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# A Study on Strategies for Cultivating Higher-Order Thinking Skills in Primary and Secondary School Students

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***Abstract:*** *Higher-order thinking is a complex form of cognition that occurs within specific contexts, involving a series of cognitive abilities such as analysis, creativity, synthesis, establishing relationships, and metacognition. It requires students to apply their existing knowledge and skills in advanced cognitive activities such as reasoning, judgment, evaluation, creativity, and problem-solving. Importantly, higher-order thinking can be nurtured and developed. Empirical research has revealed that as primary and secondary school teachers, one can enhance students' higher-order thinking abilities by providing challenging open-ended questions and projects, encouraging students to raise questions and explore, promoting group discussions and collaborative learning, and guiding students in metacognition and reflection. These strategies contribute to improving students' higher-order thinking skills and fostering continuous academic growth.*

***Keywords:*** *higher-order thinking; open-ended questions; cooperative learning*

## 1. Introduction

The 2022 revised curriculum standards in China emphasize "big unit teaching" with the primary goal of cultivating students' core competencies in various subjects at a high level and with high quality. The aim is to foster the abilities to analyze and solve problems, as well as higher-order thinking skills, ultimately nurturing exceptional and innovative talents. In the teaching practices of primary and secondary schools, teachers need to construct teaching frameworks based on the knowledge system of the textbooks and the cognitive development patterns of elementary school students. They should clearly define the core teaching issues and integrate various teaching resources at all levels. Through targeted classroom questions and a conducive learning atmosphere, teachers can explore learning models that promote higher-order thinking among students. By engaging in effective teaching practices, students' thinking can progress to higher levels.

## 2. The Connotation of Higher-Order Thinking

The American cognitive psychologist, Bloom, was the first to propose the classification of thinking into lower-order thinking and higher-order thinking. In Bloom's taxonomy of educational objectives, lower-order thinking mainly refers to simple memorization and reproduction of knowledge, while higher-order thinking refers to the psychological processes of organizing or restructuring knowledge to achieve specific goals. [1]

In addition to "knowledge," Bloom introduced five different types of thinking processes: comprehension, application, analysis, synthesis, and evaluation. Within Bloom's taxonomy, "analysis," "synthesis," and "evaluation" fall under higher-order thinking because these abilities involve the process of breaking down, integrating, or judging knowledge based on an understanding of the material, which all require the reorganization of knowledge.

In 1992, David Perkins, a psychology professor at Harvard University, proposed that under supportive teaching conditions, higher-order thinking can be cultivated and developed. Scholars from both domestic and international contexts have summarized teaching strategies that promote higher-order thinking through educational practices. [2]

In 2001, Anderson L. W. and colleagues revised Bloom's taxonomy of educational objectives,

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reclassifying the dimensions of "knowledge" and "abilities." They updated the nouns describing cognitive abilities to verbs to emphasize that thinking involves actions. The new taxonomy includes six components: remember, understand, apply, analyze, evaluate, and create.[3] The revised taxonomy highlights the close relationship between higher-order thinking and the cognitive abilities represented by "analysis," "evaluation," and "creation." In this new classification, "synthesis" has been modified to "create," placing creativity at the highest level of thinking. [1] It emphasizes the ultimate goal of higher-order thinking, which is to generate an original and unique pattern or product.

Piaget & Inhelder (1966) introduced the concept of "schema" to describe cognitive structures formed by individuals during the thinking process, which possess abstract and higher-order features. [4] Anderson (1978) suggested that schemas encompass mental representations of prior knowledge and individual's knowledge framework for understanding the world. This structured knowledge determines how individuals process and organize information in their environment. When individuals form a schema for something or a situation, they tend to maintain it. However, when confronted with new information conflicting with their prior knowledge, they will adjust, revise, and modify their existing schema under the drive of cognitive conflict until the new schema aligns with the information in their environment. [5]

