

Metasynthesis of Strategies Mode for Activating Higher Order Thinking Skills (HOTs) of University Students

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Abstract: Countries around the world are increasingly emphasizing the research and cultivation of higher-order thinking abilities, and have proposed various teaching strategies and methods. Researchers have developed various methods, strategies, and related activities to cultivate higher-order thinking in response to this issue, such as "scaffolding teaching", "heuristic teaching", "project-based teaching", "building collaborative learning", and "diverse evaluation feedback". However, current research on teaching strategies mostly focuses on methodology or teaching principles, lacking a teaching strategy model to guide teachers in specific teaching processes and designs. This study conducted a comprehensive integration of previous scientific research, aiming to summarize the strategic models for activating college students' HOTs in the past three years. By using Scopus, Science Direct, and Springer search agents for in-depth filtering, a total of 6 articles were selected. Data screening, evaluation, and CBA use two keywords, and the article is published from around 2020 to 2023. The research results indicate that in addition to the aforementioned teaching strategies, some emerging teaching models are also being widely explored and applied. The flipped learning teaching model shifts the knowledge imparted in the classroom to independent learning after class, while using classroom time to guide students in discussions and practice. Smart classrooms utilize modern technological means to provide a highly interactive and personalized learning environment. The blended learning model combines online and offline learning, fully utilizing the advantages of technology. The evidence-based teaching method emphasizes guiding teaching decisions and practices through scientific research and empirical data. These teaching strategies can effectively improve the higher-order thinking ability of college students. Therefore, integrated research has investigated some specific methods and strategy models for activating higher-order thinking skills among college students in recent years. These methods and strategy models are of great significance to educational practitioners and can provide reference for the teaching of HOTs.

Keywords: Art Major; Higher-order Thinking Skills; Smart Classroom; Peer Interaction; Learning Motivation.

1. Introduction

Since 2012, The Organization for Economic Cooperation and Development (OECD) released "Preparing teachers and developing school leaders for the 21st century: lessons from around the world", which pointed out that talents in the 21st century need to have creative thinking, critical thinking, problem-solving ability, decision-making and learning ability [1]. Subsequently, "Core Literacy Development for Chinese Students" and "5C Model of Core Literacy for the 21st Century" And the successive proposal of curriculum standards for various disciplines. Since 2012, research on higher-order thinking has been increasingly valued worldwide, and the number of published papers has shown a steady growth trend. [2]

In learning and research, higher-order thinking has been highly valued as an advanced comprehensive ability to complete complex tasks and solve problems with poor structure, and has received extensive theoretical and practical research. At the same time, governments of multiple countries have clearly stated that cultivating higher-order thinking skills is the main goal of higher education. The concept of higher-order thinking originated from Bloom et al.'s cognitive goal classification, which was later revised by Anderson [3] to define it as memory, understanding, application, analysis, evaluation, and creation. Among them, analysis, evaluation, and creation are often referred to as "higher-order thinking". With the continuous deepening of research, scholars have proposed many new insights into the connotation of higher-

order thinking. Some representative views include: Lewis et al. [4] pointing out that when a person associates new information with existing information, reorganizes it to solve complex problems, they exhibit higher-order thinking; Hwang et al. [5] believe that higher-order thinking includes three aspects: critical thinking, creative thinking, and problem-solving ability.

Some scholars have proposed that higher-order thinking refers to all intelligent activity tasks that go beyond information retrieval [6]; Advanced thinking ability refers to the process in which a person associates new information with information stored in memory and reorganizes it to achieve certain goals, or finds possible answers in a complex context [4].

Therefore, the importance of higher-order thinking is self-evident, and improving students' higher-order thinking abilities is a challenging task for teachers [7]. Researchers have developed various methods, strategies, and related activities to cultivate higher-order thinking in response to this issue, such as "scaffolding teaching", "heuristic teaching", "project-based teaching", "building collaborative learning", and "multiple evaluation feedback" [8].

The study by Chinese scholar Guo Jiong et al. [9] shows that learning scaffolds have a significant promoting effect on improving the critical thinking ability of college students. The learning scaffold includes two types: soft scaffolds such as questions raised by professors in teaching, and hard scaffolds such as learning evaluation standards used to guide student behavior. In addition, Giacumo et al. [10] found that adding

questioning prompts and evaluation metrics in learning discussions can promote the development of students' higher-order thinking abilities. Overall, the various specific methods of "scaffolding teaching" adopted by teachers are mainly aimed at helping learners build a knowledge system, which is an effective way to develop higher-order thinking in learners.

