

Application of Mind Mapping in General Zoology Teaching

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Abstract: Against the background of the new curriculum reform, teachers are no longer just expected to impart knowledge exclusively, but they also carry the responsibility to encourage students to think independently, improve students' thinking skills, and cultivate good learning and thinking habits among students, so as to enable students to use knowledge in a flexible manner and improve their thinking skills. General zoology is a highly specialized discipline, with scattered knowledge points and various concepts. Since the traditional teaching mode limits students' mastery of knowledge points, teachers need to find a teaching method that can help students understand knowledge points and exercise independent thinking. Mind mapping is a concrete thinking tool that helps students exercise their thinking skills. The introduction of mind mapping in the teaching of general zoology allows students to have a clearer understanding of the overall framework of this discipline. The application of mind mapping can be divided into four parts: pre-class preview, classroom study, after-class review, and zoology experiment. The application of mind mapping to teaching not only improves students' learning efficiency, but also enhances students' comprehensive ability and stimulates their interest in general zoology. In this paper, the 17th chapter of "Fish" in general zoology is taken as an example to elaborate the application of mind mapping in the teaching of general zoology.

Keywords: Mind mapping; General zoology; Pisces; Classroom teaching

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1. Introduction

General zoology is a discipline that studies the morphological structure of animals and the laws related to their life activities. General zoology is one of the important professional foundation courses for animal science, biological science, and ecology majors^[1]. The teaching objectives of general zoology are as follows: to enable students to understand the basic morphological structure and classification of different animal groups, as well as the basic skills of zoological research and knowledge of the taxonomic system of zoology; to understand the morphology, structure, classification, and evolution of animals; to understand the adaptation of animals to their environment, as well as the unity of structure and function^[2]; to acquire the ability to analyze and solve practical problems in science and production in this process; and to lay the foundation for subsequent courses. Since there are many complex and fragmented knowledge points in general zoology, students not only find it difficult to learn and master the knowledge points, but also feel overwhelmed when learning. At present, the teaching process is generally faced with more teaching content, limited learning time, students' weak foundation, and their struggle to learn. Moreover, the traditional teaching method embodying systematic explanation as the main teaching method in the teaching process is still adopted^[3]. This rigid teaching method subdues students' interest in learning and has poor teaching effect, thereby making it difficult to achieve the expected teaching objectives.

Mind mapping, as proposed by Dr. Tony Buzan in 1970, is a thinking tool that conforms to the laws of thinking^[4] and a visual thinking tool that embodies divergent thinking, in which the relationship among topics at all levels is represented by a hierarchical diagram of mutual affiliation or correlation through the combination of graphics and texts, and the link between keywords of a topic and images and colors is used to create a link in memory^[5]. The use of mind maps in general biology is a pedagogical way to help students better understand the subject matter and exercise their thinking skills. A review of literature concludes that the use of mind mapping as an augmentative tool in teaching can significantly increase the average score of students compared to traditional teaching methods. As an example, in a practical comparison by Pan^[6], the mean score of the class in which teachers used mind mapping in teaching was 5.19 points higher than that of the class in which traditional teaching methods were used, and the standard deviations of class performance under mind mapping and traditional teaching methods were 15.216 and 19.359, respectively, indicating that the use of mind mapping can help maintain students' performance. The Z-score was 2.314, which corresponds to a *P*-value of less than 0.05, further indicating that mind mapping has a good effect in terms of improving students' performance^[6]. Therefore, if teachers can make use of mind maps to teach general zoology interactively, it is possible to improve the classroom quality and the performance and motivation of students toward the course^[7].

2. Problems in the teaching of general zoology

2.1. Diverse and varied course content

At present, there are some problems with the traditional teaching method. General zoology is a discipline that studies the morphological structure of animals and the laws related to their life activities. It has many teaching contents^[8] of which the main contents are the main characteristics of animals and the interrelationship between various types of animals; the basic laws of the occurrence and development of the animal kingdom; and the cultivation of students' ability to analyze and solve related problems by applying zoology-related knowledge. Due to the numerous contents and scattered knowledge points, students might feel overwhelmed when learning.

