CONSTRUCTION OF A TEACHING STRATEGY MODEL FOR CULTIVATING HIGHER-ORDER THINKING SKILLS IN COLLEGE STUDENTS

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ABSTRACT-In the era of the knowledge economy, the intensification of the technological revolution and international competition have triggered a rethinking of the core competencies of talent in the 21st century by countries. Many countries have shifted their focus on talent development from specialized knowledge and skills to training in complex tasks and information-processing thinking. In higher education, guiding students to transition from lower-order thinking, such as memorisation and understanding of knowledge to higher-order thinking, such as analysis, synthesis, and evaluation of various information is a vital aspect of the new era's innovative teaching model and the enhancement of talent cultivation. This study was conducted face-to-face interviews with 12 teachers with practical experience cultivating higher-order thinking skills using purposive sampling. The collected interview data were analysed and coded using nvivo software and qualitative research methods, constructing five teaching strategy models for cultivating higher-order thinking skills in college students: scaffolding instruction, heuristic instruction, project-based instruction, collaborative learning, and diversified assessment feedback.

INTRODUCTION

The global process of technological development has accelerated the iteration of knowledge and technology, thereby placing new demands on human capabilities. When cultivating individuals, higher education must focus on nurturing talents with higher-order thinking abilities, such as problem-solving, decision-making, critical thinking, and creative thinking(Abosalem, 2016). However, the traditional lecture-based teaching model emphasises teachers' dominant role and authority, who transmit knowledge to students in a one-way, standardised manner. Even if students can quickly absorb expertise and progress in certain types of learning in a short period, this teaching model can no longer meet the needs of current educational reforms. It fails to stimulate students' intrinsic motivation and interest in active exploration and deep learning and hampers the development of their critical and creative thinking abilities. Therefore, how to cultivate innovative, versatile, and technologically skilled talents with higher-order thinking abilities is another crucial question that higher education must address in the era of the knowledge economy(Damaianti et al., 2020).

This study references Zhong Z.X's (2004) viewpoint that 'the most effective way to cultivate higher-order thinking is to integrate it into specific disciplinary teaching activities(Zhong,2004b). It primarily explores the research question, 'What kind of teaching strategy model can effectively promote higher-order thinking in college students' (Assoc et al., 2016). Building upon existing literature and research on the connotation, components, and related studies of higher-order thinking, the study aims to foster college students' higher-order thinking abilities.

PROBLEM STATEMENT

Given the uniformity, standardisation, and institutionalisation characteristics of higher education institutions' traditional classroom teaching mode, the student's role could be more robust (Anisutiani et al., 2021). Moreover, due to individual differences and imbalances among students, most need more initiative and creativity, leading to their thinking being predominantly at a lower level during the learning process(Susriyati et al., 2019). Additionally, teachers need more systematic and practical guidance on teaching strategies. Therefore, how to construct scientifically effective teaching strategies

to guide teachers in cultivating college students' advanced thinking skills to meet the requirements of contemporary talent core competencies is a research question worthy of exploration in higher education.

Higher education needs to establish a new educational objective in response to the requirements of national education reform. This objective is reflected in cultivating and developing students' core qualities but, more importantly, in the renewal of teaching concepts and the innovation of teaching methods (Bambang et al., 2022). Looking at a series of important research topics in educational reform, the core idea is to shift from "rote learning" teaching to a learner-centred approach (Drigas & Mitsea, 2021). This approach aims to actively facilitate learners in progressively constructing their cognitive framework, thereby fostering the development of higher-order thinking skills.

This study explores the research question of how to construct a teaching strategy model that effectively promotes higher-order thinking among college students. Through conducting face-to-face interviews with teachers who possess experience in cultivating higher-order thinking through teaching practices, the study aims to understand the methods and activities these teachers have employed for fostering two types of higher-order thinking, namely critical thinking and creative thinking(Kwangmuang et al., 2021). Additionally, the study seeks to identify improvement plans and relevant cultivation recommendations intended for subsequent instructional design. Through these efforts, a preliminary theoretical model of teaching strategies is formulated to cultivate higher-order thinking (Maknun, 2020). This model encompasses specific instructional strategies for developing higher-order thinking, their meanings, core components, and their corresponding application in the classroom teaching process.