The "heuristic teaching" strategy requires teachers to pay attention to the creation of learning situations, provide problem situations that are consistent with students' real life and cognitive backgrounds, so as to more likely enhance their learning interest and intrinsic motivation, and promote their transfer and application of learned knowledge and skills. The study by Young A.[11] suggests that using certain guiding clues can effectively promote learners' higher-order thinking abilities, including embedded instructional design that closely integrates specific contexts with course content and requires learners to utilize and adjust specific knowledge in the relevant field.

The "problem based and project based learning (P (j) BL)" strategy requires teachers to be able to concretize course teaching objectives and design feasible, challenging, and interesting tasks or projects when assigning thinking training tasks or projects, in order to encourage learners to use higher-order thinking abilities to achieve learning goals. At the same time, guiding principles for instructional design that promote learners' higher-order thinking abilities also require teachers to have a certain level of difficulty in designing problem-solving tasks, and to be able to stimulate, support, and strengthen the combination of cognitive and non strategic knowledge in higher-order learning[11]. In addition, project-based learning is a method of creating meaningful learning that helps improve the quality of student learning. Zhao Yongsheng et al. [12] pointed out that successful high-level project-based teaching is an innovative and open teaching task, which is the best teaching model for cultivating higher-order thinking abilities.

The strategy of building collaborative learning includes teacher led and student-centered collaborative learning, as well as collaborative learning among students. Professor Huang Ronghuai believes that collaborative learning is all the behaviors of students who collaborate and help each other to achieve the same learning goal in a group form, in order to maximize the learning experience of individuals and others. In the process of collaborative learning, students generate knowledge, experience, and emotional exchange through various forms of interaction under the guidance of teachers. When learners need to explain their viewpoints to others, it can promote clear and structured thinking outcomes. This collaborative cognitive activity of building knowledge is an effective way to develop higher-order thinking. The teaching principles that support the development of higher-order thinking abilities also point out that in order to provide learners with opportunities to exercise higher-order thinking abilities, it is necessary to leverage the mutual support of peers[11].

The strategy of "multiple evaluation feedback" requires teachers to attach importance to and design diverse evaluation systems, with evaluation subjects including teacher side evaluation and student side self-evaluation and mutual evaluation; The evaluation content not only includes quantitative data of summative evaluation, but also reflects the qualitative evaluation content of process evaluation. This can ensure a comprehensive evaluation of students' learning outcomes from multiple perspectives, comprehensively

reflecting the cultivation effect of higher-order thinking, and providing continuous feedback to teachers and students in order to adjust relevant strategies in a timely manner. The use of this teaching strategy by teachers not only deepens students' understanding and mastery of knowledge, but also helps guide them to critically think about existing and specific knowledge, explore the logical meaning of learning content, and achieve sustained learning with higher-order thinking as the main thinking activity. Zhong Zhixian[13] proposed the evaluation concept of "learner centered development", advocating the use of diversified and qualitative evaluation methods, such as learning contracts, metrics, example displays, learning archives, concept maps, performance evaluations, and self-evaluation. Multiple evaluation subjects and diverse evaluation methods can effectively promote interaction and feedback between teachers and students, and help promote students to reflect on their own learning situation, making it easier for teachers to adjust teaching strategies in a timely and flexible manner based on students' learning progress and effectiveness. Lin Xiaofan et al. [14] also believe that students using evaluation metrics to evaluate the works of others while improving their own works can cultivate critical thinking abilities.

However, current research on teaching strategies mostly focuses on methodology or teaching principles, lacking a teaching strategy model to guide teachers in specific teaching processes and designs[8]. Therefore, based on integrated research, this study investigated some specific methods and strategic models for activating higher-order thinking skills (HOTS) in college students in recent years. The results of this study can provide valuable references for future HOTS researchers and provide guidance and suggestions for practitioners in the higher education system on how to activate students' HOTS.

2. Purpose and Research Objectives

This study provides a review of several studies on HOTS. The objective of this study is to summarize the strategy models for activating college students' HOTS in the past three years.

3. Research Methodology

Integrated literature review involves systematically analyzing academic literature on a specific research problem to understand the current research status in the field [15].

Chinese literature resources mainly come from China National Knowledge Infrastructure (CNKI), while foreign literature resources come from Scopus, Science Direct, and Springer, which are searched through three keywords: activation, HOTS, and higher education. The other inclusion criteria are that the article must be published between 2021 and 2023, and that it is an empirical study conducted in a classroom environment, and that the survey targets higher education students.