2.2. Weak basic knowledge

The course "General Zoology" is generally offered in the first and second year of university. At this time, students have weak basic knowledge, as they not been exposed much. Since students are required to master numerous concepts and terminology in this course, understanding and memorizing would be challenging for students, thus resulting in poor learning effect.

2.3. Constraints of the traditional teaching mode

At present, most teachers still adopt the traditional teaching mode of one-way explanation in the teaching of general zoology. As a result, students tend to be confused and become tired easily given that the course content is already complicated and difficult to understand. This not only affects the progress of the course, but also causes students to lose interest in learning, which is not conducive to the achievement of the teaching objectives.

3. Significance of mind mapping

3.1. Enhances students' interest in learning

Many teachers in today's classrooms still use traditional teaching methods to teach. The traditional teaching mode has distinctive characteristics, namely being teacher-centered^[9], mechanical, and rigid, as demonstrated by the exclusive instillation of knowledge and the mechanical repetition among students^[10]. As a result, students have trouble remembering knowledge points, tend to lose interest in learning, and often

become indifferent in classroom due to boredom. There is strong logical aspect to mind maps. Hence, through mind mapping, students can build frameworks and integrate knowledge points by logical combing. This process not only reflects the subjectivity of students and the fun they experience by participating in it, but also enhances students' interest in learning.

3.2. Exercises students' thinking skills

The Ministry of National Education has emphasized that teachers should cultivate students' learning initiative and autonomy in the teaching process. Teaching is not only a process of imparting knowledge, but also a process of guiding students to explore [11]. When creating a mind map, students need to use their brains, eyes, and hands, as well as expand their minds and reasoning, to create a map that reflects their own thinking. This process fully exercises students' thinking skills.

4. Application of mind maps in theory classes

The application of mind mapping in general zoology aims to pique students' interest in classroom, so that they can learn more easily and master the knowledge points better. In this study, "Fish" is taken as an example to demonstrate the application of mind mapping in general zoology.

4.1. Students' independent study before class

According to Nelson, a biologist, fish species account for half of the number of named chordate species in the world, and it is now estimated that there are more than 26,000 species of fish. All in all, *Pisces* is a very large group. Therefore, students may find it difficult when learning about this topic. In order to prevent students from losing confidence and enjoyment in learning due to the complex and dense knowledge points, teachers can integrate and summarize the chapter and create a mind map that allows students to learn about the topic. The mind map can also be used by students in their own pre-class study sessions. In this way, students would be able to exercise their skills to learn independently and improve their learning efficiency [12]. **Figure 1** shows a mind map that can be used.

