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Teaching Practice Research on *Space English* under BOPPPS Model from the Perspective of Higher-order Thinking Skills Training

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ABSTRACT

It is the core mission of educational reform in the new era to cultivate students' higher order thinking skills. On the basis of clarifying the connotation of higher-order thinking skills, this paper analyzes the internal connection between BOPPPS teaching model and the cultivation of higher-order thinking skills. Then, in line with the 6 teaching steps under BOPPPS, the implementation strategy and specific path of the cultivation of high order thinking skills in *Space English* teaching practice are elaborated, serving as reference for developing high order thinking skills in other ESP courses.

1. Introduction

Under the context of the digital era, the rapid development of emerging information technologies such as artificial intelligence, machine learning and big data analysis is reshaping the education ecology at an unprecedented speed, posing new challenges to talent cultivation. Facing such a change, countries all over the world regard it as the core mission of education reform to help students develop the higher-order thinking skills to adapt to the needs of future social development.

The *Guide to College English Teaching* (2020 edition, hereinafter referred to as the "*Guide*") clearly includes the cultivation of students' critical thinking ability into the teaching goal of college English, reflecting the importance of cultivating students' higher-order thinking skills, especially critical thinking and logical analysis ability. In addition, the *Guide* clearly points out that English for Specific Purposes (ESP) courses are an important part of college English courses. These courses combine specific subject content with language teaching objectives, and the teaching activities focus on solving the language problems encountered by students in the process of learning subject knowledge. As a specially-tailored ESP course of our university, *Space English* aims to cultivate students' comprehensive English application ability and higher-order thinking skills in the field of aerospace, so as to meet the needs of career development.

The teaching design under the BOPPPS teaching model

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features clear-cut structure, emphasizing student-centered, heuristic and participatory teaching, thus promoting the effectiveness of classroom instruction. Under the BOPPPS model, students are encouraged to solve real problems through independent inquiry and cooperative learning, so as to consolidate language knowledge and skills, deepen understanding of subject content and develop higher-order thinking skills. Based on this, this paper aims to explore the practical strategies of *Space English* under BOPPPS model focusing on the cultivation of higher-order thinking skills, offering references for the cultivation of college students' higher-order thinking skills in other ESP courses.

2. Concept interpretation

2.1 Higher order thinking skills

American cognitive psychologist Bloom (1956) first divided human cognitive thinking process into six levels in his classification of educational goals: knowledge, understanding, application, analysis, synthesis and evaluation, which became an important inspiration for subsequent higher-order thinking study. Anderson (2001) revised Bloom's classification of cognitive goals into memory, understanding, application, analysis, evaluation and creation, and pointed out that analysis, evaluation and creation belong to higher-order thinking, that is, they need to mobilize high-level cognitive comprehensive abilities, which are manifested in problem-solving, critical questioning, in-depth exploration and creation.

Wen Qiufang (1999), a Chinese scholar, explained higher-order thinking by describing it as a high-level comprehensive ability that goes beyond simple memory and information retrieval. Zhong Zhixian proposed in 2004 that higher-order thinking is a mental activity and cognitive ability occurring at a higher cognitive level, which is embodied in problem solving, decision making, critical thinking and creative thinking, etc. At the same time, he also proposed that in specific teaching practice, teachers should design real, complex, challenging and attractive learning tasks, reorganize the course content through the form of questions, and promote learners to deeply process information, so as to cultivate higher-order thinking skills. Subsequently, Zhang Hao et al. (2014) further pointed out that higher-order thinking includes key abilities such as problem solving, critical thinking, creative thinking and metacognition. According to Zhang Yanyuan (2018), based on the characteristics of English subjects, higher-order thinking includes logical, critical and creative thinking generated in English language situations. Ma Shufeng and Yang Xiangdong (2021) pointed out that the connotation of higher-order thinking skills is extremely complex, so it is difficult to acquire it through simple knowledge teaching, and it can only be built by teachers guiding students to complete complex tasks in real situations. Moreover, they believe that it will be the reform trend of future classroom teaching to create a learning mode that is suitable for the synergistic interaction of different cognitive components of higher-order thinking to promote its development.