This integrated study adopted the method proposed by Walsh and Downe[16] to systematically review and synthesize the qualitative results of multiple studies. The data collection stage includes selecting articles using keywords and other criteria, and using thematic analysis tools for data extraction. This method allows for in-depth descriptive descriptions and extensive exploration of research questions.

4. Findings

selected for analysis in this integrated research, as shown in Table 1.

According to the article search screening, 6 articles were

Table 1. Meta-Analysis Findings

Title	Author/s	Year	Journal
Methodologies for Fostering Critical Thinking Skills from University Students' Points of View	Campo, L. et al.	2023	Education Sciences, 13(2), 132.
Using an Evidence-Informed Approach to Improve Students' Higher Order Thinking Skills	Hubers, M. D.	2022	Education Sciences, 12(11),
Blended learning: its effect towards Higher Order Thinking Skills (HOTS)	Yusuf, I. et al.	2021	Journal of Physics: Conference Series, 1832(1) Doi: https://doi.org/10.1088/1742-6596/1832/1/012039
Examining the key influencing factors on college students' higher-order thinking skills in the smart classroom environment	Lu, K. et al.	2021	International Journal of Educational Technology in Higher Education, 18, 1-13.
Flipped learning instruction to enhance university students' higher order thinking skills.	Suprapti, S. et al.	2021	Jurnal Kependidikan: Jurnal Hasil Penelitian Dan Kajian Kepustakaan Di Bidang Pendidikan, Pengajaran Dan Pembelajaran, 7(2), 261-269.
The Implementation of Performance Assessment Through Virtual Laboratory to College Students' Creative Thinking Skills	Sari, R. P. et al.	2021	Jurnal Penelitian Pendidikan IPA, 7(1), 5-10.

4.1. Flipped Learning Teaching

According to the research findings of Suprapti, S., Nugroho, A., & Pembangunan, H. R. P. [17], flipped learning teaching is a promising teaching model that can enhance the higher-order thinking ability of college students. According to research, there is a significant difference in scores between students in pre-test and post test. Meanwhile, by adopting flipped learning teaching combined with content video teaching, students' higher-order thinking skills have also improved. In addition, the results of the focus group discussion indicate that students hold a positive view on implementing flipped learning in the classroom. Therefore, the results of this study indicate that flipped learning teaching can effectively improve the higher-order thinking skills of college students. The research suggests incorporating flipped learning into the

teaching curriculum of university education, especially in areas that are helpful for cultivating students' advanced thinking skills.

However, interestingly. According to Campo, L. et al. [18], they believe that from the perspective of college students, the best way to develop critical thinking based on preferences and frequency (f) is through debate (f=650; 19.7%), project-based learning (f=468, 14.2%), practical experience in real-world environments (f=364; 11.0%), research (f=321; 9.7%), collaborative learning, and case studies (f=263; 8.0%). These methods account for a total of 8% or more of all responses. In addition, students believe that there are other methods that contribute less to the development of critical thinking. These methods are service learning (f=63; 1.9%), oral presentation (f=59; 1.8%), flipped classroom (f=30; 0.9%), and master's category (f=21; 0.6%).

Table 2. Methodologies that students consider to contribute to developing critical thinking.

helpful		useless	
Debates	f=650;19.7%)	Service learning	f=63; 1.9%
PBL	f=468;14.2%)	Oral presentations	f=59; 1.8%
Practices in real contexts	f=364;11.0%	Flipped classroom	f=30; 0.9%
Doing research	f=321;9.7%	Cooperative learning	f=21; 0.6%
Cooperative learning	f=263;8.0%	Others	f=2; >0.01%

4.2. Smart Classroom

Chinese researchers Lu, K., Yang, H.H., Shi, Y., & Wang, X. [19] explored the influencing factors of smart classroom environment on higher-order thinking abilities (HOTs) of college students in a 2021 study. Intelligent classrooms refer to physics classrooms that integrate advanced educational technology forms, providing students with opportunities to learn beyond traditional classrooms and participate in formal educational learning experiences.

Research has found that students' Peer interaction (PI) and Learning motivation (LM) directly affect their higher-order thinking abilities in smart classrooms. On the contrary, Smart

Classroom Preferences (SCP) and Learning Strategies (LS) have no direct impact on higher-order thinking abilities. This result is consistent with other studies, indicating that peer interaction and learning motivation have a positive impact on students' ability to acquire knowledge and skills in a learning environment. [20]

In summary, the research findings indicate that teachers should pay attention to students' learning motivation, peer interaction, learning strategies, and preferences when cultivating their higher-order thinking abilities.