LITERATURE REVIEW

This study conducts a literature search and analyses both higher-order thinking and teaching strategies as domestic and international research topics. As shown in Figure 1.
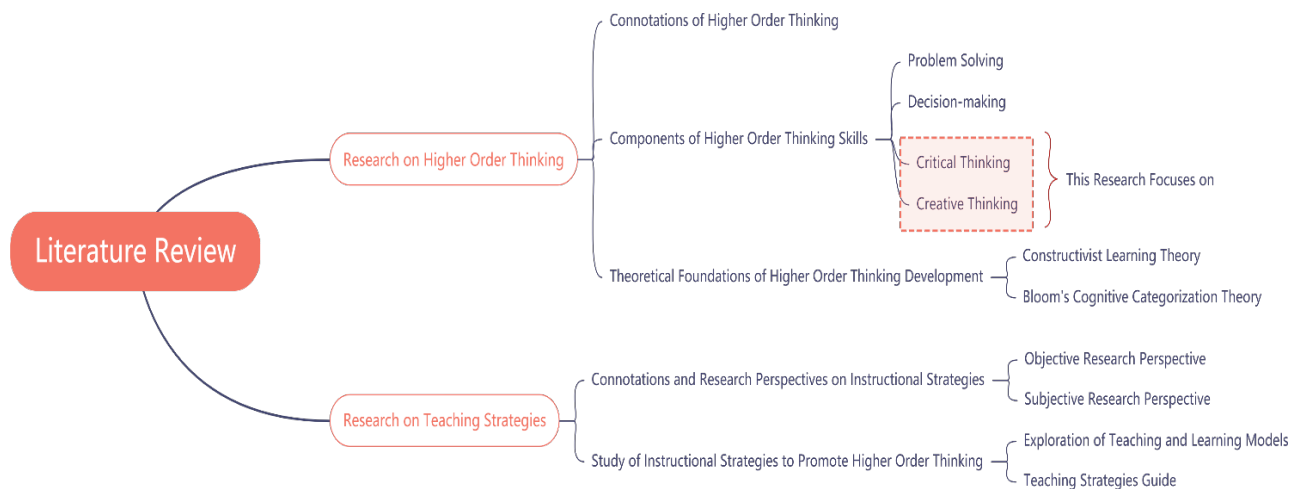

Figure 1. Literature review mind map

From the perspective of research content, foreign scholars have mainly approached the cultivation of advanced thinking in three ways: first, they analyse the theoretical aspects of cultivating progressive thinking and develop corresponding teaching resources; second, they focus on researching evaluation methods for advanced thinking to test their effectiveness in cultivation; third, they discuss the role of the technological environment in cultivating progressive thinking, believing that information technology has a promoting effect on the development of learners' comprehensive, evaluative, and creative thinking(Arnita et al., 2019). On the other hand, domestic research on advanced thinking can be mainly categorised into the following: first, introducing and comparing foreign research on progressive

thinking; second, exploring and studying specific types of advanced thinking; third, refining methods or models for cultivating advanced thinking in teaching; fourth, looking the promotion effect of information technology on the cultivation of progressive thinking from the perspective of subject curriculum(Zhang, 2021). However, the research on the practical cultivation of students' advanced thinking is relatively scattered, lacking systematic and universal approaches, and the generalizability of corresponding teaching methods and strategies needs to be considered.

