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Mathematical and Software Technology Pedagogical Model Based on Cognitive Learning Theory

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Abstract

Cognitive learning theory presents the entire process of information processing and information extraction. Constructive theory challenges the traditional pedagogical model, exposing the flaws of traditional instructional design. With the cognitive teaching theory to guide instruction, this paper analyzes drawbacks of the traditional teaching and discusses the behavior and model of teaching from the construction of the knowledge structure of students, cooperative learning and situated teaching. This paper also proposes to help students master discrete mathematics and software technology basic knowledge and skill, construct better cognitive structure and realize effective information retrieval under information processing and constructism theory. Our practice has shown that these measures have had favorable effects.

Keywords

Cognitive Psychology; Constructivism; Information Processing; Pedagogical Model

Introduction

Discrete mathematics is abstract, rigorous logic and a wide range of application. The goal of discrete mathematics education is to train the ability of learners in mathematics, including mathematical thinking ability. The goal of Elementary Technology of Computer Software (for short, software technology) curriculum is to let students to learn data structure, storage structure and the corresponding algorithm and the algorithm initial grasp of time and space complexity analysis.

To enable the two courses education effective, we expect to research the psychological process of solving problems from a psychological standpoint, and form the theory about pedagogy to guide practice. We discuss the constructivism teaching theory and the integration of courses to make students better learning. Information processing is a new learning theory presented by Robert. M. Gagné. It has a significant impact in the practice of psychology in modern school education. To use information processing theory and analyze the student learning, we can design pedagogical model aiming at students' learning process to achieve the harmonization of teaching and learning.

This paper discusses the two courses, discrete mathematics and software technology, which is comprehensive basic courses in computer science. It is the core of computer science courses in the teaching. It is important to learn these courses for in-depth understanding of computer science and continue to learn other subjects. Therefore, discrete mathematics and software technology are conducive to the quality improvement of teaching, educational innovation and the cultivation of innovative talents.

Research Situation in Discrete Mathematics and Software Technology Pedagogical Model

In the traditional sense of discrete mathematics and software technology teaching, people stress to instill knowledge to students. This has hampered the development of students in discrete mathematics and software technology learning and it is not conducive to the spirit of innovation and problem-solving abilities training. Teaching methods of objectivism is still dominant. Objectivism emphasizes the students' knowledge of the book "listening-style" education, not conducive to the independence of students' personality and spirit of exploration.

In the traditional classroom teaching, teachers considerate little of the cognitive style of students and do not want to adjust their teaching strategies to adapt those who cannot comply with their own methods of teaching. Lacking of understanding of their cognitive style in mathematics, students do not know their own strengths and weaknesses. Therefore they have not

strong interest in discrete mathematics learning and do not form a good habit of mathematical thinking.

Traditional learning argues that teachers have the authority and initiative, while the students are recipients of knowledge with passivity. Traditional knowledge is often simple and abstract of the knowledge, highlighting key features and regularity rather than the specific context, without considering their social interaction properties. This often makes the learner feel difficult in solving practical problems. Teacher-centered teaching model has already deviated the demand of modern social development and has seriously hindered the creative thinking of students.

It is only a matter of principle even if he wanted to provide them with the application to raise awareness of the practice of discrete mathematics and software technology but do not give them a practical method. Reformation is imperative in discrete mathematics and software technology pedagogical model. We need a theory of cognitive growth and learning to suggest principled changes in the curriculum. We think that this philosophy must be constructivism (Piaget, 1973) and information processing (Robert, 1979). Therefore, we should study the appropriate teaching strategies and strive to improve the existing status quo of teaching.

Constructivism and Information Processing Theory

Constructivism Learning Theory

Constructivism was first used by the Swiss philosopher and psychologist Jean Piaget (Piaget, 1968). Constructivist argues that teaching does not emphasize the process of one-way transmission of knowledge. The core idea can be summarized as: stresses the active exploration of knowledge the students take the initiative on the knowledge discovery, a student-centered and active construction of meaning. Constructivist put forward that thinkers must have the four basic elements: teaching situation, collaborative sharing, dialogue and exchange, construction of meaning.

Constructivism learning theory can be summary three points as follows: i) Learning is not simply by the teachers to transfer knowledge to students, but by the students construct their own knowledge. ii) Learning is not passive receivers of information to stimulate, but actively construct meaning. External information itself does not make sense, meaning learners repeatedly between the old and new knowledge and experience, two-way interaction of the built form. iii) Accessing to meaningful learning, is that each learner to his prior knowledge and experience, based on recognition and encoding of new information, constructs his own understanding.

Information Processing Theory

Cognitive psychology known as "information processing psychology", designed to reveal the person's learning, storage, extraction of knowledge to the essence of problem-solving (David, 1999). It believes that a wide degree of cognitive purposes, in a certain psychological structure of the process of information processing. The most typical information processing model of learning Gagné (Michael, 2005) .

