Design of Reading Question Chain in High School English Teaching Based on the Cultivation of Thinking Quality

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Abstract

The English Curriculum Standards for Compulsory Education (2022) clearly states that English curriculum design should play a leading role in core competencies. As one of the core competencies, thinking quality reflects students' levels and abilities in understanding, analyzing, comparing, inferring, criticizing, evaluating, and creating. The cultivation of thinking quality helps to enhance students' ability to discover, analyze, and solve problems. The English reading class is an important place to cultivate the thinking quality of high school students, and classroom questioning is a key link in the reading classroom. This study will explore the design of question chains in high school English reading to cultivate students' thinking qualities. The research question of this study is to explore the development status of students' thinking quality in current high school English reading teaching and the impact of problem chain teaching on their cultivation. This study will use various research methods, such as questionnaire survey and interview, to study the changes in students' thinking quality before and after problem chain teaching. Research has shown that question chain teaching has a certain promoting effect on students' thinking quality. This study can provide reasonable suggestions for future English reading teaching. In future research, exploring how to use problem chain teaching to cultivate students' thinking qualities in high school English listening teaching has practical significance.

Keywords: thinking quality, high school students, English reading class, question chain

1 Introduction

1.1 Research Background

1.1.1 Requirements of the English Curriculum Standards for Regular High Schools (2017 Edition, Revised in 2020)

The new curriculum standards clearly states that English courses should enhance students' core competencies of English discipline on the basis of implementing the fundamental task of cultivating morality and talents. The core competencies are the correct values, essential qualities, and key abilities that students gradually develop. The core competencies of English discipline include language ability, cultural awareness, thinking quality, and learning ability. Among them, thinking quality is a concentrated manifestation of the mental characteristics of the core literacy of the English subject. Therefore, high school English teaching needs to be reformed to improve students' ability to analyze and solve problems, and cultivate their thinking qualities.

1.1.2 The Problems in Current High School English Reading Classroom Questioning

The question is an inspiration for the development of thinking. At present, domestic and foreign research has found that there are a large number of problems in teacher questioning, such as imbalanced question types, excessive low cognitive level questions, high frequency of questioning, and lack of effective feedback (Wang, 2018). Liu (2019) pointed out that there are certain problems with current English classroom questioning. For example, the pertinence, comprehensiveness of questions were not strong. What is more, there was a lack of correlation between questions.

In fact, the cultivation of thinking quality cannot be separated from high-quality question design. question chain teaching emphasizes the integrity, systematicity, hierarchy, and relevance of questioning. It helps to guide students to explore knowledge deeply with questions, improve the problems existing in current classroom teaching, and promote

the development of students' thinking quality.

1.2 Research Objective

With the advancement of the new round of curriculum reform, the topic of cultivating students' thinking quality has received more and more widespread attention in the academic community. However, there is still a lack of research on cultivating students' thinking quality through classroom questioning. In order to implement the goal of the new curriculum reform on the cultivation of thinking quality, this study intends to understand the current situation of the cultivation of thinking quality of high school students through research, and explore the application of the question chain teaching model in English reading teaching, so as to promote the development of students' logical thinking, Critical thinking and creative thinking.

1.3 Research Significance

1.3.1 Theoretical Significance

English courses should enhance students' thinking quality because thinking quality is an indicator that distinguishes a person's thinking and even their intellectual level. The development of students' thinking quality is the foundation for improving their thinking ability and dialectical thinking in the future. As the foothold of curriculum reform, classroom teaching must not only focus on language, culture, and strategies, but also revolve around the development of students' thinking quality and design teaching models that are in line with students' thinking styles (Yuan, 2017).

This study explores how to cultivate students' thinking quality through designing question chains in high school English reading teaching, enriching the connotation of thinking quality, providing data support for the improvement of reading teaching theory, and further promoting research in cultivating students' thinking quality.