The research on teaching strategies for cultivating advanced thinking can be primarily categorised into design strategies and model research. For example, Luo S.M (2011) proposed constructing teaching models such as autonomous, inquiry-based, and collaborative approaches to cultivating advanced thinking in graduate students. Some scholars have also used mind mapping in science teaching for case practice and analysis to train students' progressive thinking. They pointed out that mind mapping helps students break through fixed thinking patterns, lay a knowledge foundation for interpreting complex information, cultivate students' habits of using divergent thinking, and enhance classroom engagement (Liu, 2016). Reviewing existing research, it can be observed that teachers often rely on their personal teaching experience or intuition to select and implement corresponding teaching behaviours in actual teaching activities. Due to the need for more procedural knowledge for cultivating advanced thinking, i.e., a systematic set of teaching strategies and implementation steps as guidance, teachers often need clarification about how to conduct activities to develop students' advanced thinking in the teaching process. Furthermore, the evaluation of effectiveness is usually based on end-of-term test scores, which makes it challenging to reflect the dynamic development of students' advanced thinking during the learning process. A few comprehensive evaluation methods also have subject-specific characteristics, making it hard to apply them to the assessment of teaching in other subjects.

From a research perspective, the studies that consider teaching strategies as the object of research mainly focus on exploring the effectiveness of specific teaching strategies or methods or providing recommendations for their application in different teaching contexts(Seibert, 2021). However, they need more particular explanations and practical guidance for systematic teaching strategies. On the other hand, from the perspective of the object of teaching strategies (students), existing research on teaching strategies primarily focuses on factors such as students' cognitive styles and individual learning strategies at the primary education stage(Risdianto et al., 2020).

Regarding research conclusions, there have been studies on teaching strategies for cultivating advanced thinking. However, these studies' methods or approaches are generally described, making it difficult to implement specific and systematic teaching practices(Tambunan, 2019). This difficulty hinders the implementation of these strategies in frontline teaching. Consequently, it becomes challenging to evaluate the effectiveness of cultivating students' advanced thinking and achieve the goal of nurturing high-level talents that serve the country's needs.

METHODOLOGY

Research Design

1. Research Approach

This study employs the interview method, utilising face-to-face communication between interviewers and participants to analyse changes in the interviewees' psychology and behaviour. Understanding the interviewees' authentic experiences and perceptions regarding thinking development is essential to construct a teaching strategy model to cultivate higher-order thinking among college students. Face-to-face interviews with teachers with expertise in growing higher-order thinking allow for acquiring more accurate and effective teaching strategies.

This study obtains interpretive understanding by describing and analysing the construction of behaviour and speech through interviews with research subjects. This qualitative research method has unique advantages in understanding perspectives, data collection, and theory formation compared to other research methods (Minan et al., 2021). The Grounded Theory method does not make assumptions before the research. Still, it explores the core concepts that reflect things or phenomena based on data

collection. It establishes connections between ideas through open, axial, and selective coding to construct theory from the bottom up(Mayarni & Nopiyanti, 2021).

At the same time, this study uses NVivo14 software to analyse the coded interview data. This software can help researchers organise and analyse unstructured or qualitative data by coding and establishing conceptual network systems and has been recognised by many scholars both domestically and internationally (Brandão & Miguez, 2017).