Peer interaction and learning motivation in intelligent classrooms are linked to higher-order thinking skills among students. Intelligent classrooms are student-centered, with

students taking an active role in the learning process. This contrasts with traditional teacher-centered classrooms, enabling students to communicate, collaborate, learn from one another, and enhance critical thinking, problem-solving, and creative abilities.[21]

Therefore, teachers should strive to improve students' peer interaction and learning motivation, and promote their higher-order thinking abilities in intelligent classroom environments. For example, teachers can provide opportunities for self-directed learning, explore topics and ideas that students are interested in, promote collaborative project completion, and encourage sharing of decisions during the learning process. [19,22]

In addition, Venkatraman, Benli, Wei, and Wahr [23] proposed a learning evaluation model that utilizes multiple intelligent classroom teaching strategies. This model adopts agile methods to implement the strategies of Education 4.0. This model includes innovative online intelligent tools and experiential learning, stimulating, and exploratory activities aimed at promoting the development of higher-order thinking abilities among IT students.

4.3. Hybrid Learning Model

According to the research results of Fahurrozi[24], blended learning has a positive impact on the academic performance of college students. Compared to students who learn directly, students who use blended learning methods exhibit higher academic performance. In addition, other research reports have also pointed out that effective blended learning can improve students' motivation and understanding [25], and the use of Edmodo's blended learning model has a significant impact on students' learning outcomes[26].

According to a study by Indonesian scholar Yusuf et al.[27], teaching higher-order thinking skills through blended learning can be superior to traditional teaching methods. Blended learning incorporates face-to-face, e-learning, and independent learning, utilizing technology such as chatting, email, online forums, multimedia, simulations, animations, and virtual laboratories to enhance the learning experience.

In order to deepen the use of technology by college students in T-O-IBL (Technology Oriented Problem Oriented Learning), the blended learning model of General Physics at the University of Papua has advantages in preparing HOTS learning resources, and the quality of related materials is excellent. However, due to the lack of prior experience in blended learning lectures, students still need to make adjustments in the early stages of learning implementation. It is crucial to introduce e-learning features so that students can access e-learning resources in the best possible way. Therefore, in the initial stage, researchers provided guidelines for use, allowing students to learn through e-learning[27].

The research results indicate that implementing blended learning mode significantly increases the learning interest of students in general physics courses compared to traditional learning modes. The implementation of blended learning has a positive impact on students' learning interests and helps to cultivate their learning interests. Through the learning resources provided by e-learning, students can have many opportunities for independent learning. These learning resources include using e-modules, conducting virtual laboratory experiments, and accessing e-books anytime, anywhere. Through the learning resources provided by e-learning, students become more proactive and proactive [27]. Blended learning is very beneficial for cultivating student

classroom participation, as students need to actively participate in various activities [28]. Specifically, the blended learning model achieves learning objectives by addressing the issue of insufficient traditional classroom learning time. Blended learning has been proven to be very effective for college students, as they have been trained to find multiple ways to solve problems. The blended learning model creates good interaction between teachers and students, and demonstrates the application of teaching materials in learning [29]. This means that blended learning is an active learning based learning approach that is particularly suitable for implementation in higher education. Although blended learning has many advantages, it also has some drawbacks, such as dependence on the Internet, high access costs, financial, hardware, and device incompatibility. These issues may bring pressure to some students when completing homework in a short period of time [27].

In addition, Indonesian scholars Prahani, B.K., Jatmiko, B., Hariadi, B.T., Sunarto, D., Sagirani, T., Amelia, T., & Lemantara, J. [30] have developed an innovative learning model that can enhance students' interest in learning. This model is called the Blended Web Mobile Learning (BWML) model, which combines the blended learning model with the PBL model and uses the MoLearn application to support blended learning in each learning activity.

4.4. An Evidence-Informed Approach

Hubers, M. D. [31] In his research, an Evidence Informed Approach was used to improve students' higher-order thinking abilities. The research results confirmed that the main reason for students' relatively poor performance in writing papers is their lack of ability to apply higher-order thinking skills. Marzano&Miedema[32] propose that if students lack familiarity with higher-order thinking skills, it may be advisable to adopt a more teacher-centered approach to assist them. Evidence-based methods are crucial as they enhance decision-making effectiveness compared to relying on intuition, personal judgment, and experience[33]. Moreover, data facilitates teacher reflection, providing valuable insights into their strengths and weaknesses, thus enabling improvements in teaching behavior, teacher performance, and ultimately, student performance [34].