1.3.2 Practical Significance

Firstly, the classroom is a place for teachers to teach and students to learn, as well as an important place for teachers to help students develop their thinking qualities. As an important classroom teaching activity, classroom questioning can not only help teachers test students' learning situation, but also promote the development of students' thinking quality. Therefore, the research on the design of reading question chains based on the cultivation of students' thinking qualities is of great significance for teaching practice.

Secondly, this study can understand the current thinking level of students, make corresponding learning and thinking strategy adjustments, and further enhance their thinking ability and learning effectiveness. From the perspective of thinking quality, exploring the question chain of high school English reading teaching is of great significance for improving the teaching quality of reading classes, enhancing students' reading ability, and cultivating students' thinking quality.

2 Literature Review

2.1 Research Status of Thinking Quality at Home and Abroad

2.1.1 Domestic Research on Thinking Quality

Lin (1999) was the first person to conduct a research on the definition of thinking quality. He has proposed that the quality of thinking is a personal characteristic of human thinking, reflecting the differences in people's intelligence and ability levels. He argued that thinking quality was composed of five parts: depth, flexibility, agility, creativity and Critical thinking, which were interrelated and inseparable. The thinking quality mainly refers to the logical, critical, and innovative characteristics of thinking. Firstly, it requires students to be able to distinguish and analyze various phenomena in language and culture. Secondly, students should learn to classify and summarize information, construct new concepts, and analyze and infer the logical relationships of information. Finally, it requires students to correctly evaluate various ideological viewpoints, express their opinions rationally, and have the ability to engage in diverse thinking in English (Yuan, 2017). *The English Curriculum Standards for General High Schools* (2017 edition) listed thinking quality as a core competency in the English subject, proposing that thinking quality refers to the ability and level of thinking in terms of logic, criticism, innovation, and other aspects. Zhang (2023) believed that many people may interpret thinking quality as critical thinking, or interpret critical thinking as presenting different perspectives. This viewpoint is completely wrong.

In terms of cultivating thinking quality, Xia (2018) argued that cultivating and developing students' thinking quality in the English subject was to guide students to observe language and cultural phenomena, analyze and compare similarities and differences, summarize language and discourse characteristics, and identify language forms and

discourse structures. English reading teaching usually included several stages such as prediction, thinking, finding information, understanding meaning and intention, and discussion. If these teaching stages could be effectively designed and implemented, reading teaching would promote the development of students' thinking quality (Chen, 2018). Su (2022) believed that the cultivation of thinking quality was a key element in implementing the core competencies of the discipline and achieving educational goals. In teaching practice, teachers should always be student-centered, questioning, dialogue, and experiencing in a daily way, providing multiple support for students' thinking cultivation, and promoting their comprehensive development.

2.1.2 Research on Thinking Quality Abroad

In terms of the definition of thinking quality, Guilford (1950) studied intellectual structure and creative thinking from the perspective of thinking quality, and systematically and comprehensively tested the development of thinking quality around five aspects: language, writing, behavior, images, numbers, and space. He argued that thinking quality referred to the manifestation of intellectual characteristics in individual thinking activities, reflecting the differences in intelligence or thinking level of each individual. The thinking quality can be divided into aspects such as profundity, originality, criticality, flexibility, agility, as well as logical and systematic thinking (Liu, 2018).

On the cultivation of thinking quality, Glaser (1941) deeply studied students' Critical thinking from the psychological perspective, and regarded the cultivation of students' Critical thinking as the primary task of education. Sternberg (1986) proposed the theory of successful intelligence, believing that human success is determined by successful intelligence, and based on this, conducted thinking teaching experiments. He believed that successful intelligence included analytical thinking, creative thinking, and practical thinking abilities, and advocated cultivating these three thinking abilities in teaching practice to promote the development of intelligence. Doppelt (2009) maintained that high-level teaching design was more helpful in cultivating students' creative thinking. Steve (2014) found that effective teaching activities could promote the development of students' thinking quality. In short, thinking quality refers to the individual characteristics of individual thinking, mainly referring to the development of students in the three dimensions of logical, critical, and innovative thinking.