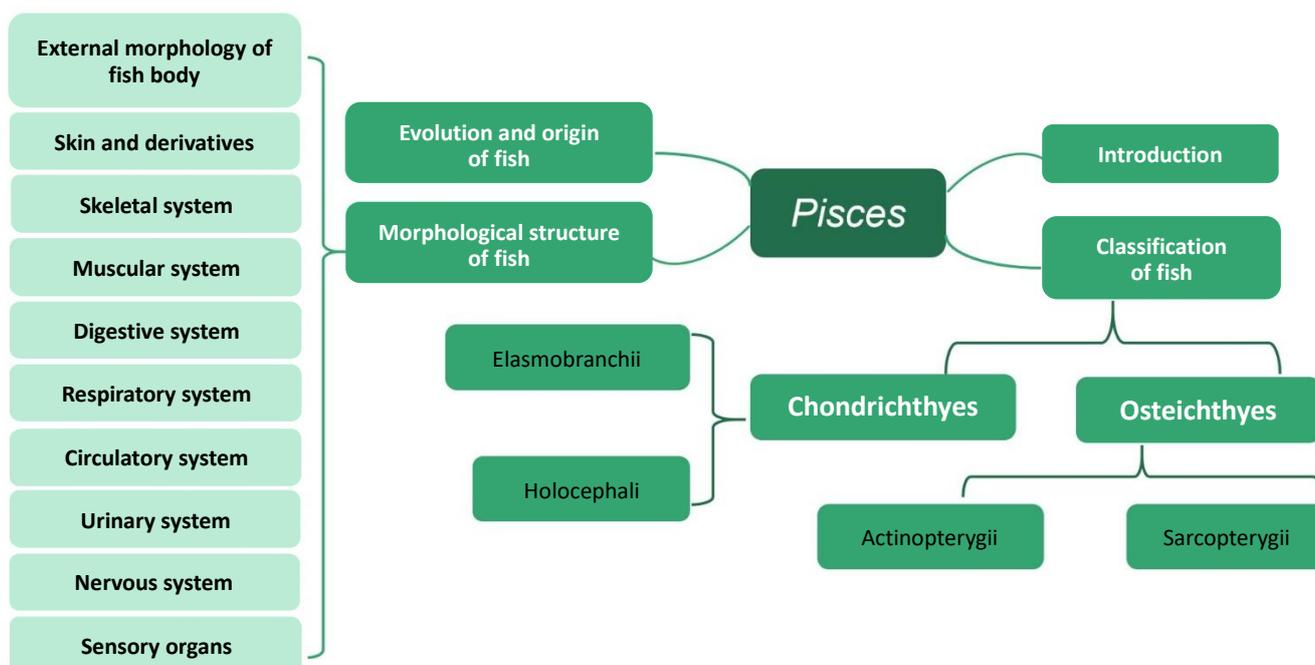


Figure 1. Example of a pre-class study mind map of fish

Firstly, “fish” is the central keyword, and branching out from the central keyword is “Introduction,” “Morphological structure of fish,” “Classification of fish,” and “Evolution and origin of fish.” Taking the morphological structure of fish as an example, students can further improve their understanding of fish by studying ten different aspects of fish: external morphology, skin and its derivatives, skeletal system, muscular system, digestive system, respiratory system, circulatory system, urinary system, nervous system, and sensory organs. Through this process, students will not only summarize in the pre-study and have an intuitive judgment of what they want to learn, but also find out what they do not understand in the topic, so that they can focus and listen during the lesson, thus improving their learning efficiency.

4.2. Teacher-led learning in classroom

In classroom, teachers can complete the mind map provided in the pre-class study stage by summarizing and refining the knowledge points and then share it with the students through courseware or blackboard-writing in a guided teaching manner. On the one hand, students can improve the mind maps given and refine them in their own way, which would not only greatly improve the efficiency of note-taking in class, but also encourage students to think about what they have learned in class and their knowledge of the topic; on the other hand, students can compare their own mind maps with the teachers’ mind maps to see what they missed and identify the mistakes they made in the pre-class study stage. Then, they can revise them accordingly, recall their pre-class study process, and identify the reasons that led to the omissions and mistakes [13]. Through this, their concentration and ability to learn independently will improve [14]. In addition, teachers can evaluate students’ pre-class study session by asking questions in class; for example, before giving the “Classification of fish” mind map, teachers can ask the students what they understand about classification of fish through their pre-class study or to come forward to complete the mind map. This will improve students’ participation in class and stimulate their interest in learning [15-17]. Students would also be more impressed with the knowledge points they have added. The mind map in **Figure 2** can be used when providing the classification of fish. First, divide it into two outlines, Osteichthyes and Chondrichthyes, and then teach the students based on their features and classification. By using the mind map shown in **Figure 2**, students will be able to quickly grasp the focus of learning and improve their efficiency of listening.

