practical operation of English interpretation.

In the "vocational English listening and speaking training" link, the "higher vocational special module" (such as "nursing English listening and speaking" and "automobile repair English pronunciation") of the AI voice evaluation system iFLYTEK can be used to provide personalized feedback for students. For example, when nursing major students practice "English expressions for comforting patients", the system can detect in real time whether the "tone" is gentle and whether "key words (such as 'don't worry')" are accurate, and give improvement suggestions such as "slow down the speaking speed appropriately and add comforting sentences such as 'I'm here to help you'"; when e-commerce major students practice "English live streaming with goods", the system can evaluate the fluency of "product introduction" and mark the "persuasive expressions (such as 'limited stock')" that need to be strengthened.

In the "vocational English cooperative writing task", online collaborative editing platforms such as Google Docs or Tencent Docs can be used to support students' real-time interaction around "major-related topics". For example, tourism major students can collaboratively write "English tour guides for scenic spots" and supplement the English description of "local customs" in real time; international trade major students can collaboratively complete the "drafting of English terms in foreign trade contracts" and revise the rigor of the expression of "payment terms" online. In the process of "individual thinking - tool assistance - peer mutual assistance", an efficient learning community can be built naturally to improve students' vocational English application ability.

5. Conclusion

Based on the development background of smart education, this study analyzes the current status of teaching interaction in *College English* classrooms in higher vocational colleges through empirical research. Combined with the core perspective of "technology empowerment", a classroom observation scale covering three dimensions ("cognitive interaction - emotional interaction - operational interaction") is established. The MAXQDA22 qualitative analysis software is used to code and quantify the classroom teaching videos, and the interaction rules are revealed through overall analysis. An in-depth analysis is conducted from the three dimensions to sort out the current situation of teaching interaction in smart education classrooms, condense the core characteristics of "technology - human - content" collaboration, and accurately identify existing problems (such as the formalization of emotional interaction and the insufficient adaptability between technology and interaction needs). The research conclusions have certain theoretical value and practical guiding significance for promoting the improvement of the quality of interaction in smart classrooms.

However, limited by the research samples (e.g., the cases are selected from colleges and universities in a certain region) and research cycle, this study still has shortcomings: first, the discussion on the differential characteristics of interaction in smart classrooms of different disciplines (such as liberal arts and science) is insufficient; second, the practical effect of the proposed strategies has not been tracked and verified. Future research can further expand the sample scope, carry out interdisciplinary comparative studies, and test the effectiveness of the strategies through action research methods to continuously improve the research results.

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