2.2 Research Status of Question Chain Teaching at Home and Abroad

2.2.1 Domestic Research on Question Chain Teaching

On the definition of the question chain, question chain referred to the process in which teachers, based on students' existing knowledge or experience, transformed textbook knowledge into a clear, systematic, and series of teaching questions in order to achieve certain teaching objectives. It was a set of central, sequential, relatively independent, and interrelated questions that aimed to address the confusion that students may encounter during their learning process (Wang, 2010). Question chain is a teaching method that is based on students' existing knowledge and experience, and aims to transform textbook knowledge into problem groups with certain relevance and logic in response to potential confusion and questions in their learning (Wang, 2023).

On the classification of question chains, Wang (2010) proposed that question chains can be divided into seven categories: introductory question chains, differential question chains, diagnostic question chains, exploratory question chains, migratory question chains, elastic question chains, and summary question chains. Wang (2017) maintained that question chains can be divided into two types: progressive question chains based on textbook logic and thematic question chains based on life logic.

On the Application of question chain in English Reading Teaching, Pei (2011) proposed three steps for applying question chains in high school English reading teaching: clarifying article ideas in the form of question chains, promoting understanding of details in the form of concept maps, and using question chains and concept maps to interpret discourse. Yang (2022) proposed the steps of the question chain teaching method. Firstly, it is necessary to clarify the pertinence of the question. Second is to explore how to construct and apply question chains. Finally, it is useful to leverage the value leading role of the question chain.

2.2.2 Research on Question Chain Teaching Abroad

Foreign research on questions mainly focuses on question teaching and its methods, with little research on question chains. Dewey (1916) proposed the problem-based teaching method and introduced the theory of "question solving" into pedagogy. Hillman (2003) further improved and developed the problem-based teaching method. He improved the unreasonable aspects of the problem-based teaching method and continuously improved the problem-based teaching method through experimental verification.

In terms of raising questions, Stevens (1912) pointed out that if teachers want to improve teaching, they must raise

questions that stimulate students to engage in reflective thinking activities. Rowe (1986) proposed that teachers should allow students appropriate thinking time after asking questions, which helps them extract relevant memories and engage in a series of thinking activities such as analysis, comparison, and association, making students' answers more complete and accurate. The more specific the feedback provided by the teacher, the more helpful it was for deepening students' thinking about the question (Stovner & Klette, 2022).

It can be seen that reaearchers abroad have always attached great importance to researches on questioning strategies and believe that classroom questioning is an effective way to cultivate thinking quality and provides a reference for relevant research on question chain teaching in China (Yang, 2017). Through reviewing a large number of literature, it can be found that the current research on thinking quality and question chain teaching has indeed achieved some good results. However, the current research on thinking quality and question chain teaching is mainly focused on theoretical research, lacking empirical research. Secondly, although there have been many studies on thinking quality and question chain teaching, there are relatively few studies exploring question chain design based on cultivating thinking quality. Especially for the basic Educational stage, how to train students' thinking quality and their ability to find, analyze and solve problems in classroom question chain design provides ideas for this research.

3 Research Design

3.1 Research Questions

In this study, two research questions were raised as follows.

Q1: What is the current situation of students' logical thinking, critical thinking and innovative thinking in the current teaching of English reading in senior high schools?

Q2: How does the question chain teaching that promotes the cultivation of thinking quality in high school English reading teaching affect students' critical, logical, and innovative thinking?

3.2 Research Object

The research object of this study is a public high school in Chengdu, Sichuan Province, involving three classes, 130 students, and 3 high school English teachers. These three classes are all regular classes, and their overall English reading level is not significantly different from other classes, and they are basically at the same level.

3.3 Research Methods

This study adopts a combination of quantitative and qualitative research methods, including questionnaire survey, interview, and classroom observation, to investigate and study the question chain teaching practice based on the cultivation of thinking quality in the school.

1. Questionnaire Survey

The questionnaire survey is divided into two sessions. The first survey is conducted before the action research, aiming to understand the current situation of the implementation of the question chain teaching in the test school to promote the cultivation of thinking quality and the current situation of the development of the students' thinking quality.

