The Teaching Reform and Research of Computer Curriculum Based on Computing Thinking Ability

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Abstract. In the information age, the army and the ultimate goal of winning the information war put forward higher requirements of military computer teaching, this paper on how to reform computer teaching to adapt to the new requirements of the information age, thinking for the teaching reform, mining and design the way of computing thinking training system, in the daily teaching of computer course training and training students computing thinking, cultivate modern military talents with strong computing thinking ability.

Keywords: Computational thinking; thinking training; educational philosophy; teaching method.

1. Introduction

With the rapid development of information technology, information age put forward higher requirements for cadets, not only requires students to study professional knowledge, improve the professional level, prison post foundation, more requires students have strong thinking ability and innovation ability, make students can qualified for modernization, information force post demand, and stronger daily national defense construction work, more to be able to quickly and effective thinking, understanding and cognitive problems, dealing with complex situation, to meet the high requirements of winning information war. This puts forward higher requirements for the students' thinking ability, and puts forward higher requirements for the talent training of computer teaching.

2. The Teaching Status of Computer Curriculum

In recent years, the teaching reform of computer curriculum is constantly promoted, and new teaching concepts and teaching modes are constantly applied in teaching. For example, the modular teaching concept, the teaching concept of theory and practice are integrated teaching, the task-driven teaching method, the research teaching method, the case teaching method and other teaching concepts and teaching methods.

But there are still some problems in computer teaching:

1.Influenced by the inertia of "examination-driven learning and examination-driven teaching", the teaching process emphasizes knowledge over thinking. In short-term utilitarian mode of thinking, often test what, learn what, test knowledge, methods and skills, students are paying attention to knowledge, methods, skills, teaching process is easy to emphasize computer basic terms, basic concepts and grammar rules, and ignore the content through, use the cultivation of computing thinking and practical ability, lead to the teaching method is one-sided pursuit of how to make the single knowledge clearly, and do not pay attention to the cultivation of thinking and training.

2.In recent years, under the advancement of teaching reform, computer teaching also gradually focus on the cultivation of thinking, but the computer teaching of the thinking training and training, only limited to programming methods involved in programming design, to how to cultivate computing thinking, there is not a comprehensive system understanding, and solid and effective landing measures.

3. The Study of Computational Thinking

Turing Award winner Edsger Dijkstra said that "the work we use affects our ways and habits of thinking, and thus profoundly affects our ability to think."[1]. In the information age, the computer has become an indispensable tool for people's study, work and life, and also gradually and deeply affects people's way of thinking. Computational thinking is a powerful thinking method, which plays a key role in improving students' thinking ability, cognitive ability and innovation ability. In order to better cultivate computational thinking in computer course teaching, it must first be clear what computational thinking is and what role it is.

3.1 The Concept of Computational Thinking

In March 2006, Professor Zhou Yizhen, director of the Department of Computer Science at Carnegie Mellon University, published an article entitled "Communications Thinking" in the "Communications Thinking" journal Communications of the ACM, which first clearly proposed the concept of computational thinking. In the article, Professor Zhou Yizhen systematically defines computational thinking: Computational thinking refers to a series of thinking activities covering the breadth of computer science by using the basic concepts of computer science to conduct problem solving, system design, and human behavior understanding[2]. That is to say, computational thinking is a kind of thinking method that uses the basic concept of computer science to analyze and solve problems.

3.2 The essence of computational thinking

Abstraction and automation are the essence of computational thinking, called "two A". In the process of using computational thinking to solve problems, it can be summarized into several basic links, such as understanding the problem, formulating algorithms, executing procedures, summarizing and making evaluation. In this process, human and computer, as the two main subjects of solving problems, play an important role respectively. First, people understand and analyze the problem, find out the known conditions and ultimate purpose of the problem, and then use various methods to separate, purify, conceptualize into descriptive, executable content, that is, abstract and modeling, in order to develop the computer can understand and automatically execute the algorithm good program; then use the computer's powerful computing power, to automatically execute the formulated program to solve the problem[3]. Obviously, in this process, people play their strengths -- Abstraction, and computers also play their strengths -- Automation. This happens to be the essence of computational thinking.

3.3 The Connotation of Computational Thinking

Computational thinking is not equal to computer programming. Computer programming will use computing thinking, programming will also cultivate computing thinking, but computing thinking its meaning is far beyond the computer programming, also requires a wider range of thinking methods, to thinking on multiple abstract levels, can system design and human behavior understanding, covers the computer science, a series of thinking activities.

Computational thinking is thinking thinking, not a skill method. When learning the subject of computer science, many people misunderstand that: the computer is just a tool, we only need to master its operation methods, operation skills, and use it to help human beings solve problems. In fact, as a tool of computer, in the process of human use, it also in turn subtly affects the way of human kind of thinking, computational thinking is the integration of the basic concepts of computer discipline, as well as the idea of extensive thinking methods.