2. Research Procedure

The researcher comprehensively considered the research objectives, characteristics of the research subjects, and topic. A semi-structured interview outline was designed, and a pre-interview was conducted before the formal interviews to ensure reliability and validity. To ensure the study's rigour, the researcher and experts in higher-order thinking cultivation collaboratively discussed and revised the interview outline. Additionally, the researcher underwent prior training in conducting interviews and coding. The specific research procedures are shown in Figure 2.
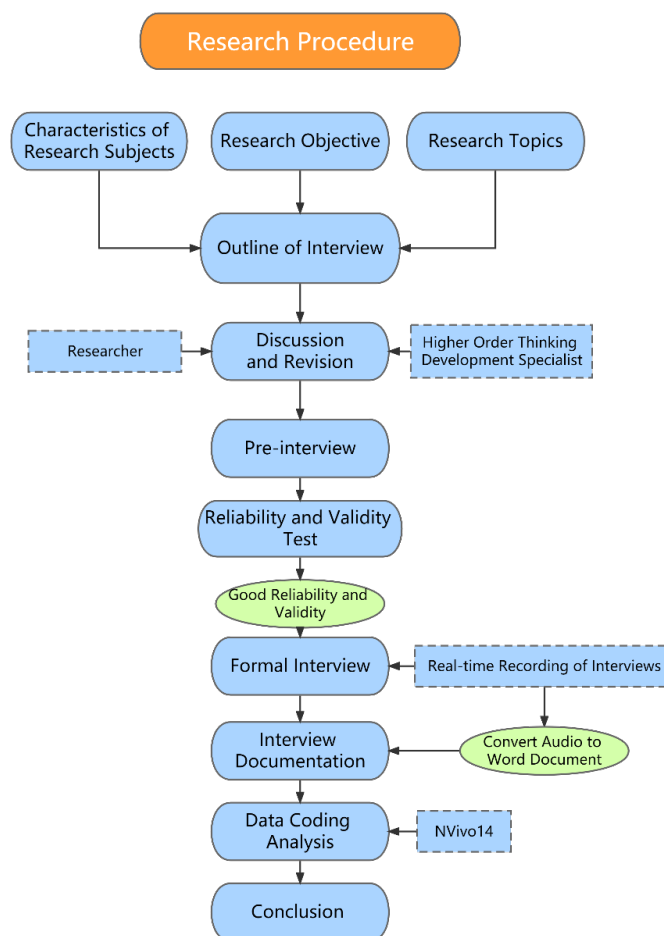

Figure 2. Research Procedure

3. Research Participants

This study employed purposive sampling to conduct face-to-face interviews with 12 teachers with practical experience cultivating higher-order thinking. The collected interview data were coded and analysed using the NVivo software and qualitative research methods. This analysis constructed a teaching strategy model to foster higher-order thinking among college students.

4. Research Site

The interview activities commenced on March 14, 2023, and concluded on March 23, 2023. The interviews took place in a quiet classroom and were primarily conducted face-to-face. The duration of the interviews ranged from 18 to 63 minutes. Upon obtaining the participants' consent, the researcher recorded the interviews in real time to transcribe the audio into Word documents (approximately 60,000 words). The transcriptions were labelled with the participants' codes (T1-T12).

5. Sampling

The approach used in this study is purposive sampling. The researchers selected 12 teachers from a university in City S who had previous experience teaching and cultivating advanced thinking (participating in the OECD project on critical and creative thinking development for university students) as interview participants. These teachers have a deeper understanding and relatively rich experience in cultivating advanced thinking compared to other teachers. The 12 teachers cover natural sciences, language, and education disciplines, equalising six male and six female teachers (Table 1).

Table 1. Basic information of the interviewed teachers

Majors Taught	Male	Female	Number of interviewees
Science Major	2	1	3
Language major	1	2	3
Education major	3	3	6
Total	6	6	12

6. Interview Questions

The interview outline, after discussions and revisions with experts in higher-order thinking cultivation, mainly focused on four questions:

- How do you understand higher-order thinking?
- What activities or methods have you employed to cultivate students' higher-order thinking? What were the effects of your course's effects?
- What difficulties or challenges have you encountered while implementing higher-order thinking cultivation in your teaching process?
- What adjustments or changes do you plan to make in the next round of teaching experiments?

Data Coding

The researcher imported 12 Word documents into NVivo14 software and used the grounded theory approach to code the interview data step-by-step. Initially, the researcher suspended personal "preconceptions" and conducted pre-coding during the open coding stage to clarify the meaning of words, sentences, and paragraphs. The researcher identified content related to teachers' understanding of cultivating higher-order thinking and provided preliminary names for them, marking them as free nodes. A total of 53 free nodes were formed through pre-coding, and after two researchers conducted independent coding and subsequent discussion, 46 free nodes were finalised.