The second survey is to distribute the thinking quality tendency scale and thinking quality test so as to observe the changes of students' thinking quality after the implementation of the action research. The tendency scale adopts the Likert rating scale with a total of 20 questions, each of which corresponds to three options, namely fully compliant, partially compliant, and non compliant. The corresponding scores are 2, 1, and 0. The scoring criteria are: a full score of 40 points, a total score of>30 points, and a high level of thinking quality tendency; $20 \leq$ total score < 30 points, with a tendency towards moderate thinking quality; Total score < 20 points, thinking quality tendency level is at a low level. The thinking quality test includes Multiple choice and short answer questions, with a full score of 40 points. Both the tendency scale and test inspected students' thinking quality from three dimensions: logical, critical, and innovative thinking.

After collecting the data, SPSS 25.0 was used for data analysis and interviews, observations, and other means were used to understand the cultivation of students' thinking qualities.

2. Interview

This study will conduct semi-structured interviews. The interview is also divided into two sessions. The first interview is a semi-structured interview with the three senior high school English teachers before the start of the

action research to understand the current teachers' cognition and implementation of question chain teaching and thinking quality, as well as the cultivation of students' thinking quality. The second interview is to understand teachers' views on the implementation effect of question chain teaching and the prospect of future teaching after the implementation of action research.

The interviewees of this study were three high school English teachers, and their basic information is shown in Table 1.

Table 1. Teachers' Information

Number	Grade	Title	Gender
A	2	senior	Female
B	1	primary	Male
C	3	senior	Female

3. Classroom Observation

This study will observe the classrooms of three teachers and record the teaching effectiveness, classroom situation, and shortcomings. The focus of the observation is on the cultivation of students' thinking qualities, such as logicality, criticality, innovation, and the application of teacher question chain teaching.

3.4 Research Procedures

The entire research process includes the following three steps.

Step 1: To make a status survey before the action research

At this stage, it is very necessary to extensively read relevant literature and understand knowledge about thinking quality, question chain teaching, and other aspects. The second is to issue questionnaires. Before the action research, 130 students and 3 teachers in the three classes were issued questionnaires to understand the current situation of the question chain teaching in the three classes to promote the cultivation of thinking quality and the problems in the cultivation of students' thinking quality. Finally, interviews should be conducted with three teachers based on the prepared interview outline, and records should be kept.

Step 2: To implement the action research

Firstly, an action plan for question chain teaching to promote the cultivation of thinking qualities should be formulated based on the current situation of question chain teaching by teachers and the cultivation of students' thinking qualities. The second is to implement the action research according to the plan, evaluate the implementation effect after the action, and summarize to improve the teaching.

Step 3: To conduct post experiment testing

After the implementation of action research, the students' thinking quality tendency and thinking quality ability should be tested again, and the changes in students' thinking quality before and after the implementation of question chain teaching should be compared, sorted out and analyzed.

Step 4: To make a result reflection and improvement

Finally, it is necessary to organize and analyze the data obtained from the research, reflect on the question chain teaching process of teachers and the cultivation of students' thinking qualities, and further propose improvement measures.

3.5 Research Results

3.5.1 Survey Results on the Current Situation of Thinking Quality among High School Students

A total of 130 survey questionnaires were distributed to the three classes of the middle school, and a total of 125 questionnaires were collected, with a recovery rate of 96%. Among them, 121 were valid, with an effective rate total number of students, and 54 girls, accounting for 44.63%. The reliability and effectiveness of the questionnaire were analyzed. The six dimensions of KMO are 0.812, 0.807, 0.823, 0.782, 0.721, and 0.815, all higher than 0.7, indicating good effectiveness. In addition, the Cronbach's α from the questionnaire is 0.875, indicating good reliability. The results of the current development status of students' thinking quality are shown in Table 2.

