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RESEARCH ARTICLE

PROBLEM-ORIENTED FLIPPED CLASSROOM TEACHING PRACTICAL BASED ON THE KNOWLEDGE FRAMEWORK AS THE MAIN LINE - TAKE " KETONE BODIES METABOLISM" AS AN EXAMPLE IN BIOCHEMISTRY

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Abstract

Taking "Ketone bodies metabolism" as an example, this paper carried out the problem-oriented flipped classroom teaching practice research based on knowledge framework as the main line in biochemistry. The classroom teaching mode helped students to clear up the ideas quickly, grasp the key points based on the knowledge framework and problem-oriented, and then learn, think and discuss actively and deeply, improved students' skills and learning initiative, so that improved students' autonomous learning enthusiasm and critical thinking ability, at the same time, helped teachers to condense, expand and deepen knowledge points continuously, improve the quality and effectiveness of problem-oriented, and then improve the teaching efficiency and quality, and thus achieve "teaching others is teaching yourself".

Introduction:-

Biochemistry is a basic course of biology and related specialty, and it is often listed as a professional course for postgraduate entrance examination.Its teaching effect has an important effect on students' future work in related industries and academic research. Biochemistry includes static part and dynamic part, in which the dynamic part includes metabolism of four substances and their relations, and is closely related to human physiological health and disease. This paper take the "metabolism of ketone boy" as an example, and carried out problem-oriented flipped classroom teaching practice of biochemistry[2-4] based on knowledge framework as the main line[1], in order to provide reference for biochemistry teaching.

The Teaching Goal
Knowledge objectives
To master the concept of ketone body, the generation and utilization of ketone body and the physiological significance of ketone body metabolism.

Competence objectives
Learn to judge the relationship between metabolism; Improve students' ability to combine theory with practice.

Quality target
Stimulate students' enthusiasm in learning biochemistry; focus on the role of biochemistry in real life; cultivate students' ability emotional communication.

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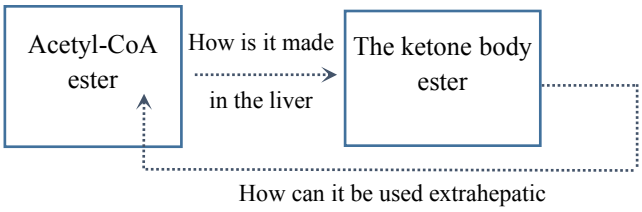
Teaching activities and organization

Flipped classroom teaching mode based on group cooperation to build metabolic network[5], teaching activities of teachers and teaching assistants were shown in Table 1.

Table 1:- "Metabolism of ketone bodies " self-learning task list.

<table>
<tr><td>Self-study target</td><td>(1) Understand the pathway of acetyl-CoA in severe starvation
(2) The dangerous of excessive weight loss</td><td>To understand
Request to grasp</td></tr>
<tr><td rowspan="8">Self-study task</td><td>Question</td><td rowspan="8">The brief answer</td></tr>
<tr><td>(1) What is the ketone body ?</td></tr>
<tr><td>(2) How are the ketone bodies formed ?</td></tr>
<tr><td>(3) What factors regulate the formation of ketone bodies</td></tr>
<tr><td>(4) How are ketone bodies utilized</td></tr>
<tr><td>(5) What is the physiological significance of ketone body formation</td></tr>
<tr><td>(6) Ketone body and health:What diseases are caused by ketone body overproduction</td></tr>
<tr><td>(7) Diabetes and ketone body:check out the latest developments in diabetes</td></tr>
<tr><td rowspan="2">Platform problem sets</td><td rowspan="2">Exercises after class 、 network teaching platform exercises、draw ketone body metabolic network</td><td>Group puzzles</td></tr>
<tr><td>The key point
The key enzymes</td></tr>
<tr><td>Self-study line</td><td> 
</td><td>Generating and utilizing site
Generating and utilizing process
Generate meaning
The calculation process</td></tr>
</table>

In class, the classroom activities of teachers and students were shown in Table 2, and the classroom questions based on the pre-class independent learning task book were shown in Table 3.

Table 2:- The class activities of teachers and students.