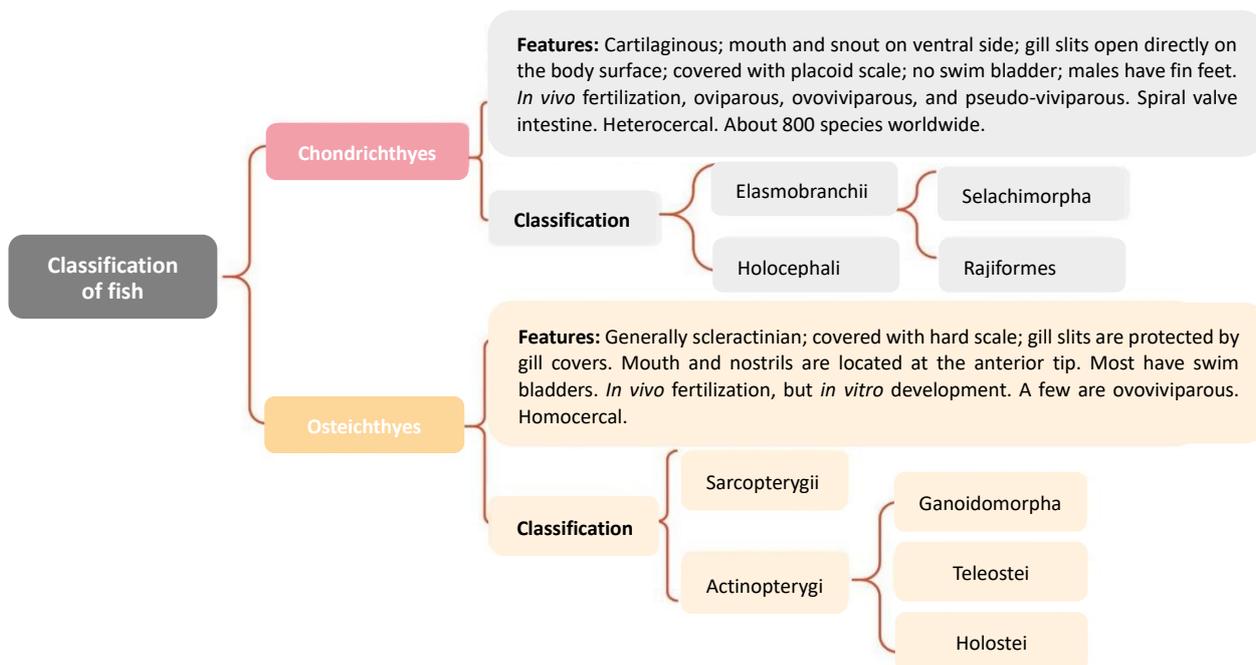


Figure 2. Example of a mind map of fish classification

4.3. Consolidation and review after class

The “Fish” syllabus is complex and wide, and students tend to feel overwhelmed when learning. Therefore, it is necessary for students to review it after class by using mind maps [3]. After completing the course preliminaries and listening to lectures in class, students would have developed a preliminary understanding of *Pisces*. By completing the mind map after class, students will develop their own insights into the fish family and form their own knowledge framework. This will help students sort out the structure of the chapter on fish and grasp the review focus and review in a targeted manner during the final review. In that way, the review process would be more efficient [18,19]. The main role of teachers at this stage is to answer questions posed by the students in the process of perfecting their mind maps, as well as to help students mark out the key points and sort out the differences between the various sections and topics of the syllabus. An example is shown in **Figure 3**.