2.2 BOPPPS teaching model

The BOPPPS teaching model is an efficient and structured instructional design framework that originated in the Instructional Skills Workshop (ISW) in Canada in the 1970s. Based on constructivism and communicative approach, BOPPPS emphasizes student-centered teaching through six closely linked teaching steps. Namely Bridge-in, Objective, Pre-assessment, Participatory Learning, Post-assessment and Summary.

2.3 Intrinsic connection

The detailed and structured teaching steps in BOPPPS teaching model are convenient for the cultivation of higher-order thinking skills.

Bridge-in: To stimulate students' curiosity and desire for inquiry by creating problem situations or displaying contradictory phenomena, and to lay a foundation for cultivating critical thinking and problem solving ability.

Objective: Clear learning goals help students focus on the core problems, guide them to actively think and find answers in the learning process, and promote the occurrence of deep learning.

Pre-assessment: To understand students' prior knowledge and misunderstanding, provide basis for teachers to adjust teaching strategies, and urge students to self-reflect, recognize the limitations of their own knowledge, and stimulate the motivation for further exploration.

Participatory Learning is the key to cultivating higher-order thinking. Through group cooperation, case analysis, debate and other forms, students not only learn knowledge, but more importantly, learn how to analyze problems, evaluate information, and propose solutions, so as to exercise critical thinking, innovative thinking and teamwork skills.

Post-assessment: Through a variety of assessment methods, such as project presentations, oral reports, etc., it not only examines students' learning outcomes, but also prompts them to reflect on their learning process and further improve their metacognitive ability.

Summary: Students are encouraged to independently summarize what they have learned and build a knowledge framework. At the same time, they are guided to reflect on

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the learning process. This process is helpful to cultivate students' systematic thinking and self-management ability.

3. Implementation strategy

3.1 Course Introduction

Entering the new era, China is stepping up from an emerging player in space to a space power. In this great historical process, Chinese spacefarers need not only to bridge the gap and learn from other space powers, but also to "go global", strengthen international exchanges and cooperation in the space field, and enhance China's global competitiveness in space. This requires Chinese aerospace personnel to have a solid mastery of space English. Combining professional knowledge of aerospace science and technology with English language skills, *Space English* requires students not only to master language skills, but also to have the ability to analyze aerospace literature and participate in international exchanges. BOPPPS teaching model, with its student-centered and participative learning characteristics, provides a new way to train students' higher-order thinking skills.

3.2 Specific steps

Under BOPPPS model, students' higher-order thinking skills cultivation is highly integrated with language practice, subject learning and values nurturing. Hgher-order thinking skills, including critical thinking, innovative ability, problem solving ability and cross-cultural communication ability, are developed step by step in a solid way.

3.2.1 Bridge-in

At the beginning of each session in *Space English*, teachers skillfully use the latest developments, historical events or technological challenges in the space field as the introduction, aiming to quickly capture students' attention and stimulate their interest in learning. For example, by showing the latest space launch videos, introducing major space achievements in history or exploring the current difficulties facing space technology, teachers are able to guide students to think deeply about the value of space English in solving practical problems. This way of introduction not only creates a learning situation closely related to the space field for students, but also lays a solid foundation for the subsequent cultivation of higher-order thinking skills.

3.2.2 Objective

Clear learning objective is an important link in BOPPPS teaching mode. In the course of *Space English*, teachers carefully set learning objectives for each lesson according to the course content and students' needs. These goals include not only mastering specific aerospace terms and English expressions, but also an understanding of the principles of space technology and the ability to analyze space project reports. With clear learning goals, students can participate in learning activities in a more targeted way, thus improving learning efficiency. At the same time, it also promotes students' active learning, so that they can clearly identify and manage their learning progress and results.