Building on this foundation, Lewis & Smith (1993) further elucidated the concept and connotation of higher-order thinking. They defined higher-order thinking as the process of connecting newly acquired information with stored memories, reorganizing them to extend beyond the original information, and thereby finding ways to solve complex problems in the intricate environment. Higher-order thinking involves analyzing problem contexts, establishing relationships between new and old knowledge, synthesizing information from different dimensions, and creating new knowledge. Metacognitive abilities are essential in regulating, managing, and supervising cognitive processes during higher-order thinking. [6]

Zhong Zhixian (2004) pointed out that higher-order thinking involves mental efforts at a higher level and cognitive abilities that encompass engaging in genuine, complex tasks, continuous self-reflection and regulation, independent judgment, and proactive creativity. It is a comprehensive ability. [7] Ma Shufeng (2021) argued that higher-order thinking is not a singular thinking process specific to certain cognitive contexts, but rather a complex form of cognition that involves a series of cognitive elements working synergistically, such as analysis, creativity, synthesis, establishing relationships, and metacognition. [8]

In summary, higher-order thinking is a complex form of cognition that occurs within specific contexts, involving a series of cognitive abilities, including analysis, creativity, synthesis, establishing relationships, and metacognition, all working in concert. During this process, individuals do not merely comprehend, memorize, or apply information; rather, they engage in knowledge analysis, synthesis, and creation. They identify similarities in knowledge structures across different contexts, establish correspondences between existing experiences and new information, form abstract and schematic understandings of current problems, integrate information, and ultimately engage in in-depth thinking to respond to and solve the problems logically. Higher-order thinking requires students to apply their existing knowledge and skills in advanced cognitive activities, such as reasoning, judgment, evaluation, creativity, and problem-solving. This paper will discuss how to promote and develop students' higher order thinking ability by combining teaching cases in primary and secondary schools.

## 3. Results and discussion

The primary and secondary school stages are crucial periods for developing students' higher-order thinking. This article will combine specific examples from primary and secondary school teaching and analyze strategies to foster students' higher-order thinking abilities. These strategies revolve around providing challenging open-ended questions and projects, encouraging students to raise questions and explore, promoting group discussions and cooperative learning, and guiding students in metacognition and reflection.

### *3.1 Providing Challenging Open-Ended Questions and Projects*

Traditional instructional content often consists of isolated, closed, well-structured, and pre-prepared typical example problems, which often neglect real-life connections. This hinder students' ability to link and recombine old and new knowledge, making it difficult for them to engage in reflective, critical,

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and innovative thinking activities. This, in turn, can impact the development of students' higher-order thinking. In educational activities, the use of open-ended questions to reconstruct instructional content and promote the development of higher-order thinking skills has been observed in curricula and teaching practices worldwide. Broadly speaking, open-ended questions adhere to three basic criteria: (1) providing all students with opportunities to demonstrate knowledge, skills, and understanding; (2) encouraging students to engage in reasoning and thinking beyond their comfort zone; (3) allowing students to utilize a wide range of problem-solving methods and strategies. [9] By using open-ended questions, students can break free from the constraints of isolated knowledge or problem presentation, opening windows for analysis, evaluation, and creativity. In fact, posing open-ended questions is not a difficult task. In daily classroom teaching, teachers can easily adapt and expand exercise problems in textbooks into open-ended questions by applying their own wisdom and integrating specific real-life contexts.

For instance, when studying "campus green area," students are required to apply the formula for calculating the area of polygons they have learned to solve real-life problems. The teacher could present the open-ended learning topic "How to Measure the Per Capita Green Area of Our School" and let the students engage in discussions and project implementation. The students' research would begin with a series of questions. What is the total green area of the school? How do we measure the per capita green area? How do we collect relevant data on the total land area of the school and the total number of students and teachers through field measurements? How do we calculate the per capita green area and conduct a comprehensive analysis of the data? Throughout the project's implementation, the students act as project leaders, using open-ended mathematical questions to cultivate their ability to independently solve problems and foster their awareness of proactive thinking. This approach promotes the gradual development of their higher-order thinking in practical activities within the context of the project.