The information processing is broadly divided into four stages: i) Paying attention to stimulating. When the signal stimulating the sensory organs caused by people's attention has been feeling the time of registration, the human body's information processing system into operation. It begins to feel the stage of registration of the stimulus signal that should be screened for some of information to ensure quick access to short-term memory. ii) Information coding. Short-term memory processing power is limited information, but if the information organized into meaningful blocks, it will increase the intake of information and improve memory retention. iii) Storing information. Information stored in one-way or another to the long-term memory in order to extract the future. iv) Extracting information. Recalled that long-term memory and reproduce the information in the process of extracting long-term memory clues and information from the more recent, the formation of pattern matching, and the more easily extracted.

Discrete Mathematics Teaching in Real Situation

Constructivism theory claims that knowledge is actively constructed by the student, not passively absorbed from textbooks and lectures. The knowledge is not simply determined by the external information. Each learner in the experience of his own original system based on new information for coding, constructing his own understanding.

Situated Learning

J. S. Brown put forward a "situational learning" concept (Brown, 1989). It argues that the traditional

way of teaching implies the assumption that conceptual knowledge can be abstracted from the context and knowledge existed in the concrete, situational, and can be made out among the activities. It is not an independent in the context of the symbol, not divorced from context and abstract practical activities exist. It is only through the actual situation of activities can be understood by the learner. They propose that the task of learning situations should be similar with the real situation to solve the students problems faced in real life as the goal. In addition, the process of teaching is similar with the problem solving process of the reality.

Creation of situations is the content of a strict disciplinary structure of the situation (mathematics with such a structure). It needs the creation of a learning environment with rich resources, which should include many examples of different scenarios and relate information to learners.

The Role of Teachers

Guided by the idea of constructivism, discrete mathematics teaching has a higher requirement for teachers. The transmission of knowledge from the traditional authority into counseling students, teachers must meet the teaching content required the creation of scenarios and prompts the link between old and new knowledge. It helps students to construct the knowledge of the significance of the current. In this environment, students can experiment, independent inquiry, cooperative learning and other ways to expand their learning. Teachers should understand the goals and teaching goals, including cognitive affective goal. Teaching is to gradually reduce the external control, increase self-control students learning process.

The task of the teacher in the constructivist paradigm is significantly more difficult than in the classical one, because guidance must be based on the understanding of each student's currently existing cognitive structures (Mordechai, 1998).

The purpose of the discrete mathematics teaching reform is to change the passive acceptance of that student's learning, to stimulate students interest in learning and innovation potential and improve the students ability applying theory to solve practical problems. In entire period of discrete mathematical teaching, teachers must also constantly learn. To focus on the use of modern teaching methods, such as the use of multimedia teaching, computer software, these can enhance students to master mathematical knowledge, mathematical methods and mathematical thought with relative ease.

Software Technology in Practical Teaching

Gagné's theory of cognitive learning has received popular recognition for teachers and learners. The student is the center of the study. Research on students to the cognitive structure of students as a starting point, not only study the cognitive processes of students, cognitive strategies, cognitive conditions, but also carry out research activities of support cognitive systems.

Cognitive psychology indicates that it is essential to improve the skills of the students and help students set up a good understanding of the structure. Learning process is not a passive acceptance, but a self-construct their own knowledge of software technology to understand the re-creation process. In software technology teaching environment, students can expand their learning by making experiment, independent inquiry and cooperative learning. Teachers' guidance must be based on the understanding of each student's currently existing cognitive structures (David, 1998). Teaching is to gradually reduce the external control, increase self-control students learning process.

Achieving Effective Extraction of Information

Software technology has been proven in many algorithms that are classic, but some algorithms for students, not well understood. So, the main focus is still used in thinking, highlighting the algorithm ideas, ignoring the details of grammar, as little as possible about theory, in terms of solving specific problems may get unexpected results. To select representative, moderate difficulty, comprehensive and strong typical algorithm, teachers allow students to program the machine. Perceptual knowledge can help students increase and improve the practical application of skills, strengthening their motivation and confidence.

Information processing theory tells us that when students accept the new information or solve a problem, need to extract the relevant stored information, and applications to interact or conduct, but the information extracted is not always successful. Activation of memory cannot be the reasons for the preservation of information. Memory information cannot be activated because the study of information processing is not enough depth.

The memories or information extraction stage can be

vulnerable to external stimuli about other stages. To a large extent, information memory depends on the information storage, as well as information and long-term memory in the past, the relationship between the content. For software technology instructional design, the proper characterization of the problem, through the extraction process to activate the external clues are important. But more importantly, it can lead students to enhance information recalled to help students provide clues for their own strategy.

