Application of Mindmap in the Teaching of Cell Biology of Medical Students

Wen-jing YU\textsuperscript{a}, Qi WANG\textsuperscript{b}, Guang-tao JIA\textsuperscript{c}, Zhi-qin GAO\textsuperscript{d} and Chun-ling ZHAO\textsuperscript{e, *}

Science and Technology of Biology's Institute, Weifang Medical University, Weifang, Shandong, China

\textsuperscript{a}wenzi790626@163.com, \textsuperscript{b}wangqi@163.com, \textsuperscript{c}gtjia2017@163.com, \textsuperscript{d}zhiqingao@163.com, \textsuperscript{e}zhaochunlingbj@163.com

*Corresponding author

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Abstract. Mindmap is a visualized learning tool. We applied it to the teachers’ teaching and the students’ learning, which helped the students to construct the knowledge frame and cultivate the strict logic thinking ability and improved the learning efficiency.

Introduction

Cell biology is one of the important basic and advanced subjects of life science and is listed as one of the three basic disciplines of life sciences. The medical students are required to learn this basic subject. As a basic subject, the teaching goal of this course is that the medical students are required to master the basic knowledge from the basic structure and function of cells and the relationship between organelles, to understand present situation of hot topics and development trends in the future in cell biology, and lay a solid foundation for related courses learning in basic medical and clinical courses.

In the teaching practice of medical cell biology for many years, although we use the case teaching, the flipped classroom, PBL teaching method and other teaching methods, we activated and aroused the students' interest in learning, we also found some problems. The students strongly mastered some memorable knowledge points, and got high marks in the objective examination. But when faced with a number of complex problems, they lacked comprehensive analysis ability, the knowledge connection ability, the ability to solve problems and lacked adaptability analysis in subjective thinking questions.

Mindmap was created in the early 1960s by the British psychologist and education experts Tony Buzan according to brain physiology interactive mode of learning to create a structured thinking tool [1]. From a central key word to spread out the multiple branches of knowledge points, each branch consists of symbols, numbers, and so on, and then each branch point sends out a related knowledge point to form a dendritic structure. Different colors and images are used to establish the memory links. Mindmap is a kind of knowledge visualization teaching and learning tool, which can help students to improve memory and stimulate the imagination [2, 3].

We tried to apply the mindmap in the cell biology teaching and learning for medical students. The organelles or cell life activities served as keywords. The chemical composition, structure, biological function, diseases etc., related with the organelles or cell life activities were extended out, so as to draw clear mindmap, which made knowledge points crisscrossed and connected, constructed knowledge frame system. The mindmap could make the students master knowledge on the whole, and had the strict logical thinking ability, but also cultivated students with the associated thinking ability.
1. Teaching Activities based on the Mindmap

1.1 Learn to Make and Use the Mindmap

Mindmap is a useful learning tool. In order to make students master this tool, we first trained students about the knowledge of the mindmap. Classical cases of mindmap were shown to let the students know what the mindmap is, how to make a mindmap and where the application of mindmap is. This could inspire students' interest in learning and using mindmap and desire to explore. Given that not all the students had a computer, we also advocated students draw a mindmap by hand. The problems would be found and resolved in time during drawing the mindmap to construct the knowledge framework of cell biology.

2. The Application of Mindmap in the Teachers' "Teaching"

2.1 The Mindmap was Applied to Carefully Design Guide Class

In the preparation process of teaching content, mindmap could be used for the design of class teaching. Lesson guide is the first link of classroom teaching, teachers should carefully design guided lesson in the teaching of cell biology. As an example with the guide class of mitochondria section [Fig1], the teacher made thinking navigation diagram using Xmind mindmap software, and their teaching ideas were summarized and all kinds of knowledge elements of the classroom teaching were organized to be together. This thinking navigation diagram let the students have the impression for the knowledge framework, which made teaching more logical and well organized.

![Figure 1. The Design of Guided Class in Mitochondria.](image)

2.2 The Mindmap was Used for Heuristic Teaching and Progressive Transformation

The teachers carried on teaching through the establishment of hyperlinks at all levels of mindmap branches. The teachers made clear the knowledge points around keywords, and also paid attention to the connection and the transition between the knowledge points, completed the analysis of the knowledge step by step. This would prompt the students to construct the systematic knowledge framework, and increase the students’ rigorous logical thinking ability.

