Research on the Teaching Reform of Medical Higher Mathematics with BOPPPS Teaching Module

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Abstract Using BOPPPS teaching module combined with the present situation of medical higher mathematics teaching in Guangxi University of Chinese Medicine, this paper introduces the application of this teaching method in medical higher mathematics teaching, and explores the thinking of teaching reform of medical higher mathematics in Guangxi University of Chinese Medicine, so as to improve classroom teaching efficiency.

Key words BOPPPS teaching module, Medical Higher Mathematics, Teaching reform

1 Introduction

BOPPPS teaching module, first proposed by Douglas Kerr of the University of British Columbia in 1978[1], is a teaching goal-oriented and student-centered teaching model. BOPPPS teaching module divides classroom teaching process planning into six stages (elements), namely Bridge-in, Objective, Pre-assessment, Participatory learning, Post-assessment and Summary. The English initials of different stages are combined as BOPPPS (Fig. 1).

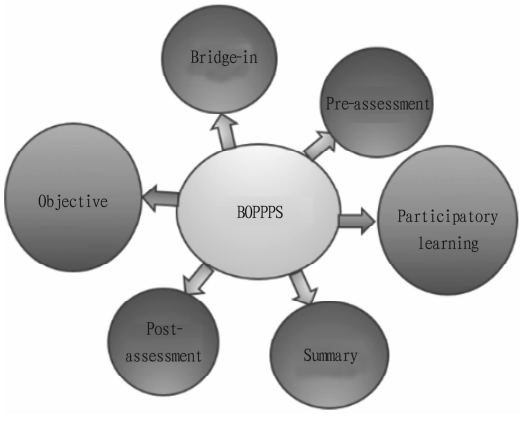

Fig. 1 BOPPPS teaching module

The characteristics of BOPPPS teaching module are as follows: Through meaningful introduction, students' interest in learning can be stimulated, and students can quickly enter the learning state; students are made clear and informed of the learning objectives of this class, so that students know the direction of their efforts and the expectations of teachers; students' cooperative learning and autonomous learning are emphasized, and the teaching of teachers' teaching method is reduced; effective interaction between teachers and students is emphasized, and attention is paid to teaching feedback data[2].

2 Present situation of medical higher mathematics teaching in Guangxi University of Chinese Medicine

Medical higher mathematics is an important general compulsory course for medical majors. Through the study of this course, we can have the mathematical foundation needed for the follow-up study of professional basic courses and professional courses. In addition, it also teaches mathematical thoughts, cultivates students' innovative consciousness, and gradually improves students' mathematical literacy, mathematical thinking ability and ability to apply mathematical knowledge[3], which is self-evident. In recent years, the teaching content of medical higher mathematics in Guangxi University of Chinese Medicine is basically unchanged. In the past teaching process, we mainly adopt the traditional teaching method. In the case of less class hours, we adopt the single teaching method of "multimedia + whiteboard" and one-way indoctrination teaching method. The interaction between teachers and students, between students in the classroom is not enough, which leads to the low participation of students in the classroom and the unsatisfactory teaching effect. Except for a few students who have a good mathematical foundation and can easily master the knowledge, most students still stand in awe before medical higher mathematics. In addition, some students are not clear about the importance or necessity of learning higher mathematics, their learning motivation is not clear and their motivation is not strong, so they have a lax learning attitude. The quality of universities needs to be improved, and the development of connotation education requires us to pay attention to the teaching quality of undergraduate education. The key to ensuring the quality and output of education is curriculum setting[4].

Therefore, we should reform the teaching of medical higher mathematics, change the current teaching mode, and change the class with only one sound and dull classroom. The goal of teaching reform is to take students as the center, let students take the initi-

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ative to participate in teaching, ask questions through the guidance of teachers, think about questions, analyze questions and discuss questions, and then students show their discussion results, so that students can get full affirmation in the teaching process. Only when students devote themselves to learning and actively participate in classroom teaching, can they really learn effectively[5].