Role	Teaching activities
Teacher	Lead the classroom and answer questions
Teaching assistants	Ask a series of classroom questions around the independent learning task book
The students who writing on the blackboard	Ahead of draw the knowledge framework on the blackboard before class 5 minutes
Group leaders	Lead group discussion
Traders	Draw lots to decide which group will speak
The other students	Study, discuss and answer questions

Table 3:- Classroom problem based on the setting of independent learning task book before class.

The serial number	Classroom problems
1	By learning "catabolism of sugars and lipids", we know that under normal circumstances, glucose and fatty acids in diet can produce a large amount of acetyl-CoA after catabolism, and these acetyl-CoA will enter TCA cycle for oxidation capacity. But how does the body compensate for acetyl-CoA deficiency during fasting,exercise or severe hunger?
2	What is the ketone body?

3	How are these tiny ketone bodies formed? Key enzymes in ketone body formation?
4	What factors regulate the formation of ketone bodies?
5	The ketone bodies generated in the liver must be transported by blood to the extrahepatic tissues for oxidative decomposition. So how are ketone bodies used outside the liver.
6	It can be seen that ketone bodies have important physiological signification. Please elaborate.
7	Under the normal circumstances, the amount of ketone bodies in the blood is normal. But, when hunger, diabetes, high fat and low sugar diet, excessive weight loss, fat mobilization increased,ketone body production increased, when the use of extrahepatic tissue, what disease will lead to?
8	The relationship between diabetes and ketone bodies?

On the basis of the students answered these questions,the teacher summarized the question 1,that is, “burning fat produces a large amount of acetyl-CoA by burning fat. When acetyl-CoA exceeds the limit that the tricarboxylic acid cycle can handle, ketone bodies will be generated through another way”, so the concept of ketone body is introduced. For the question 2, the teacher guided the students to understand the content of ketone body in normal blood(plasma level: 0.03-0.5 mmol/L or 0.3-5 mg/dL), and the principle and method of clinical ketone body detection(micro-lesson video). And in the biochemistry experiment class, the students were asked to detect the content of ketone body in urine through eight-strip urine test paper for future consolidation.For the question 3, students are required to fill in the knowledge framework on the platform and explain at the same time. Teachers guide students to summarize from four aspects about raw materials, parts, generation process and key enzymes. For the question 4, teachers summarize, that is, “raw materials: after satiation, fat mobilization is reduced, fatty acid synthesis, malonyl CoA can prevent fatty acid β-oxidation increases greatly when starvation occurs. Hormone: increased insulin, high glucose metabolism in the liver, reduced fat mobilization, reduced fatty acids into the liver, ketone body formation; conversely, glucagon increases.” On the basis, the teacher guides the students to discuss “how to lose weight correctly?” And guide students to understand the dangers of excessive weight loss. For the question 5, the same as question 3, the students who explain should come to the platform to fill in the knowledge framework and explain at the same time. The teacher guides the students to summarize by using parts, process and energy generation. For the question 6, the teacher guides students to summarize form three parts: on the one hand, ketone body is the normal intermediate metabolite of fat in the liver, and it is a form of energy output by the liver; on the other hand, ketone bodies dissolve in water and are small molecules that can pass through the blood-brain barrier, which is an important energy source for brain tissue; the most important thing is to prove energy for vital organs such as the heart and brain in case of hunger or disease. For the question 7, on the basis of students understand the ketonemia, ketonuria and ketoacidosis, let students think about how to treat the ketoacidosis, giving the answer “Alkaline drugs may be given” at the end. For the question 8, through teachers guide and summarize “insulin can be very beneficial fat metabolism inhibitors, sugar metabolism and strong promoter, even low levels of insulin would inhibit most beta oxidation, diabetes patients lack of insulin in the body, thus leading to high blood sugar and urine sugar, and fat metabolism speeds up, cause a lot of acetyl-CoA generated a lot of ketone body, thus appear ketonemia and ketonuria. Patients with diabetes can be given insulin and glucose to correct glucose metabolism disorders, increase glucose oxidation, and reduce the fat mobilization and ketone body formation.” In addition, the abnormal smell of acetone breath, such as the ketogenic diet of people trying to lose weight forcing the body to decompose fat for energy, such as increased intracellular reduction oxidation ration ($NADH/NAD^+$) after alcohol poisoning. The metabolism dependent on the normal reduction oxidation ratio ($NADH/NAD^+$) is abnormal and ketone body production is increased.