Table 2. The Current Development Status of Students' Thinking Quality

Item	Thinking quality ability	Thinking quality tendency
Maximum score	36	35
Minimum score	6	11
Average score	24.15	21.57
Scores > 30	18	16
20≤scores < 30	51	45
scores < 20	61	69

From Table 2, it can be seen that 69 people, accounting for 53.1%, had a total score of less than 20 on the Thinking Quality Disposition Scale. 45 people, accounting for 34.6%, had a total score of less than or equal to 30 and more than 20. And 16 people, accounting for 12.3%, had a total score of more than 30. As for the thinking quality test, 61 people, accounting for 46.9%, had a total score of less than 20. 51 people, accounting for 39.2%, had a total score of less than or equal to 30 and more than 20. And 16 people, accounting for 13.8%, had a total score of more than 30. Based on the two tests, only 17 people have a higher level of thinking quality tendency, accounting for a total of 13.1%. The level of students' thinking quality is mostly concentrated in low and medium, accounting for a total of 86.9%, indicating that the overall level of students' thinking quality is generally low.

3.5.2 Current Situation of Cultivating Logical Thinking

According to the new curriculum standards, students' logical thinking levels include observation, comparison, analysis, inference, induction, and construction. The current situation of students' logical thinking in the tendency scale is shown in the following table 3.

Table 3. Results and Analysis of Students' Logical Thinking Quality

	A	B	C
Question 2	6.5%	55.3%	38.2%
Question 5	9.6%	61.5%	28.9%
Question 8	11.5%	49.2%	39.3%
Question 13	18.1%	48.9%	33%
Question 15	4.8%	57.5%	37.7%
Question 19	7.4%	75.2%	17.4%
Question 20	16.5%	56.5%	27%

A=fully compliant, B=partially compliant, C=non compliant

According to Table 3, Question 2: 55.3% and 6.5% of students partly agree or fully agree that they will guess the theme of the article based on the observation title or accompanying pictures to capture the reading objectives; 38.2% of students expressed a negative opinion; This indicates that most students will infer the theme of this discourse based on details such as graphics and text.

Question 5: 61.5% and 9.6% of students partly agree or fully agree that they will preset the theme content of the view during video viewing activities; 28.9% of students expressed a negative opinion; This indicates that most students will refine the theme of this article based on materials such as videos provided by the teacher.

Question 15: 57.5% and 4.8% of students partly agree or fully agree that they can summarize the characteristics of different genres of text, such as argumentative writing, expository writing, etc; 37.7% of students expressed a negative opinion; This Reflects that most students have a certain level of inductive ability.

In summary, the logical thinking of most students in reading activities can be valued, nevertheless it still needs to be strengthened in terms of deep exploration of the emotional value of the text, coherence of discourse content, and systematicity.

3.5.3 Current Situation of Cultivating Critical Thinking

Students' Critical thinking in reading teaching is mainly manifested in that students can give their own unique views and opinions when facing problems, and have the ability to analyze and question them. The current situation of students' critical thinking in tendency scale is shown in the following table 4.

Table 4. Results and Analysis of Students' Critical Thinking Quality

	A	B	C
Question 1	5.3%	32.3%	62.4%
Question 3	6.6%	54.3%	39.1%
Question 7	11.5%	38.2%	50.3%
Question 11	11.7%	44.4%	43.9%
Question 12	9.8%	47.5%	42.7%
Question 17	3.4%	36.2%	70.4%
Question 18	14.4%	45.1%	40.5%

A=fully compliant, B=partially compliant, C=non compliant

According to Table 3, Question 1: 32.3% and 5.3% of students partly agree or fully agree that they will seek help from teachers when encountering problems; 62.4% of students expressed a negative opinion; This indicates that a considerable number of students do not seek help from teachers.

Question 7: 38.2% and 11.5% of students partly agree or fully agree that they will express their ideas instead of supporting a viewpoint that has the majority of people's support; 50.3% of students expressed a negative opinion; This also reflects that most students tend to be more inclined and agree with others' viewpoints when facing questioning questions.

Question 17: 36.2% and 3.4% of students partly agree or fully agree that they will question and evaluate controversial English issues; 70.4% of students expressed a negative opinion; This indicates that students' self-reflection and thinking awareness are relatively weak.