Next, the researcher established connections among the free nodes obtained through open coding. After repeated comparisons, analysis, and integration, ten nodes were formed and labelled as three nodes. Based on the connections coding, the researcher further selected codes to develop "core categories" and finally determined three core categories: teaching strategies for cultivating higher-order thinking, influencing factors of producing higher-order thinking, and recommendations for cultivating higher-order thinking.

RESULTS

The two researchers first conducted an in-depth analysis of the interview data. Then, they proceeded with the back-to-back coding method, constructing five teaching strategies for cultivating higher-order thinking skills among university students. (The intercoder reliability coefficient was 0.870)

Through the first round of open coding, 29 nodes related to "teaching strategies for cultivating higher-order thinking skills" were identified. Among them, the top two nodes were "facilitating independent thinking" (mentioned 21 times) and "using questioning to guide students" (mentioned 18 times). Through further associative coding, the researchers classified all the nodes into five categories: "heuristic teaching," "project-based teaching," "scaffolded teaching," "constructing collaborative learning," and "multifaceted evaluation feedback."

Table 2. Teaching Strategies for Cultivating Higher-Order Thinking Skills and Reference Scores

Note: The numbers in parentheses represent the frequency of the respective nodes being identified in all interview texts.

Core Coding	Associative Coding	Open Coding
Teaching Strategies for Cultivating Higher-Order Thinking Skills	Scaffolded Teaching	Supplementary learning of required literature (14), selected teaching materials (11), deepening the understanding of conceptual knowledge (9), personalised tutoring (7), and pre-assessment of students' learning situations (7).
	Heuristic Teaching	Promoting independent thinking (21), guiding students through questioning (18), creating scenarios (8), fostering self-directed learning (8), encouraging divergent thinking (6), stimulating students' intrinsic motivation and interest (6), and analysing cases (1).
	Project-Based Teaching	Assigning thinking training tasks (14), setting goals (8), interpreting background (8), arranging progressive learning tasks (8), facilitating the transfer of thinking strategies (7), and requiring course paper writing (3).
	Constructing Collaborative Learning	Enhancing intergroup communication (14), implementing peer assessment within groups (12), promoting group collaboration (10), arranging group discussions (9), guiding reflection (8), and requiring assignment revisions and improvements (7).
	Multidimensional assessment feedback	Enhancing formative assessment (14), fostering an open course atmosphere (10), combining online and offline approaches (9), providing feedback (7), and increasing classroom interactivity (4).

Scaffolded Instruction

"Scaffolded instruction" is an instructional approach that accounts for 17.8% of the coding reference points. This study refers to the teacher gradually constructing a learning scaffold in the teaching process to guide and assist students based on the analysis of their learning situation. Research has shown that appropriate scaffolding is essential for promoting learners' higher-order thinking skills. Through action research, Guo et al. (2015) found that constructing learning scaffolds can effectively enhance college students' critical thinking. This study regards the core idea of the "scaffolded instruction" strategy as learner-centred, where teachers gradually build scaffolds by providing necessary

learning resources such as books, literature, or PowerPoint presentations, guiding students to solve problems they cannot handle independently, strengthening communication between teachers and students, and helping students move beyond their current developmental zone(Guo, J., & Guo, Y. H., 2015).

Therefore, this study proposes corresponding activity flow suggestions for "scaffolded instruction." Firstly, teachers should thoroughly analyse the student's learning situation, providing appropriate learning scaffolds based on the characteristics of the learning content, the instructional objectives' requirements, and the developmental status of students' thinking(Abrami, 2015). Then, they should carefully select learning materials closely related to the instructional content to enrich and enliven the learning process, helping students understand the key points and complex aspects of the knowledge and promoting the construction and improvement of their knowledge system(Lin et al., 2022). Gradually, this approach stimulates students' higher-order thinking and deep learning abilities.