Dealing with Individual Differences

Traditional teaching methods not only fail to provide students with high cognitive level of skill areas, but easy to misunderstand. Teachers can carry out teaching plans and practices and students look forward to the results of the program design process rather than program design in software technology teaching. Teachers decide whether students achieve a certain level of understanding.

Cognitive structure is diversification in the minds of students with different knowledge structure. Some students systematic knowledge structure is better structured, when used existing knowledge to solve new problems. But the knowledge structure of some students is in fragmented mind. When students find the mind cannot have the knowledge to explain the contents of the new study, it will have a sense of tension and imbalance. Therefore, teachers should not ignore individual differences of students and use the traditional lecture teaching methods. Teachers should pay attention to each student's knowledge structure to take care of the differences between the students, and create different ways to help students completing the individual meaning construction of new knowledge.

Conclusions

Combining discrete mathematics and software technology teaching practice, this paper analyzes the common problems at the present and proposes the framework of teaching guided by cognitive theory. Constructivist provides theoretical guidance to the construction of new models and new methods. Information processing theory of cognitive strategies guides science teaching. Both of them improve the teaching effect and develop students capacity. This enrich our understanding of the instructional design of teaching reform. It has a positive significance for education curriculum reform.

We should face the criticisms that the constructivist can result to the extreme in some way. Some of the views of constructivism have obvious subjectivism and relativism. But the theory emphasizes that learning is an active process of construction and reveals the nature of knowledge. It is of great significance to the traditional teaching in trying to achieve the broad learning and flexible migration, changing teaching ideas in the reform.

REFERENCES

Brown, J. S., Collins, A. & Duguid, P. “Sitllated cognition and the culture of learning. Educational researcher.”, 18 (1): 32 – 48,1989.

David Groome. “An Introduction to Cognitive Psychology.” Psychology Press Ltd, 1999.

David Jonassen. “Designing Constructivist Learning Environment s.” ICCE 98 proceeding,1998.

Michael W. Eysenck, Mark T. Keane. Cognitive psychology: a student's handbook.” Edition: 5, Taylor & Francis publisher, 2005.

Mordechai Ben-Ari. “Constructivism in computer science education.” Proceedings of the twenty-ninth SIGCSE technical symposium on Computer science education, p.257-261, February 26-March 01, 1998,

Robert. M. Gagné, L. T. Briggs, Principles of Instructional Design. 1979.

Piaget, J. “To understand is to invent.” New York: Grossman, 1973.

Piaget, J. “Genetic Epistemology.” University of Columbia. 1968.

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Cognitive Learning Theory implies that the different processes concerning learning can be explained by analyzing the mental processes first. It posits that with effective cognitive processes, learning is easier and new information can be stored in the memory for a long time. On the other hand, ineffective cognitive processes result to learning difficulties that can be seen anytime during the lifetime of an individual. A. Social Cognitive Theory. In the Social Cognitive Theory, we are considering 3 variablesÂ Social Cognitive Theory includes several basic concepts that can manifest not only in adults but also in infants, children and adolescents. Observational Learning learning from other people by means of observing them is an effective way of gaining knowledge and altering behavior. 1 year ago â€¢ Cognitive Theories, Learning Theories & Models â€¢ 1. Summary: A cognitive theory of multimedia learning based on three main assumptions: there are two separate channels (auditory and visual) for processing information; there is limited channel capacity; and that learning is an active process of filtering, selecting, organizing, and integrating information.Â There are two separate channels (auditory and visual) for processing information (sometimes referred to as Dual-Coding theory); Each channel has a limited (finite) capacity (similar to Swellerâ€™s notion of Cognitive Load); Learning is an active process of filtering, selecting, organizing, and integrating information based upon prior knowledge. Cognitive learning theory presents the entire process of information processing and information extraction. Constructive theory challenges the traditional pedagogical model, exposing the flaws of traditional instructional design. With the cognitive teaching theory to guide instruction, this paper analyzes drawbacks of the traditional teaching and discusses the behavior and model of teaching from the construction of the knowledge structure of students, cooperative learning and situated teaching. This paper also proposes to help students master discrete mathematics and software technology basic The combined approach, involving learning theory, cognitive psychology, and neuropsychology, is perhaps practiced most in the UK, and probably reflects British clinical psychology training. I return to this later in Section 8.20.8.Â Given that CBT was developed based on behavioral, cognitive, and social learning principles, understanding more about how specific techniques in CBT utilize aspects of various learning theories may shed light on potential areas for improvement or augmentation. This chapter provides an overview of numerous ways in which learning may occur within CBT, while also highlighting up-to-date research on how CBT therapists can maximize their clientsâ€™ learning.