In a word, in the process of cultivating students' critical thinking, most students can put forward their own views on the acquired knowledge in group discussions, and can solve problems through simple and effective activities. However, students still need to strengthen and improve their ability to raise reasonable doubts about various viewpoints and assumptions.

3.5.4 Current Situation of Cultivating Innovative Thinking

Innovative thinking is mainly manifested as students being able to innovate and seek novelty. Common innovative teaching activities for cultivating thinking qualities include brainstorming, debate, etc. The current situation of students' innovative thinking in tendency scale is shown in the following table 5.

Table 5. Results and Analysis of Students' Innovative Thinking Quality

	A	B	C
Question 4	12.7%	38.3%	49%
Question 6	9.6%	44.7%	45.7%
Question 9	5.4%	27.2%	67.4%
Question 10	18.4%	22.7%	58.9%
Question 14	12.5%	31.1%	56.4%
Question 16	7.6%	35.3%	57.1%

A=fully compliant, B=partially compliant, C=non compliant

According to Table 3, Question 4: 38.3% and 12.7% of students partly agree or fully agree that they can raise innovative questions and opinion; 49% of students expressed a negative opinion; This indicates that most students

are still unable to creatively express their opinions.

Question 9: 27.2% and 5.4% of students partly agree or fully agree that they will try various possible new solutions to solve problems; 67.4% of students expressed a negative opinion; This indicates that most students are not good at thinking creatively.

Question 16: 35.3% and 7.6% of students partly agree or fully agree that they have a rich imagination to think independently in English learning; 57.1% of students expressed a negative opinion; This indicates that discourse activities play an important role in cultivating thinking quality and are also important carriers.

In summary, in terms of cultivating innovative thinking qualities, most students have problem-solving ideas and awareness, but do not have the ability to solve the problems that arise. At the same time, teachers are required to design effective teaching activities in terms of innovative thinking qualities to enhance students' innovative thinking abilities.

3.5.5 Interview on the Current Situation of Question Chain Teaching in Promoting the Cultivation of Thinking Quality

In terms of question chain teaching, it can be seen that the teachers have some understanding of question chain teaching. However, their understanding is not very deep. At the same time, these three teachers have not yet used a fixed question chain teaching model in the reading class.

In terms of thinking quality, they maintain that the development of thinking quality is extremely important, emphasizing students' thinking ability, and agree that the development of thinking quality will also improve students' English learning effectiveness. At the same time, they also agree that if question chain teaching can be designed and implemented well, and applied to reading teaching, it can help students better grasp knowledge and improve their thinking ability.

In summary, it was found through interviews that the current use of question chain teaching models in schools is relatively limited. Many teachers do not have the awareness of question chain teaching, and only a small number of teachers are in the initial use stage.

3.5.6 Action Research Analysis of Question Chain Teaching in Senior English Reading Class

In order to explore the impact of question chain teaching on students' thinking quality, the author conducted in-depth observations of the classrooms of three teachers, and observed and recorded the situation of each teacher's question teaching.

Table 6. Overall Situation of Teacher Classroom Question Chain Teaching

	Average question numbers
A	24
B	34
C	29

From table 6, it can be seen that the average number of questions asked by these three teachers in each class is about 30. That is to say, on average, a teacher will ask a question in just over a minute. These data indicate that teachers attach great importance to the importance of questioning in reading teaching and have raised a large number of questions in the classroom. However, in English reading classes, having too many questions means that students need to spend a lot of time understanding the questions, which may reduce their reading time.

Table 7. The Average Types of Questions

	Introduction questions	Progressive questions	Exploratory questions	Migration questions
A	9	8	3	4
B	10	16	5	3
C	8	7	6	8

Therefore, the key to cultivating students' thinking quality is not to design too many questions, but to design different questions based on the characteristics of teaching materials and students' current level, guiding students' thinking quality to develop from a lower level to a higher level. On this basis, the author conducted statistics on the average types of questions asked by three teachers, and the results are shown in Table 7.

