

“Five Rings Teaching Methods” in Engineering Mechanics Teaching of Private University Civil Engineering Specialty

Y.Q.ZHAO

Changchun Architecture & Civil Institute, ChangChun, Jilin, China

ABSTRACT: According to the Confucius' heuristic teach idea and the "discovery learning" theory of the famous American educationist Bruner, aiming at training students' engineering practical ability, then to refine out with “Five rings teaching methods” that is: "Create the situation and stimulate the interest, Inspire to get into principles, Explore the laws, apply actually and Induce systematically" as the main content, which is suitable for the basic methods of engineering mechanics classroom teaching in non-government colleges.

KEYWORD: Teaching method; heuristic teaching; Discovery learning; the ability of engineering practice.

With advances in science and technology and the rapid development of economy in our country, the big wave of education reform pour in to every corner of the higher education. How to develop the teaching of engineering mechanics, cultivate applied talents who can meet the social development, has become the most concerned problems of the majority of private university teachers. In this paper, according to the teach practice of engineering mechanics in our hospital, focusing on the relationship between teaching and learning. With the goal to promote the cultivation of students' engineering practice ability, we refined and tried out a basic method for teaching civil engineering mechanics courses in private university, which is guided by the heuristic teaching thought of Confucius and the “discovery learning” theory of the famous American educationist Bruner, that is “Five Rings Teaching Methods”.

1 THE ORIGIN OF THE "FIVE RINGS TEACHING METHOD"

The theory of “discovery learning” was proposed by the famous American educationist Bruner. The so-called "discovery learning, is for the students' learning methods namely the students should be active to find problems, to explore the problems, to create a new self and future in the process of learning. establishing a corresponding discovery teaching methods, according to students' learning rules and thinking ways, to reach a harmonious relationship between teachers and students to communicate is the so-called "discovery teaching".

The "discovery teaching" and the "discovery learning" are closely related, and they are two complementary aspects in the process of teaching. However, the “Five rings reaching methods” is based on the heuristic education thoughts of Bruner's "discovery learning" and the theory support of Confucius's “do not angry does not start, do not desire does not inspire” to inquiry and practice.

Engineering mechanics is an important professional basic course of civil engineering. It includes many abstract concepts and formulas which are difficult to remember. So how to decrease its abstractness, reduce its practicality, in order to make up for deficiency of the students' cultural foundation of private university, at the same time to meet the students' thirst for knowledge of construction engineering, is the key to teaching plan. For this, give full play to the initiative of student learning, gradually formed an engineering ability with the guidance by teachers, is the main purpose of the course teaching. We carry out the "Five rings teaching method" in order to establish the engineering situation and create a relaxed and democratic teaching atmosphere. Under the teachers' targeted inspire, we guide students to think problems actively, to find the problem and then form a warm and orderly interaction. According to the students' need, the teachers can develop the students' thinking, combining with the engineering practice and the relevant knowledge, the teaching and learning achieve a resonance in the joyful situation. The students feel the engineering, understand knowledge and digest them in the "vivid" situation.

Such a bilateral relations of “teaching and learning” make a full use of two most important teach elements.

2 THE CONTENTS OF THE “FIVE RINGS TEACHING METHODS”

There are five teaching links in the “Five Rings Teaching Methods”, namely:

Create the situation and stimulate the interest→ inspire to get into principles→ explore the laws→ apply actually→ Induce systematically.

2.1 *The link of “Create the situation and stimulate the interest”*

In the teaching implementation project, we apply multimedia courseware to create engineering situation and contact engineering practice, combining the theory teaching contents closely. Through images, video, animation, sound and other means to create engineering situations, we want to make the students can see, can hear, can touch as far as possible, aiming at mobilizing the students' interest in learning and integrating the engineering atmosphere. Solve the problems students encounter in theory and in engineering practice timely, change "forced" to "guide", "cramming" to "happy". Once the Students nerve of interest is triggered, they will be moved by what one sees in a realistic context. For example, in the chapter of "bending stress", contact the structure of the factory beams, the crane beam and the lintel, with the help of teaching tools on the section normal stress and the reason for installation of longitudinal steels and hanging steels, making the students not only master the calculation formula, but also understand the professional knowledge.

2.2 *The link of “Inspire to get into principles”*

If the former focuses on the fascinating, now it is time to start learning knowledge, leading the students thinking. In the chapter of “fixed axis rotation of a rigid body”, we compared the rotation law with Newton's law, to inspire the student to pay attention to the differences between mobile and rotation: Acceleration and angle acceleration corresponding, force and moment correspond, mass and moment of inertia corresponding, neat in Antithesis, their meaning are similar, make deep understand the laws.