Computational thinking is not a computer thinking. Computational thinking is a way of thinking about solving problems, not just limited to computer solutions. The computer is a tool to implement the results of human thinking, its itself does not think and create, is the human ability to give the computer. With the help of computer equipment, human beings use their own wisdom, through

reduction, embedding, transformation and simulation methods, a seemingly difficult problem interpretation, so as to understand and solve a variety of complex, large problems, with more powerful ability.

Computational thinking is the complementarity and fusion of mathematical thinking and engineering thinking. Computer science, essentially derived from engineering and based on mathematics, is a hybrid of mathematics and engineering. On the one hand, it has the mathematical abstract, rigorous, accurate, is built on the basis of mathematical models; on the other hand, it widely applies a variety of engineering methods, to establish a system of interaction with the real world; its core idea is the essence of both, can be considered: computational thinking = mathematical thinking, engineering thinking.

3.4 The Influence and Effect of Computational Thinking

Computing is everywhere, so the use of computational thinking is also everywhere. For example, when planning a travel path, calculate different paths according to the least time or the least cost, whether to select the queue with the least people or the least items, or how to fully utilize time, space, human, material, financial resources, including system design, overall scheduling, serial or parallel processing. Computational thinking is the synthesis of human thinking ability and computer ability. With the development of computer science and technology, computer has penetrated into all walks of life, profoundly affecting the human society and scientific research[4]。

4. Cultivation Method of Computational Thinking in Four Computer Course

4.1 Cultivation of Targeted Computational Thinking in Classroom Teaching

At present, there are both object-oriented thoughts and process-oriented thoughts, which cover both the basic concepts of computer and the basic methods of computational thinking. In the teaching process, teachers are required to carefully study the teaching content and its characteristics, dig out the implied computational thinking, conduct classroom teaching design for the course of the training and training of computational thinking, and comprehensively cultivate and train students' computational thinking ability.

For example, in programming, calling its own programming technique is called recursion (recursion), which is widely used in the programming language as an algorithm, and is a method by which a process or function calls itself directly or indirectly in its definition or description. Recursive thinking often transforms a large and complex problem into a smaller problem similar to the original problem to solve it. Only a small number of programs can describe the multiple repeated calculations required by the solution process, greatly reducing the amount of code of the program. Recursive thought is a very typical and widely used thought in computational thinking. It is very important to cultivate computational thinking.

In the computer programming basis has a teaching progress for "function recursive call", in teaching practice, with the help of the teaching content of learning, not only teach students to master the definition of recursive function and calling method, will use recursive function to solve practical problems, more consciously cultivate students 'recursive thinking, improve students' computing thinking ability.

So "function recursion call" the progress of teaching clues for "knowledge —— skills —— thinking": through this class learning requires students to master function recursion calling method, will use recursion function to solve practical problems, and in the teaching process experience computer discipline to solve the problem of thinking law and thinking method, cultivate recursion thinking method, improve the ability of computing thinking.

The specific teaching links are designed according to the BOPPPS model, specifically as follows:

Bridge-in (import): In the field training scenario, " How to choose food to make the highest total calories in the backpack?"For the introduction, throw out the 0-1 backpack questions, while stimulating the students' interest in learning.

Objective (learning goal) + Pres-assessment (pre-test): lead the students to analyze the 0-1 backpack problem, try to solve the problem through the existing ideas, in the process of analysis, complete the detection of the students' thinking methods, pay attention to observe whether the students have the prototype of recursive ideas. After making various attempts, I still did not find the appropriate solution, and then found another way to put forward the concept of recursion, make clear the learning goal of this lesson, and learn with the goal.

Participatory-Leaning (participatory learning): This link is divided into three small links, first take N factorial as an example, lead students to analyze simple problems, try to summarize the definition and calling method; then take Fibonacci series as an example, initially use recursive thinking for problem analysis and language solution; finally use recursive function to solve the 0-1 backpack problem. In the whole process, the teachers play a leading role in inspiring, guiding, summarizing and summarizing, while the students, as the main body of learning, have always been in the state of active thinking and active exploration.

Post-assessment (post-test): Tell the Hanoi tower problem, lead students to analyze and solve problems, and see if students will use recursive ideas to solve the problem.

Summary (Summary): After mastering the knowledge of recursion and using recursive functions to solve practical problems, I lead students to analyze and summarize the characteristics of recursive thinking, and introduce the application of recursive thinking, so that students can master recursive thinking methods, and will use recursive thinking to think and solve problems.

In the whole teaching process, how to solve the problem of 0-1 backpack is teaching, around the main function of recursive definition and call is knowledge line, and analyze the problem and problem solving thinking process of recursive thinking is thinking line, knowledge line and thinking line cross fusion, complement each other, not only pay attention to knowledge learning, pay more attention to the cultivation of computing thinking.