From the table, it can be seen that there are significant differences in the types of questions faced by different teachers. Introductory questions can cultivate students' analytical and summary abilities in thinking, which reflects the innovation of students' thinking. For example, question: "What can you get from the video" is an introduction question. Progressive questions can cultivate students' ability to analyze and synthesize, which reflects the logical thinking of students. This type of question has a significant effect on improving students' generalization ability. For example, question: "What might they talk about" is a progressive question. Inquiry questions can help students analyze and judge, improve their ability to distinguish right from wrong and their Critical thinking. Migration questions help cultivate students' innovative thinking. Teacher B has fewer migration questions, indicating that the teacher may have less training in students' innovative thinking. And Teacher C places more emphasis on students' innovative thinking.

Overall, teachers have placed more emphasis on introduction and progressive questions, while not paying enough attention to exploratory and migration questions. That is to say, teachers mainly focus on cultivating students' logical thinking qualities, while neglecting the critical and innovative cultivation of students' thinking qualities.

3.5.7 The Development of Students' Thinking Quality after Action Research

After the action research, the students' thinking quality was measured again, and the results are shown in table 8, table 9 and table10.

Table 8. The Development of Students' Thinking Quality after Action Research

Item	Thinking quality ability	Thinking quality tendency
Maximum score	38	39
Minimum score	19	21
Average score	35.43	32.78
Scores > 30	47	56
20≤scores < 30	64	53
scores < 20	19	21

Table 9. Paired Sample T test: Comparison of the Overall Level of Thinking Quality Tendency between Pre and Post Tests

	Sample size	Average value	Mean difference	Standard deviation
Pre-test	130	24.15	-11.28	10.584
Post-test	130	35.43		

Table 10. Paired Sample T test: Comparison of the Overall Level of Thinking Quality Ability between Pre and Post Tests

	Sample size	Average value	Mean difference	Standard deviation
Pre-test	130	21.57	-11.21	8.446
Post-test	130	32.78		

It can be seen from the table 8 that after action research, all items of students' thinking quality test have been significantly improved, such as the highest score, average score, number of excellent students, etc. Therefore, the results of the pre test and post test of students' thinking quality tendency have distinctiveness and differences.

It can be seen that after the implementation of Action research, the question chain teaching directed at the cultivation of thinking quality goals has a promoting effect on the three dimensions of students' thinking quality as a whole.

3.5 A Brief Summary

Research data shows that the question chain teaching model has a certain improvement and promotion effect on the overall tendency of thinking quality and the three dimensions of thinking quality ability: logical, critical, and innovative. Research has found that teachers may overlook exploratory and migration questions in the application of question chains, which may be detrimental to the cultivation of students' innovative thinking

Although this study confirms that question chain teaching has a promoting effect on the development of students' thinking quality, there are still shortcomings. The research sample in this study is not large enough, with only 130 students from three classes. There may be some randomness in the research conclusions. Therefore, more research subjects should be selected in the future.

5 Question Chain Teaching Strategies Based on Cultivating Thinking Quality

Questions play an important role in English reading classrooms, and their content and methods guide students' thinking direction. question chain teaching has an important impact on the development of students' thinking quality. Therefore, the author proposes the following strategies on how to use question chain teaching to cultivate students' thinking quality.

5.1 To Balance a Variety of Questions and Increase the Proportion of Higher-order Questions

Teachers should ensure the diversity of question types when designing questions, so that each type of question occupies a certain proportion. In addition, teachers need to broaden their perspective on questions, delve deeper into teaching content, design questions with high thinking content, and effectively increase the proportion of high-order questions while ensuring the proportion of low-order questions.

5.2 To Deeply Explore the Connotation of the Article

Exploring the connotation of an article can guide students to master language knowledge and skills, while also enhancing the logical and systematic thinking of students. Mind mapping is an effective reading teaching tool. It helps teachers clarify the logical mainline of the text, and also helps students master and apply reading text information, as well as master application skills and strategies. In addition, mind maps can also help students transform linear thinking into network thinking (Chen, 2005). Only after clarifying the content of the article can teachers raise more in-depth questions to stimulate students' thinking.