In the chapter of “inertial force”, teachers and students felt the “inertia force” together from a traveling car brake suddenly "experience" by means of multimedia, and then to learn some relative concepts, it seems sensible and profound.

On the surface of the teaching tool draw many vertical lines and horizontal lines, teachers use

moment to bend it, it is just the time to inspire the student to observe the change of the vertical lines length, analysis the difference in different areas of the up and down, then it is easy to understand the tensile area or compression area, the neutral layer, neutral axis etc, this way seems logical and believable.

2.3 *The link of “Explore the laws”*

As a mechanical teacher, we want to make the creativity of the students into full play, so we need to be reflected in teaching from different angles, different ways to think, so that students are not satisfied with a correct answer but satisfied with more than one questions or answers. Take the phenomenon of “Light rope bypass a crown block” for example. The ends of the rope has been tied with objects of different weight, to calculate the acceleration of the objects at both ends, the usual method is: firstly, pulley, and single object should be taken respectively as the research object, then list three dynamic equations and combine them to solve the problem. If from a macro perspective: due to the size of the object has no effect on the problem, we can see the object as a point. Again due to the length of the light rope has no effect on the problem, we can see an object as a mass point on the rim. Suppose the object mass= J/r^2 , at the moment we can write the system's angular acceleration expression directly, if multiplied by the radius of the wheel, we will get the acceleration of the object. Through so many interactions of micro with macro, intuitive with abstraction, divergence and convergence, to explore the inherent law of things, to cultivate student scientific thinking methods and technique, then achieve the goal of diathesis education.

2.4 *The link of “apply actually”*

Mechanics course has a complete theory system. However the purpose of studying mechanics is to apply. We made targeted teaching with the example of the established construction in our local city. We designed “Reinforced concrete composite beams”, “Statically indeterminate steel frame” and other material mechanics comprehensive design experiments, we organize students to study knowledge in the practice and the knowledge application, and then to find problems and put up with questions further.

In the teaching of strain energy of material mechanics, On one hand, we compare the strain energy formulas of axial tensile (compression), torsion and bending, to enhance understanding and memory, on the other hand, in the process of calculating strain energy, pay attention to observe the differential relationship of an outside force given by the strain energy, guide the student to understand

the principle of calculating with the energy method, by applying the foreshadowing for subsequent knowledge concept, to help p or students to prepare for the next lesson.

2.5 The link of "Induce systematically"

As the saying goes: Knitting frames or knitting baskets, the most important thing is closing up. After class, we have to sum up. When we need to understand some things in common, to grasp the acknowledge rule at the same time, paying attention to the differences with other things, summary systematically the development rules of the things is not only beneficial to today's learning, but also conducive to the future development. For example, when we conclude the inductive theorem of momentum of particle system or theorem of angular momentum, not only the content of the theorem is our task, it is particularly important to emphasize that no matter how large the internal force is, has no effect on problems. But when we conclude the theorem of kinetic energy, we must emphasize that the internal force has a direct effect on problem.

As another example, the initial phase of material mechanics research problem is always "external force \rightarrow internal force \rightarrow stress and deformation. Method for calculating the bending moment can not always stay in the level of "cut, leave, substitute, balance". Based on the known forces, combined with the teaching model, we summarized a "direct method" to calculate the internal forces according to outside force which leads the calculation now. At the same time, do spade work for the study of complex problems.

3 THE PRINCIPLES FOR IMPLEMENTING THE "FIVE RINGS TEACHING METHOD"

In the process of application of "Five rings teaching method", follow the following principles can improve the effect.

(1) In the link of "Create the situation and stimulate the interest": Situation is similar, the effect is desired, come straight to the question, make we absorbed into the situation.

(2) In the link of "inspire to the principles": To start because of the need and the environment, and strive to make think naturally, logic strict.

(3) In the link of "explore the laws": Apply scientific thinking, situated in, do it step by step in-depth and follow.

(4) In the link of "the actual application":

Accurately grasp the conditions, strive to efficiency, do detailed and brief properly, understand the truths and methods.

(5) In The link of "summary systematically": Add the finishing touch, scattered order, and strive to breakthrough, make fuse with overall and partial.

The implementation of the "Five rings teaching method" for six years reflects such education ideas of "students as the main body, teachers as the leading factor, teach them to fish" etc. It promoted the effect of our engineering mechanics course teaching, improved examination results obviously and students' practice abilities have been improved. In 2009, the material mechanics course was named choice curriculum in Jilin province. In 2010, the teaching team of materials mechanics was named outstanding teaching team in Jilin province.

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AUTHOR'S BRIEF INTRODUCTION

YuanQin Zhao, male, professor, born in 1945, vice president Civil engineering academe of Changchun Institute of Architecture.