

Heuristic Teaching Method Research for Complex Systems

Jihua Dou

667#, Jiefang Road, Zhongshan District
Dalian, China

Xingbao Yang

667#, Jiefang Road, Zhongshan District
Dalian, China

Chuanwei Zhu

667#, Jiefang Road, Zhongshan District
Dalian, China

Abstract—According to the characteristics of heuristic teaching in complex systems, the heuristic teaching methods were put forward, including elicitation, contrasting, intuitive, passionate, discriminating, reasoning, and practical methods, which can be useful for the heuristic teaching of complex system discussion, doubt, contrast, intuition and practice. Passionate heuristic teaching, discriminative heuristic teaching, reasoning heuristic teaching and practical heuristic teaching can provide methodological basis for the implementation of heuristic teaching in complex systems.

Keywords—system; heuristics; teaching methods; teachers; students; reasoning

I. INTRODUCTION

In the teaching of complex systems, the teaching methods adopted by teachers directly affect the quality of teaching. Heuristic teaching is a democratic and scientific teaching method with teachers as the leading role and students as the main body. It can stimulate students' enthusiasm and initiative in learning, and enable them to use their brains think positively and practice actively so as to achieve the purpose of mastering knowledge and skills. The heuristic teaching method lies in correctly dealing with the relationship between teaching and learning, and establishing the main position of students in teaching. In the process of teaching, different heuristic teaching methods can be adopted according to different teaching contents to enlighten students' thinking and stimulate students' active learning so as to achieve good learning results [1]. Therefore, it is necessary to carry out heuristic teaching methods for complex systems.

II. DISCUSSION HEURISTICS

Random roll-call or automatic hand-raising can activate the atmosphere of collective discussion, and timely comment and drum on ideas with flashing points. Teachers can clarify the teaching background and encourage students to ask questions according to the teaching knowledge and the actual situation. When students ask questions and seek answers, teachers should guide students to discuss the problem by following good inducements and step by step inspiration. It

makes use of the collective wisdom synthesized by one's own thinking to solve the problem satisfactorily. After putting forward the questions, organize students to discuss in groups, and study, analyze and explore the solutions to the problems with all the students. In the process of discussion, we should gather wisdom, carry forward democratic style and allow different voices to appear. At the end of the discussion, teachers should summarize and summarize the discussion according to the situation of students, so as to promote the positive interaction between students and teachers, students and students, stimulate students' interest in learning knowledge and exploring problems, and make dull teaching content attractive.

III. QUESTION-ASSUMING HEURISTICS

Questioning is one of the important ways for teachers and students to exchange ideas in the process of teaching, and mobilize students' enthusiasm and initiative in learning. Before the end of each class, according to the teaching content and teaching objectives of the next class, students can be guided to prepare some questions before class, conduct research and answer by themselves, and then ask questions in the next class, which can enable students to enter the classroom with questions, concentrate their attention on learning, and improve the efficiency of teachers' classroom explanation. Assumption is the basic teaching skill of a teacher, and the starting point and fulcrum of exploring knowledge and inspiring thinking. In the implementation of heuristic teaching, teachers should take suspicion as the starting point, so that students are in a temporary state of confusion, and inspire students to start thinking about doubts, and then stimulate the motivation and interest to solve doubts, and naturally open their minds after solving doubts. Whether teaching or learning, the key lies in the word ask. Educational psychologists believe that difficult problems are most likely to cause orientation-inquiry reflex, which is the reflection that makes thinking come into being at the historic moment. Teachers are required to carefully set up some problems which are difficult, but can be solved by hard work before teaching new contents, and then guide and assign students so that the problems can be solved from