Regarding how to build the "scaffold," based on existing research, teachers can consider the following methods:

a. Provide and encourage diverse viewpoints to promote mutual inspiration and cultivate independent thinking through debates(Noprinda & Soleh, 2019).

b. Initiate necessary discussions and exchanges for knowledge construction.

c. Pose timely questions, provide suggestions and feedback during the teaching process, and clearly explain critical concepts(Lee, 2014).

d. Provide opportunities for learners to share their experiences to facilitate mutual understanding and the construction of new knowledge (Zhong, Z. X., 2004c).

Correspondingly, to promote the development of higher-order thinking abilities, students need to do the following in scaffolded instruction: engage in learning with personal reflection, critically analyse and actively contemplate inconsistencies among viewpoints, revise relevant knowledge and experiences, actively conduct a literature review, selection, and extraction, and collaborate in group/team learning to improve the knowledge system collectively(Putri et al., 2020).

Heuristic Instruction

"Heuristic instruction," accounting for 25.7% of the coding reference points, in this study refers to the teacher's use of flexible and varied questioning techniques to promote independent thinking among students. It involves actively transferring and applying existing knowledge and experiences to current problems. Situated cognition theory suggests that learning aims to place oneself in specific contexts where knowledge is generated and actively participate in social practices within those contexts to acquire knowledge, construct meaning, and solve problems(Zohar, 2004). The essence and characteristics of higher-order thinking also emphasise the transfer and application of knowledge, requiring students to think independently, understand the learning content, and gain a deep understanding of the critical elements of the context(Seibert, 2021). They should be able to apply the concepts, principles, or methods through "analogical reasoning" and make accurate and precise judgments regarding different problems, thereby achieving the transfer and application of knowledge.

Therefore, the "heuristic instruction" proposed in this study integrates questions as the main thread for cultivating higher-order thinking abilities throughout the teaching process. Teachers can guide students to explore real-life problems through problem discovery, problem design, and layered questioning(Feriyanto & Putri, 2020). This further enhances the richness and completeness of the knowledge system. It helps teachers refine classroom teaching content and promotes students' reflection on the intrinsic connections of core knowledge points. By designing thoughtful questions, teachers attract students' attention to the core ideas expressed in the instructional content, enabling students to connect new knowledge with their existing knowledge and experiences(Hadisaputra et al., 2020). This stimulates students to compare, analyse, question, challenge, and innovate concerning the knowledge they have learned. Therefore, this study proposes a corresponding activity flow for "heuristic instruction," which involves teachers carefully designing higher-order learning questions,

closely integrating questions with real-life situations, stimulating students' curiosity and interest in learning, starting from details and perplexities, guiding students to actively discover and pose questions actively actively, and encouraging students to link knowledge with real-life contexts. This process facilitates the transition from lower-order thinking to higher-order thinking, ultimately achieving the goal of flexible transfer and application of knowledge.

Project-Based Instruction

"Project-based instruction," accounting for 17.8% of the coding reference points, in this study refers to the teacher's practice of collaboratively determining the course learning objectives with students and then assigning progressively challenging thinking tasks. This approach encourages students to comprehensively apply their existing knowledge and skills to complete tasks, design projects, and produce a product that reflects integrated knowledge(Hamzah et al., 2022). The core elements of project-based instruction include functions that aim to develop higher-order thinking abilities, such as project design, topic presentations, and case analyses. These tasks are both challenging and relevant to real-life situations. Compared to traditional instructional models, project-based instruction places greater emphasis on student autonomy, and the teacher's role primarily involves guidance and facilitation of project progress, as well as engaging in extensive communication and discussion with students during project implementation.

The corresponding activity flow proposed in this study for project-based instruction involves teachers setting clear objectives and driving student self-regulated learning through challenging and exciting learning tasks/projects. This includes overcoming difficulties during the deconstruction of project requirements, managing time and progress effectively, promoting deep processing of learning content, and continuously engaging higher-order thinking abilities to produce the final product(Hwang et al., 2019).