Applying evidence-based approach can be advantageous in teaching higher-order thinking skills in academic education, as it involves complex thinking patterns that often generate multiple solutions[7].Lewis and Smith[35] define higher-order thinking as the process of integrating and expanding new information stored in memory, enabling individuals to achieve their goals and find solutions amidst confusion.

Indonesian scholars Ratih Permana Sari et al.[36],used performance evaluation through virtual laboratories to improve the innovative thinking ability of college students in their research. This quantitative descriptive study adopts a quasi experimental research method and a one-time case study design. This study used 27 college students from the 2018/2019 academic year as the sample. During the preparation, implementation, and experimental result presentation stages of virtual laboratory learning, performance evaluation data is collected using observation instruments. The research results indicate that the implementation rate of the evaluation of the entire learning material in the experimental results presentation stage is higher than that in the preparation and implementation stage, with an average score of 88.3%. Through the implementation

of performance evaluation in virtual laboratories, the improvement of various indicators of creative thinking ability among college students is demonstrated. The highest score for evaluation indicators is 0.69. It can be concluded that implementing performance evaluation through virtual laboratories can improve the innovative thinking ability of college students, especially in terms of evaluation indicators.

Virtual laboratories provide an interesting learning atmosphere that can enhance students' creative thinking abilities. In addition, virtual laboratories simplify students' practical work and make it easier for them to understand chemical concepts. This is consistent with the study by Jagodzinski and Wolski[37] that using virtual laboratory learning has a positive impact on improving teaching efficiency. Students have also improved in memorizing information and have made significant progress in memorizing material information (concepts).

5. Discussion

Yost, E. C. et al.[38] found that students' fear of failure is an obstacle to teaching higher-order thinking skills, possibly due to their cognitive development stage. When students learn to analyze and synthesize new knowledge and apply it to solve problems in different contexts, they will gain higher-level thinking. Teachers tend to focus on professional development and provide CT teaching skills based on practice and discussion.

Chinese scholars Wang Jing and Cui Xin [39] found in their research that high problem-solving ability is positively correlated with deep learning; Low problem-solving ability is positively correlated with shallow learning. In learning, students' metacognitive abilities are often reflected through the problem-solving process, and the development and improvement of their metacognitive abilities must be cultivated through the problem-solving process. In summary, problem-solving is an important way to cultivate students' metacognitive abilities. From the perspective of the relationship between deep learning and higher-order thinking abilities, deep learning motivation has no significant impact on higher-order thinking abilities, while deep learning strategies have a significant positive impact on problem-solving abilities, metacognitive abilities, and team collaboration abilities, but have no significant impact on creative thinking abilities; From the perspective of the relationship between higher-order thinking sub abilities, problem-solving ability significantly positively affects metacognitive ability, team collaboration ability, communication ability, and creative thinking ability. Team collaboration ability significantly positively affects communication ability, and communication ability significantly positively affects creative thinking ability. However, metacognitive ability has no significant impact on creative thinking ability, while team collaboration ability has no significant impact on metacognitive ability and creative thinking ability. In this study, researchers divided deep learning methods into two variables, namely deep learning motivation and deep learning strategies. The results show that there is a significant positive correlation between deep learning motivation and deep learning strategies; Deep learning motivation has no direct significant impact on higher-order thinking ability, while deep learning strategies significantly affect higher-order thinking ability (problem-solving ability, metacognitive ability, team collaboration ability). The conclusion indicates that learning motivation is

an internal psychological mechanism of learners and cannot be directly observed. It can only be indirectly inferred through external behaviors such as task selection, task persistence, individual engagement, and verbal expression. And learning strategies are the process in which learners purposefully choose and formulate complex learning plans in order to improve learning efficiency and effectiveness, which to some extent is a mapping of learning motivation.