shallow to deep, and from perceptual to rational. First of all, we should fully prepare lessons, and analyze the textbook structure, and clarify the knowledge points and key points, and raise questions to students and set suspense. In order to set up problems reasonably, we should set up problems according to the classroom teaching structure, and set up problems to highlight the teaching focus. There should be a correlation between problems and problems. The combination of several problems is the knowledge framework of the whole class. Teachers should set up problem scenarios in classroom teaching. It is better not to teach the teaching content as ready-made knowledge to students, but to teach in the way of answering questions, to raise some hot issues, to attract students' attention by using question-asking method, to constantly raise the content to students as a question, to stimulate students' positive thinking and to exert their imagination. In this way, when students preview, they will be constantly inspired while looking for answers to questions. When students' thinking is blocked, the heuristic teaching method should be properly used. When using wooden method, teachers should put some words in the clear and key places to solve puzzles of students, which is conducive to the smooth solution of problems. After several questions are explored, they will know the key points of knowledge in the whole class, promote students' self-learning ability and stimulate their interest in acquiring new knowledge, so as to achieve twice the result with half the effort. Before difficulties arise, students will be inspired to think highly. Students will use existing knowledge to think actively, and explore and imagine boldly, and finally come to the correct conclusion, so as to receive good classroom teaching effect [2]. In the teaching of hinting method, teachers only hint and do not clearly say the answer. The purpose is to solve the problem through their efforts by mobilizing students' thinking.

IV. CONTRASTING HEURISTICS

Whether the contrast is strong and distinct decides whether the students are impressed deeply, and whether they are able to memorize knowledge. It is applicable to the distinction between similar and plausible teaching contents, so that students can get clearer concepts from confusion. Learning process is not only a cognitive process, but also a process of inquiry. Knowledge does not exist in isolation. They are all related to or opposed to some other knowledge. It is necessary to distinguish the essential characteristics of things through relevant or opposite comparisons, and to make the students sort out the knowledge they have learned, so as to make the subject structure and textbook structure clear and clear, and to help students understand and memorize, and to form their own knowledge system, and to firmly grasp the knowledge they have learned and achieve good teaching results [3]. They are suitable for horizontal or vertical comparison. In the process of teaching, teachers can use comparative methods to make positive or negative comparisons between the old and the learned knowledge, so that students can get inspiration, deepen their memory, and consolidate the knowledge they have learned.

V. INTUITIVE HEURISTICS

The modern computer means adopted cannot dominate the class. We should give priority to assistant teaching, cooperate with the main teaching means, and integrate them into practice so as to achieve a good teaching effect. Such a vivid teaching method, can not only attract students' attention, increase students' interest in learning, but also increase students' understanding of knowledge, enhance students' creative thinking, thereby improving the quality of classroom teaching. It is through multimedia, physical objects and models to show students pictures, animations and objects which are closely related to the courses they have learned. In particular, multimedia teaching is used to select and use modern teaching media, which is organically combined with traditional teaching methods to participate in the whole process of teaching, and multi-media information is used to act on students to achieve the optimal teaching effect, so that students can associate, analyze and actively participate in the teaching process. Through demonstration, students can understand the contents they have learned perceptually. On this basis, teachers can explain the problems with rational knowledge, guide students to think independently, strengthen students' perceptual knowledge, and realize the sublimation of students from perceptual to rational thinking. In classroom teaching, when confronted with abstract, boring and difficult to understand knowledge, teachers can turn to modern teaching methods for help. With the help of computer-aided instruction, abstract knowledge can become vivid, dull knowledge can become vivid and difficult to understand knowledge can become easy to understand. In teaching, wall charts, physical specimens, projectors, videos and experimental demonstrations are widely used in combination with lectures.

VI. PASSIONATE HEURISTICS

Classroom teaching not only accomplishes the task of transmitting knowledge and information through the interaction between teachers and students, but also connects the emotional exchanges between teachers and students. Psychological research has proved that optimism and upward mood can promote the fountain of thoughts, while depression can inhibit thinking. Therefore, in the classroom, teachers should be full of emotion and feel the students. After inspiration and encouragement, students can naturally mobilize their thinking enthusiasm and initiative, and experience the joy and enjoyment of successful learning [4]. Teachers create a pleasant situation with their rich emotions in the course of teaching to arouse students' interest in learning and stimulate their thinking vitality; or use the situation, reason, interest and modality in textbooks as inducers to arouse students' feelings, inspire students' feelings of life, and let students consciously and actively explore and comprehend the textbooks with their own feelings of life, so that the emotional causes of textbooks can be realized. Therefore, in the process of teaching, teachers should stimulate students' optimism and upward mood like music conductor, and make them think actively and pay attention to it, which is conducive to the smooth development of heuristic teaching. From a physiological

point of view, teachers who are confident, excited, amazed and admired in class are conducive to promoting and improving the activity of nerve cells in both hemispheres of the brain.