3.2.3 Pre-assessment

Pre-assessment is a key link in BOPPPS teaching mode used to assess students' prior knowledge and understanding. In *Space English*, the teacher assesses students' basic space knowledge and English vocabulary by means of quick questions and answers, quizzes and other forms. This not only provides an important basis for teachers to adjust their teaching strategies, but also encourages students to develop self-reflection, so as to be more mindful about their learning needs. Through the pre-test, students can more actively participate in the follow-up learning activities, and try to make up for their own shortcomings.

3.2.4 Participatory Learning

Participatory learning is a core part of BOPPPS teaching mode and an important way to cultivate higher-order thinking skills. In *Space English*, teachers have designed a variety of participatory learning activities to train students' critical thinking, teamwork and innovative thinking.

Case analysis: Teachers choose typical space projects as cases, and guide students to discuss and analyze them in groups. By exploring solutions in depth, students can exercise their critical thinking and learn to look at problems from multiple perspectives. At the same time, group work also promotes communication and collaboration among students and cultivates their teamwork skills.

Simulated international conference: In order to improve students' oral English expression ability and cross-cultural communication ability, teachers organize students to simulate international conferences in the field of aerospace. In groups, students acted as representatives of different countries and made English speeches and Q&A sessions. This kind of activity not only exercises the students' oral expression ability, but also makes them more familiar with the procedures and rules of international conferences, laying a solid foundation for future international exchanges.

Academic paper writing: In addition, teachers also guide students to write academic papers in the field of aerospace.

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By developing a writing style with clear logic and sufficient arguments, students are able to develop their innovative thinking and problem-solving skills. At the same time, writing academic papers also exercises students' English writing ability, enabling them to better combine their aerospace expertise with their English language skills.

3.2.5 Post-assessment

Post-assessment is an important part of BOPPPS teaching mode used to evaluate students' learning effectiveness. In *Space English*, teachers design comprehensive post-test tasks, such as writing space technology comments, conducting English debates and so on. These tasks not only examine students' mastery of the course content, but also focus on assessing their improvement in higher-order thinking skills. Through the post-test, teachers can have a comprehensive understanding of students' learning results, and provide a strong basis for subsequent instructions.

3.2.6 Summary

At the end of each lesson, the teacher guides the students to summarize the key points of the lesson and encourages them to share their learning experience and gains. By summarizing, students are able to review what they have learned more clearly and facilitate the internalization and transfer of knowledge. At the same time, sharing learning gains can also enhance students' self-confidence and sense of accomplishment, and lay a positive psychological foundation for their subsequent learning. In addition, the summary also emphasizes the practical application value of space English, so that students can more deeply understand the importance and significance of learning space English.

To sum up, under the BOPPPS teaching mode, students can not only master aerospace professional knowledge and English language skills, but also cultivate higher-order thinking skills, laying a solid foundation for future study and career development through carefully designed various links.

3.3 Actual feedback

Through the implementation of BOPPPS teaching mode, students' learning enthusiasm and participation in *Space English* have been significantly improved, especially in critical thinking, innovative thinking and problem solving ability. Students' feedback shows that the participatory learning activities have enhanced their interest in learning, deepened their understanding of space expertise, and also improved their English application ability. The teaching effect evaluation shows that the model helps to achieve the curriculum objectives and improve the students' comprehensive quality.

4. Conclusion

To sum up, this paper discusses the teaching practice of *Space English* under BOPPPS model for the cultivation of higher order thinking skills of college students. The BOPPPS teaching model, with bridge-in, objective, pre-test, participatory learning, post-test and summary as specific steps, systematically promotes students' higher-order thinking skills such as critical thinking, innovative thinking and problem-solving ability. Under such a model, students are no longer passive receivers, but active explorers and creators. By participating in a variety of learning activities, they not only deepen their understanding of space expertise, but also learn how to apply what they have learned to solve practical problems, showing significant improvement in higher-order thinking skills. This transformation not only proves the effectiveness of BOPPPS teaching model in cultivating students' higher-order thinking skills, but also provides valuable reference for future teaching reform in ESP courses.

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