Firstly, focus on intervening in deep learning strategies. Research findings indicate that deep learning strategies have a significant positive impact on problem-solving, metacognitive abilities, and team collaboration. Therefore, intervention in deep learning strategies is necessary. Teachers play a key role as guides and facilitators in student learning. They can intervene in learners' selection of strategies through teaching design and environment. For instance, tasks should be complex and relevant to real-life situations, necessitating thorough preparation. Learning resources should be abundant, requiring learners to develop information-gathering skills. In the selection of learning modes, teachers should choose problem-solving based learning modes and encourage learners to continuously adjust their learning strategies during the problem-solving process; Teachers can utilize information technology to guide learners in selecting and implementing deep learning strategies within the learning environment. Learners should consciously adopt deep learning strategies, such as active thinking, questioning, and collecting relevant materials and information related to learning tasks while continuously adjusting their problem-solving process.

Secondly, a teaching model that emphasizes problem-solving. The research results show that problem-solving ability is a core competency in higher-order thinking abilities. The improvement of learners' problem-solving ability can promote the development of other higher-order thinking abilities. Therefore, the teaching mode of problem-solving is worth choosing and applying for educators. Domestic and foreign researchers have conducted extensive and in-depth research on problem-solving teaching models, which provides support for the practical teaching of educators.

Thirdly, focus on effective communication and interaction in team collaboration. From the research results, it can be seen that team collaboration ability affects communication ability, and communication ability affects creative thinking ability. Therefore, creating a collaborative team environment for learners is crucial. However, it is worth noting that team collaborative learning is not a simple division of labor for learning tasks. Team members need to engage in effective communication and interaction when solving common problems. The teacher's teaching intervention and the application of technology provide a means of communication and exchange between team members and between teams, enabling them to constantly examine and develop each other's perspectives and ideas in interactive dialogue, thereby achieving continuous promotion and creation of collective knowledge.

Regardless of the teaching mode adopted, we are aware of the importance of problems for the development of higher-order thinking in students. More realistic problem scenarios and problem-solving activities can better promote the development of higher-order thinking in students. Therefore, problem-solving teaching has become an indispensable choice in classroom teaching. The clever questions designed by teachers and the independently generated questions by students can stimulate students to fully engage in exploratory

learning, deeply understand the knowledge learned, and apply it to practical problem-solving activities, thereby promoting the development of higher-order thinking in students. (Yang Sijie. (2018))

6. Conclusion

Research has shown that the higher-order thinking ability of college students is their key ability in solving complex problems, innovative thinking, and critical thinking. In the field of education, teachers have been exploring how to effectively cultivate students' higher-order thinking abilities. In recent years, flipped learning has attracted widespread attention as a new teaching model. Flipped learning emphasizes allowing students to acquire knowledge outside of the classroom through watching videos, reading materials, and other means, while in the classroom, more emphasis is placed on discussing, solving problems, and applying knowledge. Research has found that flipped learning teaching has a positive impact on the higher-order thinking ability of college students, as it can stimulate their active learning and independent thinking, cultivate their critical thinking and problem-solving abilities.

In addition to flipped learning, peer interaction and learning motivation in smart classroom environments are also closely related to students' higher-order thinking abilities. Research has shown that students in group cooperative learning can promote each other's thinking development through communication and collision of ideas, thereby enhancing higher-order thinking abilities. At the same time, learning motivation is also an important factor affecting students' higher-order thinking ability, as their learning motivation can affect their deep exploration of knowledge and deep thinking of problems.

In addition, blended learning has been proven to have a positive impact on the learning interest and higher-order thinking ability of college students. The blended learning model combines traditional classroom teaching and online digital learning, providing a wider learning space through flexible learning methods and resource rich teaching content, stimulating students' interest and initiative in learning. Especially through the implementation of performance evaluation in virtual laboratories, it can improve the innovative thinking ability of college students, enabling them to engage in practical exploration and creative thinking in virtual environments.

Finally, evidence-based teaching methods are also considered to have a positive effect on cultivating students' higher-order thinking abilities. Evidence based teaching emphasizes making decisions and solving problems based on data and research evidence, which can help students cultivate critical thinking, logical reasoning, and problem-solving abilities. Therefore, teachers should adopt various teaching strategies when cultivating students' higher-order thinking abilities, and pay attention to their learning motivation and peer interaction to enhance their learning interest and higher-order thinking abilities.

Through comparative analysis with existing research, it can be found that the four teaching strategies summarized in this study are theoretically feasible for cultivating higher-order thinking, and are a beneficial exploration for innovative teaching models. In addition, teachers should pay attention to the specific characteristics of the course in their teaching, and adopt various teaching strategies with emphasis in the early, middle, and later stages of the course based on the students'

own qualities and thinking development level. They should flexibly combine and apply them to effectively cultivate students' higher-order thinking while achieving teaching objectives.

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