VII. DISCRIMINATING HEURISTICS

Associative thinking is a supplement to logical thinking, but it is often neglected in the past teaching, and even strangled by some teachers. Many scientific discoveries and technological inventions originate from the rich associations of human beings. In heuristic classroom teaching, students' thinking ability cannot always be in a state of hyperactivity. When thinking deviation occurs, teachers should hint at students by means of language and paralinguistics, mobilize students' positive thinking, and successfully complete the task of analyzing and solving a certain problem. Teachers give various answers to a certain question or the application of certain rules in class. Some of them are right or wrong, and then inspire students to distinguish between the right and wrong, and analyze the correct basis and the reasons for the mistakes. If doubting enlightenment lays stress on doubting, then thinking enlightenment lays stress on thinking, that is, by guiding students to learn to analyze, solve problems and suspense with the knowledge they have learned, they can "learn", improve their thinking ability and achieve the purpose of enlightenment. Intuitive Association inspiration is that teachers set a specific problem in class, and then inspire students to associate with their own intuition, breaking through the limitation of time and space, in order to solve the problem, the more novel and peculiar the content of students' association, the higher the fluency of thinking. This is the inspiration of discrimination analysis. This kind of enlightenment can enable students to learn to think all-round in the complicated connection of things, and to learn and improve their ability to discover the essence of problems. It is conducive to cultivating students' thinking profundity and criticism [5]. This method is helpful to broaden students' thinking and cultivate and improve students' creative thinking ability.

VIII. REASONING HEURISTICS

Deductive reasoning is the reasoning that deduces the conclusion of individual things from the principle of universality. This way is an important way for students to acquire new knowledge and know new things. It can make students easily find ways to think and solve problems and develop students' abstract thinking ability when they encounter new problems. This method can develop students' thinking of seeking common ground, cultivate students' ability of touching by analogy, and promote the transfer of knowledge and ability. Inductive reasoning is a common and general conclusion derived from the analysis of many individual things. Analogical reasoning is based on the fact that two objects are identical in a series of attributes, and that one of them is known to have certain attributes, thus inferring that another object may also have such attributes. Deductive reasoning enlightenment is to guide students to draw correct conclusions based on the general knowledge of certain things acquired in the past and to guide them to

recognize some new and individual things in such things. Analogical reasoning enlightenment is to guide students to compare the original knowledge they have mastered with the new problems they want to study and find out their common points and laws. Inductive reasoning enlightenment is to enable students to analyze and compare certain things, find out their characteristics, distinguish between essential and non-essential characteristics, summarize the essential characteristics of such things, deduce the general characteristics of such things, and form general concepts or rules, which is conducive to cultivating students' abstract thinking ability and generalization ability.

IX. PRACTICAL HEURISTICS

In the process of teaching, teachers should not be mechanical workers who instill knowledge into students, but should make the classroom a bridge between the "book world" and "life world" of students. Although it is important for students to master book knowledge in the process of learning, their ability to use knowledge to solve practical problems is equally important in view of the requirements of innovative education and comprehensive and all-round education. This not only enhances the knowledge and interest of the classroom, but also enables students to connect with reality and apply knowledge to practice. This requires teachers not only to clarify the content of knowledge in textbooks, but also to be good at using knowledge to attract valuable ideas, so that students can understand and easily remember.

X. CONCLUSION

Heuristic teaching method is one of the commonly used teaching methods for complex systems. By discussing heuristic methods for complex systems, doubting heuristic methods, contrastive heuristic methods, intuitive heuristic methods, passionate heuristic methods, discriminative heuristic methods, reasoning heuristic methods and practical heuristic methods, the heuristic teaching methods for complex systems, doubtful heuristic teaching methods, comparative heuristic teaching methods, intuitive heuristic teaching methods and practical heuristic teaching, enthusiastic heuristic teaching, discriminative heuristic teaching, reasoning heuristic teaching and practical heuristic teaching organization provide methodological basis to improve the classroom teaching effect of complex systems.

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