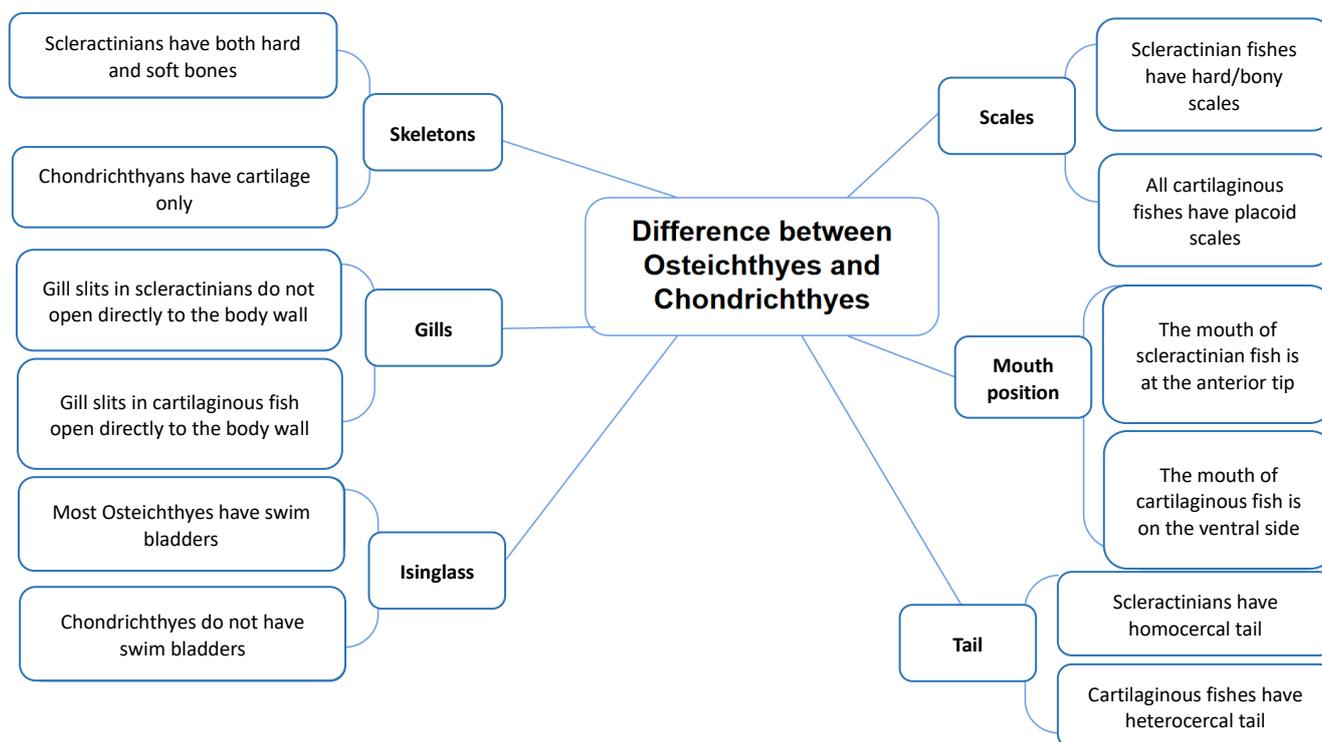


Figure 3. Mind map of the difference between Osteichthyes and Chondrichthyes

The differences between Osteichthyes and Chondrichthyes are as follows: (i) different skeletons; Osteichthyes have both cartilage and bone, whereas Chondrichthyes have cartilage only; (ii) different scales; Osteichthyes have hard or enameled scales, whereas Chondrichthyes have placoid scales; (iii) different gills; Osteichthyes branchial slits do not open directly to the body wall and have gill covers, whereas Chondrichthyes branchial slits open directly to the body wall; (iv) different oral positions; the mouth of Osteichthyes is at the front of the head, whereas the mouth of Chondrichthyes is on the ventral side of the head; (v) presence of swim bladder; most Osteichthyes have a swim bladder, whereas Chondrichthyes lack one; (vi) different types of tail; Osteichthyes have homocercal tail, whereas Chondrichthyes have heterocercal tail.

5. Application of mind maps in laboratory classes

The zoology laboratory course is an essential part of general zoology education because the learning of each phylum of the animal kingdom begins from the shape and internal structure of the representative

animals of each phylum. Through the observation and dissection of these representative animals, students will come to understand the appearance and internal structure of the animals more intuitively, thus consolidating their memory of the textbook content.

However, in zoology laboratory classes, students often do not have a firm grasp of the knowledge points taught by the teacher and are unimpressed by these knowledge points; moreover, they do not understand the questions raised by the teacher about the internal structure of the animal. If a mind map is used in laboratory classes, a mind map can be drawn in advance with regard to the experiment, experimental materials and supplies, experimental content, and experimental operations and observations [20,21].

Mind maps not only render the main content and process of experiments clear to students, but also allow students to reinforce what they have learned when drawing and deepen their understanding of the shape and internal structure of certain animals. For example, students can create a mind map similar to **Figure 4**.