### *3.2 Encouraging Students to Raise Questions and Explore*

An effective way to develop learners' higher-order thinking is through knowledge construction, and interaction and sharing are particularly crucial. Questions and tasks play a central role in fostering learners' higher-order thinking abilities. [10] Questions serve as the starting point of thinking, and thinking activities heavily rely on the support of this carrier. They provide a powerful tool and clues for both teaching and learning. In classroom instruction, questioning serves as a vital link and communication between teachers and students and is an essential means for students to construct knowledge." Teacher questioning" involves teachers purposefully guiding students to explore learning contexts and identify points of conflict based on students' thinking qualities, developmental characteristics, and learning objectives. The aim is to stimulate students' thinking and inquiry, thus improving the quality of teaching. Therefore, teachers should play a leading role in the teaching process, continually posing questions and raising doubts, encouraging students to think critically and engage in active mental processing.

"Student questioning" refers to students constructing a new system of questions based on their existing experiences and expressing these questions clearly in their own language. It emphasizes students' ability to think and raise inquiries based on their cognitive conflicts during the learning process. In this context, compared to the teacher's supportive role, students take on a more valuable role in driving the learning process independently. Unlike "teacher questioning," "student questioning" highlights the student's agency in the teaching and learning process. It can promote students' self-internalization of the learned knowledge and independent construction of disciplinary systems, which is conducive to stimulating their creative thinking. Questions are the premise of creativity and the best way to foster critical and creative thinking. Guiding students to raise valuable questions is the key to cultivating their critical thinking and innovation awareness.

"Student questioning" is an essential means for cultivating higher-order thinking. In classroom teaching, teachers can understand students' thoughts promptly by addressing the questions they raise. This fosters a process of mutual discussion, collision of ideas, and inspiration between teachers and students, promoting a harmonious teaching and learning environment. Nurturing students' ability to raise questions allows them to become active explorers of knowledge, driven by strong curiosity to discover and solve problems. For example, in a history class, students can choose a historical event of interest, pose questions, and conduct in-depth research. By consulting reference materials, interviewing experts, or conducting field visits, students develop their investigative and critical thinking abilities.

Similarly, in interdisciplinary exploration of the theme "The Secrets of Chocolate," teachers can

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begin by captivating students' attention with appealing chocolate advertisements. Students are then encouraged to raise a series of questions about chocolate: How is chocolate produced? What are the raw materials for making chocolate? Where does the cocoa fruit grow? Who first made chocolate? How did chocolate spread worldwide? Does eating chocolate affect one's health? What are the best packaging materials for chocolate? In an environment of independent thinking and group encouragement, students collectively propose a series of valuable questions. They use these questions as clues to conduct in-depth investigations on the research topic and ultimately draw conclusions.

### *3.3 Encouraging Group Discussions and Cooperative Learning*

Effective classroom discussion can include the following aspects: Firstly, in the context of classroom discussions organized by the instructor, it is imperative that students show mutual respect towards one another. They should utilize language that is both civil and courteous when expressing their own viewpoints or responding to those of others. Secondly, students are not required to raise their hands before contributing their thoughts. They are encouraged to directly articulate their perspectives. Thirdly, while another student is engaged in discourse, it is expected that fellow group members listen attentively. They should wait until the speaking student has concluded their remarks before presenting their own opinions, refraining from interrupting the ongoing discourse. Fourthly, the instructor holds the responsibility of ensuring that each member within the group is afforded the opportunity to voice their viewpoints. In instances where a student's participation has been lacking, it is incumbent upon the instructor to politely invite them to share their insights.

During the group cooperative discussion phase, students take on the roles of both discussion leaders and facilitators to ensure smooth progress. At the beginning of the discussion, each student presents their arguments within the group and provides logical reasoning. They should clarify their stance on the core issue, followed by citing facts or persuasive data to support the validity of their viewpoint. The use of evidence during the argumentation must be based on a solid foundation, and students should also indicate the supporting conditions or sufficient evidence for the validity of their claims.