4.2 The Thinking Visualization Technology Helps the Cultivation of Computing Thinking

Thinking is the indirect and generalized reflection of the human brain to objective things, which reflects the essence of things and the connection between things. The thinking activities of the human brain are very large, and these thinking activities often become messy in the mind.think Dimension visualization is to use a series of graphic techniques to present the thinking activities of the human brain, including thinking methods, thinking paths, thinking rules, etc., so as to make the originally invisible thinking clearly visible[5]. Visual thinking is easier to be understood and remembered, which can improve the efficiency of information processing and information transmission. In the teaching process, the use of thinking visualization technology to "show the thinking as much as possible" is not only conducive to the transmission of knowledge, but also conducive to the cultivation of students' computational thinking ability. The method of cultivating computational thinking through thinking visualization technology mainly has three aspects: the pre-implantation of knowledge framework, the display of teaching clues and knowledge clues, and the construction of knowledge system.

4.2.1 Pre-implantation of the knowledge framework

In the preview link or the pre-classroom test link, first of all, the teaching and teaching objectives should be explained clearly in advance, so that students can have a general grasp of the content of this chapter and the teaching of this class, and what kind of goals to achieve, and have an overall grasp, with the purpose to carry out learning. The traditional teaching method is only a simple text interpretation or list of the teaching content or teaching objectives. First of all, the readability and memory are relatively poor, and the text description of students facing unfamiliar knowledge itself is more difficult to understand, and even more difficult to remember. Mind mapping technology is used to show the knowledge framework of this chapter or this section (without not showing the

details), along with the teaching objectives corresponding to the knowledge framework and the implementation process, which is well-illustrated, clear, more vivid and intuitive. For example, The Internet foundation is shown in Fig 1 .
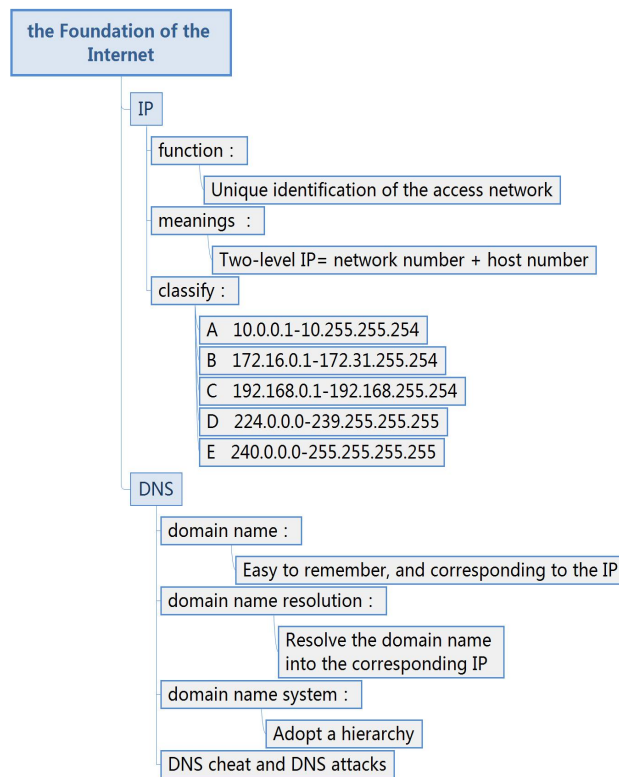

Fig 1. Internet basic knowledge mind map

4.2.2 Display of teaching clues and knowledge clues.

In the process of teaching, the mind map is drawn according to the teaching clues, and then the mind map will be dynamically played. One knowledge point draws the next knowledge point, shows the mutual correlation between the knowledge points, pays more attention to the divergence of thinking and logical sorting, and cultivates the students' divergent thinking and logical thinking ability[6]. An example is shown in Fig 2.The picture shows the teaching clues of sound digitization.

4.2.3 Visual visualization of thinking

Chain list is a more difficult part of the programming language, highly comprehensive, need to use pointers, dynamic storage, structure and other knowledge, strong abstract, difficult to understand, complex operation, need to use the node data domain and node pointer domain reference. But the link table can make full use of memory space, dynamic management of memory, so it is widely used. Taking the chain list as an example, the thinking visualization technology is innovatively applied in the teaching, and the process path of thinking is established by visual means.

First of all, the use of fish bone figure, will appear the nature of the problem and the problem on the fish bones, will solve the problem and the essence of the method in the bottom, using the way of contrast up and down, listing problems and their reasons, up and down contrast, clear, clear regulations, can greatly improve the efficiency and effect of understanding the problem.

Then, the process path of solving the problem is dynamically plotted to form a thinking path map. Using graphic technology to analyze and solve the thinking logic step by step, dynamic representation. Thinking along the visual thinking clues is clear and not easy to confuse.

Finally, the schematic technology summary is used to clearly present the knowledge and key techniques used to solve problems, intersect between thinking and knowledge, and associate to form a complete thinking system and knowledge system.

Fig 2. Digitization of sound mind map

5. Summary

Computer courses involved in the basic concepts, methods and thinking methods are permeated with computing thinking, add computing thinking training link, in the classroom teaching practice of computing thinking into the daily classroom teaching training, make students in learning knowledge, methods, skills, subtly cultivate the computing thinking, so as to train and improve the students' thinking ability and innovation ability, to cultivate new military talents for a new generation of navy.

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