3 Exploration of applying BOPPPS teaching module to medical higher mathematics teaching

3.1 B: Bridge-in The purpose of bridge-in is to arouse students' attention and interest, which is the basis of forming a good classroom atmosphere and improving teaching effect. A good bridge-in can not only attract students to the class quickly, but also make the class interesting and informative, and help students focus on or connect with the content to be introduced. The bridge-in method can be carried out by narrating stories related to the topic, personal experiences, current news, topics of interest to students, *etc.* However, the content of the bridge-in must be related to the content of this lesson, and it is best to arouse students' thinking and lead to the necessity and significance of learning this lesson. For example, when explaining the limit of sequence, "What sequences did you learn in high school? Our university will discuss the sequence again, mainly studying it as a whole and discussing its changing trend", the teacher asked. By introducing the problem of cutting off from a saying in *Chuang Tzu-The World* written by Zhuang Zhou, a philosopher in the Warring States period, "Cut away half of a rod and keep on halving what is left, and there will be no end to that process", teachers try to arouse everyone's interest, so as to build a simple sequence. "When the number of days tends to infinity, what is the change trend of the length of rod? This involves the sequence and the limit of sequence to be studied in this lesson", teacher asked.

3.2 O: Objective At the beginning of a class, what students want to know most is what goals they can achieve after studying this class, what abilities they can acquire, and how these abilities will help them in the future. Therefore, in order for students to put their energy into the class and make them learn something, teachers must know what goals they want students to achieve. In the process of forming learning goals, teachers should also share these goals with students. Learning objectives mainly include three-dimensional learning objectives, as shown in Fig. 2.

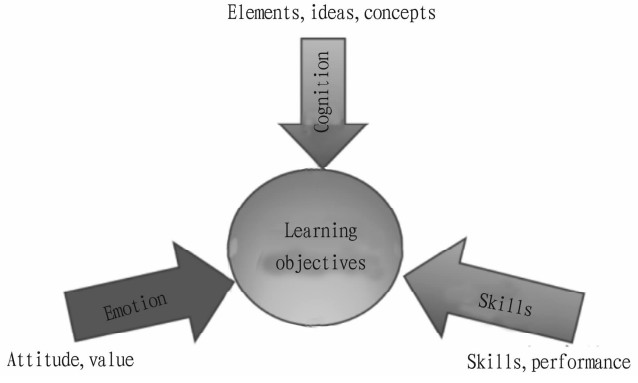

Fig. 2 Three-dimensional learning objectives

"Three-dimensional objectives" are not three goals, but three aspects of the same problem, which essentially reflects the students' internal psychological structure changes after the end of teaching activities. In the course of Medical Higher Mathematics, some knowledge points require students to master operation and skills proficiently. Teachers should design the learning objectives concretely in each class, which is convenient for teachers and students to evaluate the teaching effect.

For example, when talking about the limit of sequence, the learning objectives are as follows:

Knowledge objective: (i) The definition of limit of sequence can be briefly described; (ii) The geometric meaning of the limit of sequence can be briefly described; (iii) The uniqueness and boundedness of convergent sequence can be exactly stated.

Ability objective: Students can apply the definition of to prove the limits of a sequence.

Quality objective: A simple sequence is established through *Chuang Tzu-The World*, to cultivate students' patriotic feelings and cultural self-confidence, and learn the perseverance of the ancients; the concept of limit is understood, to cultivate students' thinking ability of summing up the law of changes in things; the existence of function limit is judged, to cultivate students' logical thinking ability and problem analysis ability.

3.3 P: Pre-assessment Pre-assessment is the development of teaching content. After completing the learning objectives, students are tested before class, which is called pre-assessment. Through the pre-assessment, teachers can have a good understanding of students' existing experience, understand students' interests, determine their attention in advance, and help students quickly focus on the knowledge points to be taught, so that teachers can adjust the depth and progress of teaching at any time, and at the same time help students consolidate old knowledge and prepare for learning new knowledge.

For example, when talking about L'Hôpital's rule, set the following pre-assessment: Calculate $\lim\limits_{x\to x_0}\dfrac{f(x)}{g(x)}$, in which $f(x)$, $g(x)$ are continuous functions.