5.3 To Use Effective Feedback Language Reasonably

Feedback discourse is an important component of teacher discourse in the classroom, which refers to the main discourse content produced by teachers to consolidate and promote students' learning efficiency after completing a certain learning task. It mainly includes thematic feedback, formal feedback, and content feedback (Liu, 2009). In English reading teaching, in order to cultivate students' thinking qualities, teachers need to encourage students to think through the use of appropriate feedback discourse. Therefore, teachers should provide students with a certain amount of feedback after answering each question. The teacher first needs to confirm the students' answers and then question them again, triggering them to search for their language knowledge and fully apply it, thus completing the heuristic teacher-student interaction. On this basis, students can delve deeper into thinking and effectively activate their thinking.

5.4 To Emphasize the Analysis of Learning Situation and Highlight Students' Current Development Areas

The development of students' thinking quality level and language ability is not synchronous and has individual differences. Students with different levels of thinking quality differ in terms of difficulty, complexity, depth, and breadth of thinking. Therefore, when designing questions, teachers should not only fully consider the existing level of students' thinking quality, but also choose suitable learning materials for students based on their differences in thinking quality. They should also arrange learning activities of different complexity levels, design different learning objectives and evaluation standards, and teach students according to their aptitude.

5.5 To Design a Reasonable Question Chain Based on the Differences in Students' Thinking Quality Levels

In the implementation process of question chain teaching, the design of question chains is of utmost importance. There should be continuity before and after the question, and the difficulty of the question can affect students' thinking. Therefore, teachers should understand students' current thinking and cognitive levels, take into account students of different levels when designing question chains, and maximize students' participation. For students with strong thinking qualities, teachers can ask deep level questions to stimulate their desire for challenge and exploration,

which is conducive to promoting students' critical and creative thinking qualities. For some students with relatively weak thinking qualities, teachers must actively encourage them to participate in the classroom and actively participate in problem-solving.

6 Conclusion

This study starts from the perspective of cultivating thinking quality and employs a combination of classroom observation, questionnaire survey, and interview research methods to investigate the relevant situation of question chain teaching in the current high school English reading classroom.

6.1 Research Findings

In the process of question chain teaching based on cultivating thinking quality, based on two research questions, the following research findings are summarized.

Firstly, the development of thinking quality among high school students is currently uneven. Teachers focus more on cultivating students' logical thinking, but less on cultivating students' critical thinking and innovative thinking. From the reading teaching of these three teachers, it can be found that the questions raised by the teachers are more related to logical thinking. Critical thinking and innovative thinking are relatively a bit neglected. Most students, however, are eager to express their opinions. From this, it can be seen that teachers lack the cultivation of students' thinking qualities, and it is necessary to enhance students' higher-order thinking abilities and set more open-ended questions.

Secondly, the question chain teaching based on the cultivation of thinking quality has obviously promoted the development of students' logical thinking, critical thinking and innovative thinking. Research has found that after implementing question chain teaching, all three dimensions of students' thinking quality have been improved. Nevertheless, the practice of question chain teaching based on cultivating thinking quality in high school English classrooms is still in its infancy. Teachers have not tried this teaching method before, and it is difficult to avoid phenomena such as low order questions and single feedback. Overall, if high school English teachers want to use question chain teaching to cultivate students' thinking qualities, they still need to continue to hone and continuously improve their teaching methods in practice.

6.2 Limitations and Prospects

Due to the limitations of the implementation research, this study also has certain limitations, mainly in the following aspects. Firstly, the sample size is small. The research subjects were limited to 130 students from three classes. The research scope has certain limitations. Secondly, research time is limited. The development of students' thinking quality is a long-term process, although it has produced certain effects in the short term, it has contingency and requires long-term verification in the future. Finally, due to the need to improve the author's personal theoretical level and limited practical skills, the writing of this study has certain limitations. The discussion and analysis of some issues are not in-depth enough.

Due to the factors such as a lack of experience, this study only focuses on English reading classes. In future research, the applicability of question chain teaching based on thinking quality cultivation in other class types such as listening and writing will be explored.

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