Finally, the teacher made a class summary based on the blackboard knowledge framework, that is, “Ketone body is a kind of intermediate metabolites of fatty acid decomposition, which is synthesized in the liver and used in the liver, and HMG CoA synthase is the key enzyme in the synthesis process. Ketone formation is an important energy source for heart, kidney, brain, skeletal muscle, especially brain tissue. Excessive production of ketone bodies can lead to ketonemia, ketonuria and ketoacidosis. So we need to be careful to eat regularly, eat sensibly and not lose too much weight.” At the same time, ask students to think about “the consequences of high-sugar and high-fat diets?”, thus leads to the downstream knowledge point “acetyl-CoA can also be used as a raw material for cholesterol and fat synthesis.”

Investigation of teaching practice effect

295 students of grade 2017, 2018, and 2019 were surveyed on the teaching effect of "How satisfied are you with the problem-oriented flipped classroom teaching based on knowledge framework compared with the traditional teacher-oriented teaching in biochemistry course". The results were showed in Table 4.

Table 4:- Teaching effect survey and percentage of satisfaction.

Help / Teaching mode	A Improve critical thinking ability	B Improve learning enthusiasm	C Quickly grasp the knowledge framework	D Clear your mind	E Get to the point quickly	F Improve autonomous learning ability
Knowledge framework is the main line	0%	0%	100%	93%	94%	75%
Problem oriented	84%	95%	89%	87%	85%	0%
Flip the classroom	86%	96%	0%	0%	0%	96%
Problem-oriented flipped classroom based on knowledge framework as the main line	93%	98%	100%	96%	95%	100%

Note: a . Percentage is proportion of those satisfied with the item to the total number of people(295)

b. The valid questionnaire of this survey is 100%

The results showed that the teaching of knowledge frame as the main line and problem-oriented teaching can improve students' critical thinking ability. Knowledge frame as the main line of teaching and problem-oriented teaching help students to quickly master the knowledge frame, clear learning ideas and quickly grasp the key points. Knowledge frame-based teaching and flipped classroom help to improve students' autonomous learning ability. Organic combination of the three teaching modes and problem-oriented flipped classroom based on the knowledge frame as the main line can comprehensively improve the above abilities of students, thus improving learning efficiency, especially in helping students quickly master the knowledge frame and improve their independent learning ability.

Teaching Reflection

The classroom teaching through layer problem oriented guide students from the production of ketone body concept, ketone body and utilization, the ketone body of work with three aspects to study and discuss, and then summarizes teachers, with a focus on the generation and use of ketone body, as fills the knowledge framework and interpretation of the students, the teachers teaching in the form of supplementary explanation of difficulty is ketone body of work with, by setting up questions for students to think and discuss, teachers explain to help students to combine theory with practice, dialectically understand the advantages and disadvantages of ketone body in human body, deepen the understanding of the relationship between sugar metabolism and lipid metabolism, and constantly expand and internalize the knowledge framework of substance metabolism in the brain. At the same time to promote teachers to improve and condense the problem effective guidance, form a virtuous teaching cycle.

In addition, the classroom teaching is based on network teaching platform has biochemical course construction, on the basis of students based on knowledge framework as the main line, to autonomous learning task list as the guide, through the platform data preview after team discussion, class under the problem oriented in-depth thinking and learning, to improve the students' critical thinking ability and learning enthusiasm[6], it is helpful for students to grasp the knowledge framework faster in the process of learning biochemistry, clarify their learning ideas, quickly grasp the key points, save class time, improve students' independent learning ability, and help teachers to further guide students to combine theory with practice, broaden and deepen their knowledge,so as to achieve teaching and learning.

In addition, the classroom teaching improves students' ability of unity, cooperation, emotional communication and organization through students' taking turns to participate in classroom teaching activities and organization, which

plays an important role in students' future career development, and meanwhile, it also promotes teachers to constantly improve top-level teaching design and improve teaching quality.

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