Therefore, when assigning learning tasks/projects using the project-based instruction strategy, teachers should strive to stimulate the following thinking processes in learners(Putranta & Supahar, 2019):

a. Comparing, contrasting, and clarifying differences and similarities between objects or phenomena;
b. Classifying objects based on their properties and features;
c. Generalizing abstract principles through observation, analysis, and summarisation;
d. Deducing unknown results through logical reasoning based on existing principles and laws;
e. Identifying and clarifying flaws in one's own and others' thinking processes;
f. Providing objective supporting evidence for each viewpoint or opinion;
g. Identifying hidden patterns or regularities beneath complex information;
h. Clearly and concisely explain viewpoints on problems and outline the thought process for completing the project.

In other words, only when the design of learning tasks/projects aligns with the characteristics of learners' thinking activities described above can it effectively contribute to developing their higher-order thinking abilities.

Collaborative Learning

"Collaborative learning," accounting for 22.3% of the coding reference points, refers to the teacher's use of heterogeneous or self-selected grouping methods in the classroom to form learning groups. Through collaborative learning, communication, presentation, and peer assessment within these groups, students are stimulated to engage in thinking collisions, leading to multiple effects such as mutual learning, experience sharing, and self-reflection. In collaborative learning activities, learners can observe their peers or teachers demonstrating, explaining, and arguing and compare and analyse their understanding of knowledge, assignments, or products(Ramadhani et al., 2021). This social and participatory interaction triggers higher-order thinking. Collaborative learning trains learners' teamwork skills and promotes meaningful learning, allowing students to experience the joy of learning through group collaboration and being more likely to stimulate and sustain creative expression.

Multidimensional Evaluation Feedback

The "multifaceted assessment and feedback" category accounts for 16.4% of the coding reference points. This study refers to adopting a diverse perspective in instructional evaluation, utilising qualitative comments and quantitative data evaluation methods to provide students with timely and comprehensive feedback. This feedback promotes self-reflection, critical thinking, and creative improvement of learning strategies and techniques. Specifically, the evaluation involves both teachers and students. In addition to traditional teacher evaluation, including student self-assessment helps students develop a habit of reflection and summarisation, cultivating self-awareness and a continuous learning mindset. It also provides references for teachers to improve their teaching. The evaluation content includes final scores, representing the outcome, and process-oriented data such as teacher comments and student reflection journals. This helps students actively monitor their learning progress. The evaluation methods include immediate feedback in the classroom and delayed feedback through other communication platforms after class (such as email, QQ, or WeChat groups), delivered through verbal and written forms. "Multifaceted assessment and feedback" benefits students by encouraging them to continuously improve their learning strategies while paying attention to their learning progress. Focusing on the learning process enables students to perceive their cognitive abilities as dynamic and developmental rather than fixed and unchangeable, further maintaining individual learning confidence and motivation. Moreover, it provides valuable references for teachers to adjust their teaching strategies based on the effectiveness of classroom instruction(Shaw et al., 2020).

Therefore, this study proposes that teachers, in line with the requirements of "multifaceted assessment and feedback," adopt diverse evaluation perspectives and feedback methods. Particularly, emphasis should be placed on the significance of process-oriented evaluation, focusing on students' learning progress and changes in their thinking abilities, stimulating students' active exploration and motivation for learning, and elevating their thinking to higher levels.

CONCLUSION AND IMPLICATIONS

Based on the above, this study obtained the experiences of 12 teachers from different disciplines through interviews regarding the cultivation of higher-order thinking skills. A preliminary teaching strategy model for cultivating higher-order thinking skills in university students, which includes five teaching strategies, was constructed. The model eliminates the limitations of traditional teaching methods to develop higher-order thinking skills and combines the process of higher-order thinking with teaching practice. Furthermore, a reference process for implementing complementary strategies in teaching activities is provided.

Teachers, focusing on the goal of cultivating higher-order thinking skills in university students, engage in teaching activities using five teaching strategies: providing appropriate learning scaffolds, embedding problems in specific contexts to inspire students, conducting project-based teaching driven by tasks, creating collaborative learning communities through group cooperation, and adopting multidimensional evaluation feedback. The study suggests that the relationships among these five teaching strategies are parallel and somewhat independent. Teachers should consider the characteristics of the course, students' qualities, and their level of thinking development. Accordingly, they should adopt complementary teaching strategies in different course stages, design teaching activities based on predetermined rules, and gradually make flexible adjustments to cultivate learners' higher-order thinking abilities.