Additionally, students should consider counterarguments to their original viewpoints, highlighting situations in which their initial stance may not hold or presenting other reasons supporting opposing viewpoints. Furthermore, students have the freedom to question the materials presented in the discussion. If any parts of the content are unclear, students can supplement or correct them based on their own understanding.

This approach empowers students to critically analyze and contribute to the discussion, ensuring a dynamic and comprehensive exploration of the topic. By actively engaging in this process, students further develop their analytical skills, effective communication, and the ability to consider various perspectives, thereby nurturing their higher-order thinking abilities. During the group discussion process, students need to respond to each other's viewpoints. Each member of the group often holds different perspectives on the core issue, and even if they share the same stance, their reasons may vary. One student's evidence supporting their argument may be refuted by another student. In some cases, students may change their original stance after hearing counterarguments and seek new evidence to support their new points of view. These behaviors are all encouraged in cooperative reasoning discussions. The purpose of the discussion or debate is not to have one viewpoint triumph over the other but to present different perspectives for everyone to evaluate and contemplate, leading to a multi-perspective understanding and cognition of the problem.

Throughout the back-and-forth debates, students enhance their argumentative abilities and strengthen their logical coherence. The two examples provided earlier involved learning projects based on group discussions and collaboration, effectively fostering critical and creative thinking. By engaging in cooperative reasoning discussions, students develop essential skills such as critical analysis, open-mindedness, and the ability to see problems from multiple angles. This process nurtures their higher-order thinking abilities and prepares them to be well-rounded learners who can consider diverse perspectives and make informed judgments.

### *3.4 Guiding Students in Metacognition and Reflection*

A single lesson or unit of teaching is not the end of instruction but a stage of completion in the learning process. Timely reflection and review are essential. After completing a unit or a specific learning project, teachers can frequently pose questions such as: What were the gains during this unit/project's learning process? What was the most significant progress made? What were the major

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shortcomings? How can improvements be made in the next stage of learning? Regarding this research topic, do you have further thoughts and can you propose new questions or research directions? During group collaboration, related questions can also be asked: What was the most outstanding aspect of your team's performance in this project? What impressed you the most about your team members? Who would you like to express gratitude to among your peers? Whom do you wish to offer advice or suggestions to?

This approach encourages students to review and reflect on their learning journey, and more importantly, it helps monitor and adjust the learning process and outcomes. This metacognitive process is crucial for developing critical thinking skills in students. By posing reflective questions during the learning process, teachers target higher-order thinking related to the essence of the subject matter in a single lesson or unit, as well as the broader need for developing students' common higher-order thinking skills, such as critical thinking. By engaging in metacognitive processes and reflective practices, students become more aware of their own thinking and learning strategies, which in turn enhances their ability to monitor, regulate, and improve their learning outcomes. This fosters self-directed and self-motivated learners who are better equipped to tackle complex problems and adapt to various learning situations.

During discussion activities, children engage in self-regulation and autonomous management. The sequence of speaking, topic progression, initiation and development of topics, and mutual support and encouragement all emerge organically. This kind of self-directed management behavior is not limited to students with leadership qualities but is also evident in other group members. Thus, it can be observed that group discussions foster children's experience in regulating, managing, and supervising their own and others' cognitive processes.

## 4. Conclusion

Higher-order thinking plays a crucial role in the cognitive development of primary and secondary school students. Through this research, it has been found that as educators, teachers can enhance students' higher-order thinking abilities by providing challenging open-ended questions and projects, encouraging students to ask questions and explore, fostering group discussions and collaborative learning, and guiding students in metacognition and reflection. Creating an open and conducive learning environment allows students to undergo diverse thinking processes and gain new cognitive experiences. Repeatedly experiencing such breakthroughs can lead to the formation of new cognitive patterns, which is a vital pathway for students to achieve cognitive development and transcend their own limits. Thus, these strategies contribute to continuously improving students' academic abilities.

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