(i) If $g(x)\neq 0$, what is the value of $\lim\limits_{x\to x_0}\dfrac{f(x)}{g(x)}$ (Substitute $x=x_0$ into the formula to get $\dfrac{f(x_0)}{g(x_0)}$);

(ii) If $f(x)\neq 0$, $g(x)=0$, what is the value of $\lim\limits_{x\to x_0}\dfrac{f(x)}{g(x)}$? (Calculate the reciprocal of formula, and then use the relationship between infinitesimal and infinity to get the answer ∞);

(iii) If $f(x)=0$, $g(x)=0$, what is the value of $\lim\limits_{x\to x_0}\dfrac{f(x)}{g(x)}$? (Remove the zero factor).

That's a good idea. If we can remove the zero factor, we can work out the result. What if we can't remove the zero factor? For example, calculate $\lim\limits_{x\to x_0}\dfrac{e^x+e^{-x}-2}{1-\cos x}$.

Students will find that they can't find the zero factor. Students are asked: How should we deal with this problem? The great mathematician L'Hôpital' discovered a way to deal with such

problems, which is what we will learn in this lesson-L'Hôpital's rule. L'Hôpital was born into a French aristocratic family in 1661. At the age of 15, he solved Pascal's cycloid problem, and later solved Bernoulli's steepest descent curve problem. He studied calculus under Bernoulli, a Swiss mathematician, and became a major member of the new French analysis. L'Hôpital's *Infinitesimal Analysis*, the earliest textbook in calculus, created an algorithm (L'Hôpital's rule) to find the limit of the quotient of two functions satisfying certain conditions. By introducing L'Hôpital's story, it is intended to enhance students' interest in learning mathematics and learn from mathematicians their spirit of hard work and innovation.

3.4 P-Participatory learning Participatory learning is to realize the interactive learning of the core content of the curriculum, which improves the predicament that students can't actively participate in learning in traditional teaching, and effectively solves the problem of "insufficient interaction between teachers and students, between students in class". This link requires teachers to adapt to changes, flexibly apply various teaching media and learning resources, encourage more students to actively participate in teaching and learning, let students fully display their views, debate different views, deepen their understanding of the knowledge points they have learned, and thus have more confidence and motivation in learning medical higher mathematics.

For example, when talking about the concept of definite integral, the set ability objective is to find the distance of variable speed straight line motion with four steps, and abstract the concept of definite integral through teachers' guidance and students' discussion. Around this goal, we introduce the definition of curved trapezoid through three figures and two questions (Fig. 3).

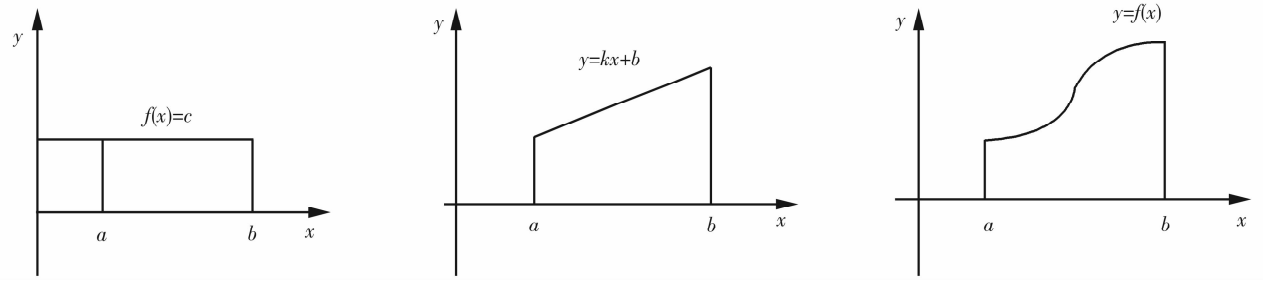

Fig. 3 Introducing the definition of curved trapezoid

Question 1: What is the figure?

Question 2: What is the area of the figure?

After the teachers and students get the definition of curved trapezoid, they ask Question 3: What is the area of curved trapezoid?

Students will naturally think of the cut-and-supplement method used in middle schools. After graphic analysis, the cut-and-supplement method can't solve the problem. At this time, teachers begin to teach how to find the area of curved trapezoid by dividing, taking approximate value, summing and taking limit, and sum up four steps. Next, it is discussed in groups: find the distance of variable speed linear motion, give students (a group of 4 people) 5 minutes to discuss, and then show the discussion results by the group leader. Finally, the definition of definite integral is obtained abstractly by teachers' analysis and students' thinking. At the same time, ideological and political education is carried out for students. In study and life, our efforts are like abilities: abilities are the integral of efforts, achievements are the integral of abilities, and good images are the integral of achievements[6].