2.3 The Mindmap were Applied to Establish the Correlation between Knowledge

Knowledge is the fruit for human to understand the objective world in practice. It includes the description of the facts, information or skills in education and practice. Knowledge is the existence of a solid and has many attributes. Based on the presence of these attributes, connections appear between knowledge points and knowledge points. These connections are the foundation of the knowledge correlation. Through the knowledge correlation, we can extend from knowledge A to
acquire knowledge B, C, thus stretched out, until we acquire the right information to solve the problem.

Through the application of mindmap in the teaching, teachers paid attention to the establishment of connections between knowledge (including internal and external correlation), prompt the students divergent thinking, cultivate students' comprehensive ability to analyze. For example, the main function of mitochondria [Fig2] is involved in the main process of cellular respiration, including the formation of acetyl CoA, citric acid cycle and oxidative phosphorylation. Energy materials are first converted to acetyl CoA, while only CoA acetyl and oxaloacetic acid together to synthesize citric acid, which can open the citric acid cycle. The greatest significance of tricarboxylic acid cycle lies in providing hydrogen from the material metabolism. And then, hydrogen is dissociated to hydrogen ions and electrons, and the electrons are transferred along the respiratory chain to the end of the oxygen. Finally, catalytic oxidation phosphorylation occurs. So, the formation of acetyl CoA, citric acid cycle and oxidative phosphorylation are closely related by timing and internal.

Oxidative phosphorylation structure foundations are respectively the respiratory chain and ATP synthase, which are located on mitochondrial inner membrane, and this makes oxidation and phosphorylation process coupled. The mechanism of cellular respiration is a chemosmotic hypothesis. This hypothesis of the interpretation of the mitochondrial function is correlated with protein distribution and unpermeability of hydrogen ions on the inner membrane. Mitochondrial distributions of chemical composition, especially of the enzymes in different ultrastructure of mitochondria, are related to mitochondrial metabolism of different materials. So, the chemical composition, structure and function of mitochondria are closely related with each other. But mitochondria are not isolated, and interconnected with other organelles. For example, as an organelle to produce energy, mitochondria are usually distributed in cells parts needed for energy and mitochondria need to move to these part, which depends on microtubule transportation as transportation rail.

![Figure 2. Knowledge Correlation from Mitochondria.](image_url)
3. The Application of Mindmap in the Students "Learning"

3.1 The Mindmap was Applied to Preview

Preparing lessons before class is an effective method of study. Students drew a mindmap to show each knowledge point according to the learning content and to have an overall understanding through the knowledge framework, rather than simply looked at the textbook, which gave them very few impression.

3.2 The Mindmap was Applied to Make Notes in Class

The situation that the students just passively listened to lectures in class would be changed. Students took an active part in making notes about knowledge points and raveling out the relation between them. The use of a visualized mindmap helped students to master relevant knowledge of the overall framework, and to improve the efficiency of class learning.

3.3 The Mindmap was Used to Summarize and Review what They Learned in Time after Class

The students tidied knowledge into modules by use of the mindmap in a timely manner after class. Each section of cell biology had a piece of mindmap, and the content of each chapter also had a piece of mindmap. And Attention was paid to the connection between each section and chapter. At the same time, students were required to follow the instruction of the mindmap to review what they learned.

4. The Mindmap was Applied to Summarize and Evaluate Teaching and Learning and Prompted the Interaction between Teachers and Students

The teachers collected hand-drawn workpieces of mindmap from students regularly after class, and timely reviewed, gave comments and put forward amendments for deficiency to be modified by the students. Mindmap is a visualized tool, which can manifest and implicit thinking process visualization. The teachers could learn about the students’ knowledge reserves and the depth and breadth of knowledge and make an effective judgement for the pattern of cognitive process by reviewing the mindmap pieces. The excellent mindmap pieces would be photoed and showed to the students. This would make them learn from each other, complement each other, enhance their level of making a mindmap and their confidence. Using the mindmap in class, the questions and difficulties content would be evaluated, summarized and at last inspected to the achievement of the teaching and learning goals.

5. The Survey Analysis for Application Effect of Mindmap

The questionnaire survey for the application of mindmap in teaching and learning was carried on in grade 2016 medical undergraduate students in our school. The results were sorted and analyzed. The results showed that most of the students thought that they were interested in the mindmap and it could play an effective role in promoting their own learning. It also could effectively construct their own knowledge framework, and clarify the connection between the knowledge points. In addition, it could improve their logical thinking ability, comprehensive analysis ability, and arouse the enthusiasm of their learning initiative. Most students were willing to use the mindmap for future study related to other medical courses. In summary, the mindmap is worth being popularized in medical colleges and universities.

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