The study recommends that in the early stages of the course, teachers can focus on using scaffolding and heuristic teaching strategies to help learners construct and refine their knowledge systems by providing appropriate learning supports combined with flexible questioning guidance. This is an essential knowledge foundation for cultivating higher-order thinking. In the middle stages of the course, teachers can create authentic and concrete problem situations to promote learners' deep thinking and transfer of acquired knowledge. In the later stages of the system, teachers can emphasise using project-based teaching and collaborative learning strategies.

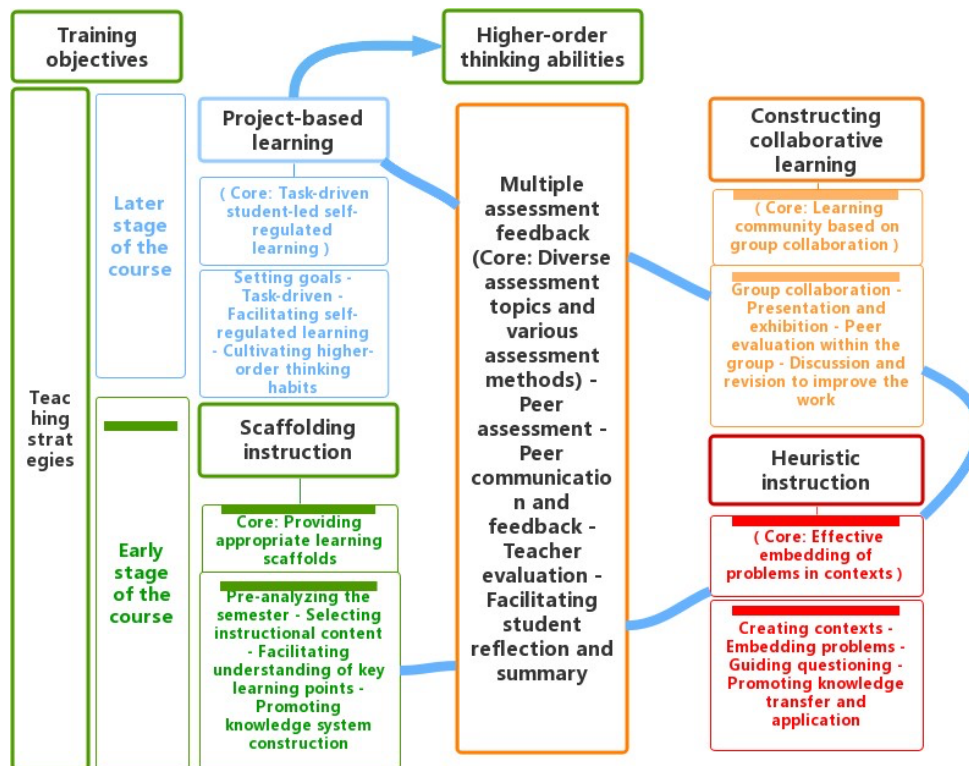The diagram below illustrates the preliminary teaching strategy model (Figure 3).

Figure 3. Teaching Strategy Model for Cultivating Higher-Order Thinking Skills

Furthermore, research on constructivist theory that supports the development of learners' higher-order thinking abilities indicates that the development of higher-order thinking skills should be integrated with specific disciplinary domains. Researchers like McPeck also advocate for cultivating thinking skills through specific subject areas. Therefore, in subsequent research, the constructed teaching strategy model for developing higher-order thinking skills will be applied to instructional practice by integrating the goal of cultivating higher-order thinking into the design of relevant activities within specific courses. This will test the feasibility and effectiveness of the strategy above model and analyse and explore the effects of cultivation.

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