3.5 P: Post-assessment Post-assessment is an evaluation method to test the learning effect in class, through which teachers can judge whether students achieve the expected goals. Post-assessment usually requires teachers to consider two questions, "What students have learned?" and "Whether the expected goals have been achieved?" According to the feedback of post-assessment results, teachers can reflect and adjust the instructional design, so as to make the teaching objectives easier to achieve. At the same time, students can know their mastery of knowledge in time and enhance their sense of acquisition.

For example, when talking about L'Hôpital's rule, solve $\lim\limits_{x\to x_0}\dfrac{e^x+e^{-x}-2}{1-\cos x}$ after explaining example 1. Summarize the general steps of applying L'Hôpital's rule:

(i) Judge the type of limit; (ii) Apply L'Hôpital's rule or equivalent infinitesimal; (iii) Conclude or re-apply L'Hôpital's rule.

Practice in class:

$$\lim_{x\to 0}\frac{a^x-b^x}{x}\ (a>0,\ b>0); \tag{1}$$

$$\lim_{x\to 0}\frac{e^x-e^{-x}-2x}{x-\sin x}. \tag{2}$$

Find the following limits:

Design intent: from the shallower to the deeper, layer by layer, it should enable students to easily accept what they have learned. In Question (1), by substituting 0 into the formula, the limit is $\dfrac{0}{0}$, we can apply L'Hôpital's rule to get the answer; in Question (2), the limit is $\dfrac{0}{0}$, we can use L'Hôpital's rule. But after using L'Hôpital's rule, we don't get the answer, and the limit type is still $\dfrac{0}{0}$, and at this time, we can use L'Hôpital's rule again, or use equivalent infinitesimal first and then use L'Hôpital's rule again to get the answer. "What are the general steps to use L'Hôpital's rule?", students are asked. It aims to deepen students' understanding of L'Hôpital's rule.

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3.6 S: Summary Summary is to sort out the content of this lesson. Some people compare the class summary to the "ending" or "finishing touch" of Go, which shows the important role of summary in classroom teaching. Teachers can summarize by writing on the blackboard, mind mapping and memorizing formulas. A good summary can make students think and explore further on the basis of classroom teaching, and make clear the important and difficult points of the content, which is helpful to improving students' autonomous learning ability and creative ability.

For example, when talking about the concept of derivative, the class summary is as follows: (i) The concept of derivative: the limit of incremental ratio; (ii) The geometric meaning of derivative-slope; (iii) Find derivative by definition-three steps: find increment; calculate the ratio; find the limit; (iv) A function that can be derived must be continuous, but a function that is continuous is not necessarily derivable.

4 Conclusion and discussion

Guangxi University of Chinese Medicine is now actively implementing BOPPPS teaching module, aiming to make teachers change the previous teaching mode and devote themselves to the reform of education and teaching. Compared with traditional teaching, BOPPPS teaching module has great advantages. Teachers need to study the theoretical knowledge of BOPPPS teaching module and constantly explore how to apply it to the class imperceptibly. In fact, it is obviously not possible to apply BOPPPS teaching module directly to our teaching overnight, and it will take a long time to explore and study here. However, it is believed that it is feasible to learn from the advantages of BOPPPS teaching module for solving some problems existing in teaching. In specific teaching, there is no fixed and universal method, everything depends on people and circumstances, so the key to the effectiveness of an effective class is to let students get something. As long as the goal of teaching and learning can be achieved, all legal and reasonable methods can be adopted. In the future teaching practice, with the support of the leaders of the college, we will explore together with the team teachers of the teaching and research section, change the teaching concept, gradually improve the teaching methods, apply the advantages of BOPPPS teaching module to the teaching practice of medical higher mathematics course in Guangxi University of Chinese Medicine, and constantly try to solve the problems in the current medical higher mathematics teaching with BOPPPS teaching module.

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