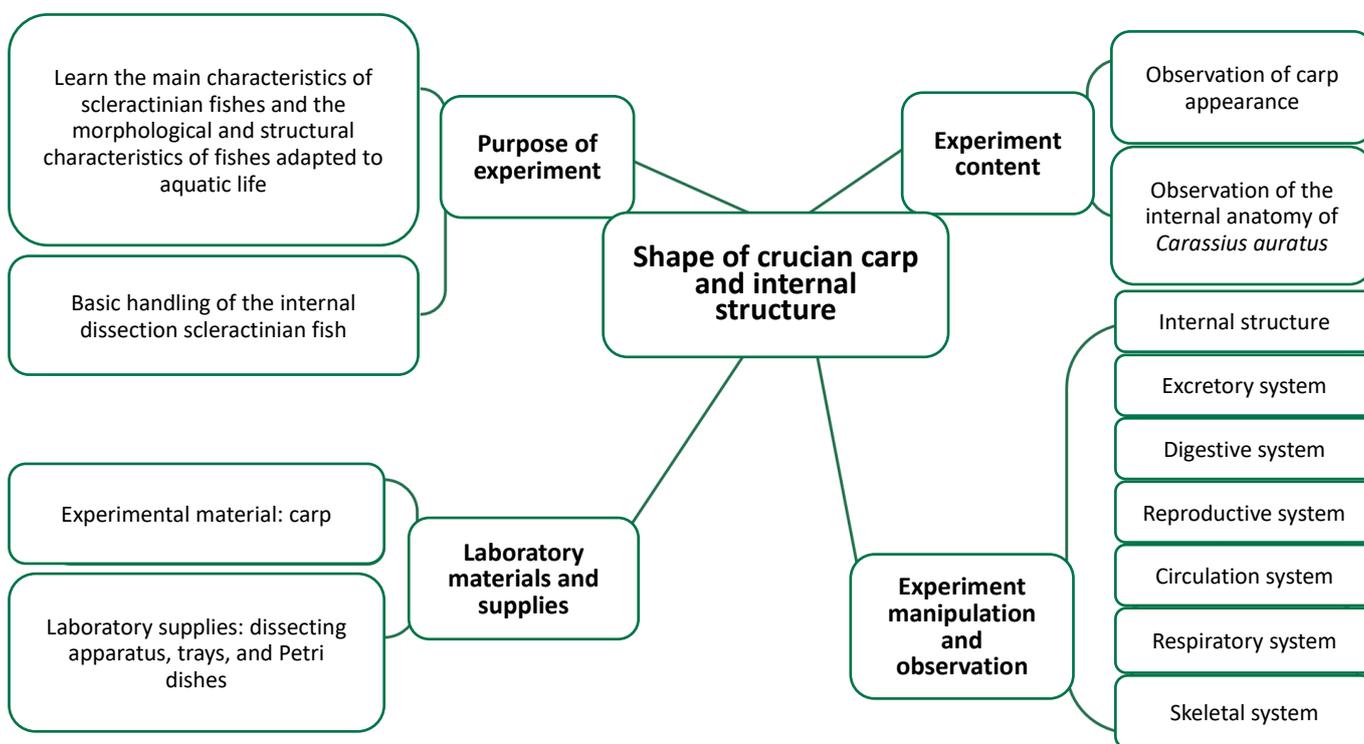


Figure 4. Mind map of the shape and internal structure of *Carassius auratus*

By using a mind map of the shape and internal structure of crucian carp, students would be able to follow the teacher’s rhythm, answer the questions raised by the teacher, and also grasp the overall framework of the experiment, which would not only consolidate their memory, but also improve the effect of listening to the lecture.

6. Conclusion

General Zoology is a fundamental course for many biology majors. Due to the robust specialization and complexity of knowledge in general zoology, students’ interest in learning may change precipitously, and the pace and progress of teaching may be affected to a certain extent. In this regard, the mind mapping tool can be used in pre-class study, classroom learning, after-class review, and laboratory classes. Mind mapping can change the way students learn from passive learning to active learning and pique students’ interest in general zoology. By encouraging students to organize and summarize their knowledge from general

zoology textbooks to create a mind map for each chapter, they will be able to form their own knowledge framework and thus have a clearer understanding of general zoology as a whole. Mind mapping not only improves students' learning efficiency, but also encourages students to think more actively and improves their memory of certain knowledge points. In the process of drawing mind maps, students would also develop good habits of meditative thinking and independent learning.

Disclosure statement

The authors declare no conflict of interest.

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