

Teaching design of mixed course of Material Forming Principle based on mind mapping

Huijuan Luo

School of Mechanical and Electronic Engineering, Suzhou College, Suzhou 234000, China

Abstract: Mind mapping is an efficient thinking tool and knowledge organizing tool. Based on the analysis of the course characteristics and learning situation of “Principle of Material Forming”, this paper puts forward the method of mind mapping as a teaching tool, and discusses the application of mind mapping tool in the teaching procedures of “Principle of Material Forming” online and offline mixed teaching, such as teacher teaching, student notes, student homework and course review. This teaching design can effectively improve the teaching quality of “Principle of Material Forming” course.

Key words: mind mapping; Material forming principle; Mixed teaching; Note-taking; homework

I. Introduction

Mind mapping is a highly effective thinking tool invented by Tony Bozan, a famous British psychologist and educator, in the 1860s. It is known as a creative and effective method of note-taking. Since its invention, it has been widely used in various fields. Many researchers have actively applied mind mapping to the teaching process and have carried out beneficial exploration and practice on it. In this paper, the application of mind mapping in the teaching of “Principles of Material Forming” is briefly discussed.

II. The characteristics of the material forming principle course

Principle of Material Forming is a basic course for the major of material forming and control engineering. This course mainly uses the existing basic theories and technical basis of mathematics, physics and chemistry as well as the basic knowledge of materials science to clarify the internal principles and physical and chemical nature of liquid forming, welding forming and plastic forming, which can deal with various problems existing in actual products and lay a solid technical foundation for learners to carry out material manufacturing and research and development of new materials.

The course “Principles of Material Forming” has many and complicated teaching contents, many concepts and terms, and many basic theories. The course is far from the reality of life and boring. But the class time is very small, only 32 class hours. In class, PPT courseware is used, the teacher instills knowledge, but the students passively accept it and cannot digest and understand it well. Students listen to the clouds in the fog, very easy to perfunctory treatment. Due to the large amount of content and few class hours, students do not have enough time to take notes, let alone participate in class discussions, and students can not keep track of records and understanding. Online learning tools for learning, mainly used for teaching materials such as textbooks, courseware, micro-video sharing and assignment. The combination of online and offline teaching is still lacking in the establishment of students’ complete knowledge system and curriculum thinking.

When the talent training goal is oriented towards engineering education certification, and the course teaching is oriented towards the development of depth and breadth (such as engineering case analysis), the teaching reform of Material Forming Principle must be carried out to realize the clarity of curriculum theory, the simplification of knowledge and the connection of theory with practice, so as to lay a good foundation for the future teaching of professional courses.

III. Material forming principle course learning situation analysis

Principles of Material Forming is a basic course offered by the fourth academic year of the discipline of Material Forming and Control. The pre-course courses include mechanical drawing, Fundamentals of Material Science, theoretical mechanics, computer drawing experiment, scale drawing experiment, entrance education and Professional Introduction, and cognitive practice. The courses offered in the same period include the law of material forming and comprehensive experiment of properties, Mechanics of materials and modern analysis methods of materials. Students basically have no previous professional foundation accumulation, no engineering practical experience, and generally lack theoretical knowledge, let alone the practical training of applying professional theoretical knowledge to solve practical problems. In the second semester of the sophomore year, most of the students gradually develop good self-learning ability and habits, but there are still a few students with poor self-control. This needs to further cultivate students’ good learning habits, and strive to guide individual students to make obvious progress.

In the course of “Principles of Material Forming”, there are more and more strange, rigid and profound concepts and theoretical knowledge. Learners should not only understand these knowledge points, but also quickly understand, memorize and apply them, otherwise they can not keep up with the teaching progress. The difficulty of the course makes it difficult for students to maintain their initial interest in learning for a long time, which greatly reduces the teaching effect and wastes their learning time. Once these problems occur, teachers should not only think of ways to arouse students’ interest in learning, but also give full consideration to students’ learning effect. The teaching progress will inevitably be negatively affected, so the classroom problems will be very obvious.

Mind mapping is an effective way of thinking, but also a creative and efficient note-taking technology, which can effectively solve

the teaching problems of “Principles of Material Formation” course. At the same time, with the combination of case method, micro-video, micro-experiment and applied homework design, students can understand and apply the knowledge points of the course and complete the teaching objectives.

IV. The guiding role of mind mapping in teachers’ teaching

Teachers who teach “Principles of Material Formation” often have a certain burden when teaching. The concepts that the teacher thinks are obvious are often beyond the grasp of the students. This is because the content of the course is chaotic and irregular, and it is not easy for teachers to grasp the key points of teaching. The teaching chapters of each class are abundant, and students do not have the ability and time to extract the key and difficult points of the course after absorbing several pages of textbook content. They cannot keep up with the teacher’s teaching ideas. As teachers, if they can clearly convey their teaching ideas and key points to students in the course of teaching, it will be of great help to students to understand and memorize knowledge points. This requires the support of advanced teaching skills. Mind mapping can help teachers achieve their intention of clearly communicating teaching ideas to students. When preparing the lesson, the teacher should draw the mind map as far as possible for the knowledge requirements of each chapter and section of the book, to find the key points of knowledge points, difficulties and their internal relations, to find the key points of the textbook, to clarify the teaching key points and difficulties, to allocate teaching time, to prepare rich teaching cases and practical homework, and to write good teaching plans.

V. Mind mapping teaching design

Mind mapping teaching design is divided into the following five steps:

1. Online learning through the assignment of preview

The mind map is simple and clear, the context is clear, impressive and convenient to remember. Now the teaching generally adopts the combination of online and offline teaching. The online learning platform we have adopted is Xuetong. Teachers post micro-videos on the platform, import the course content, and guide students to preview the taught chapters. In the preview process, students can draw a preliminary mind map by hand to form a systematic thinking structure. The teacher can use the mind map drawn by the students to find the preliminary preview degree of each part of the students, and adjust the classroom teaching plan in time. Taking the chapter “Theoretical Basis of Liquid Forming” in the textbook written by Wu Shusen as an example, the teacher first released a number of solidification forming teaching videos and assigned pre-class homework on the drawing and forming process. Then, students were guided to draw a mind map of the chapter, as shown in Figure 1. This chapter covers the theoretical knowledge required in turn for the forming process of liquid metals. First, students must master the characteristics of liquid metals and understand the flow and heat transfer of liquid metals. Secondly, students must master the solidification nucleation and crystal growth of liquid metal during liquid metal forming. Finally, students will master the control of the solidification structure of multi-component liquid metals. The mind map shows that the logical structure of the course development is synchronized with the actual solidification production process, and the students’ learning is closely integrated with the production practice. This can help students quickly find the knowledge points they are interested in and improve their interest in class listening.

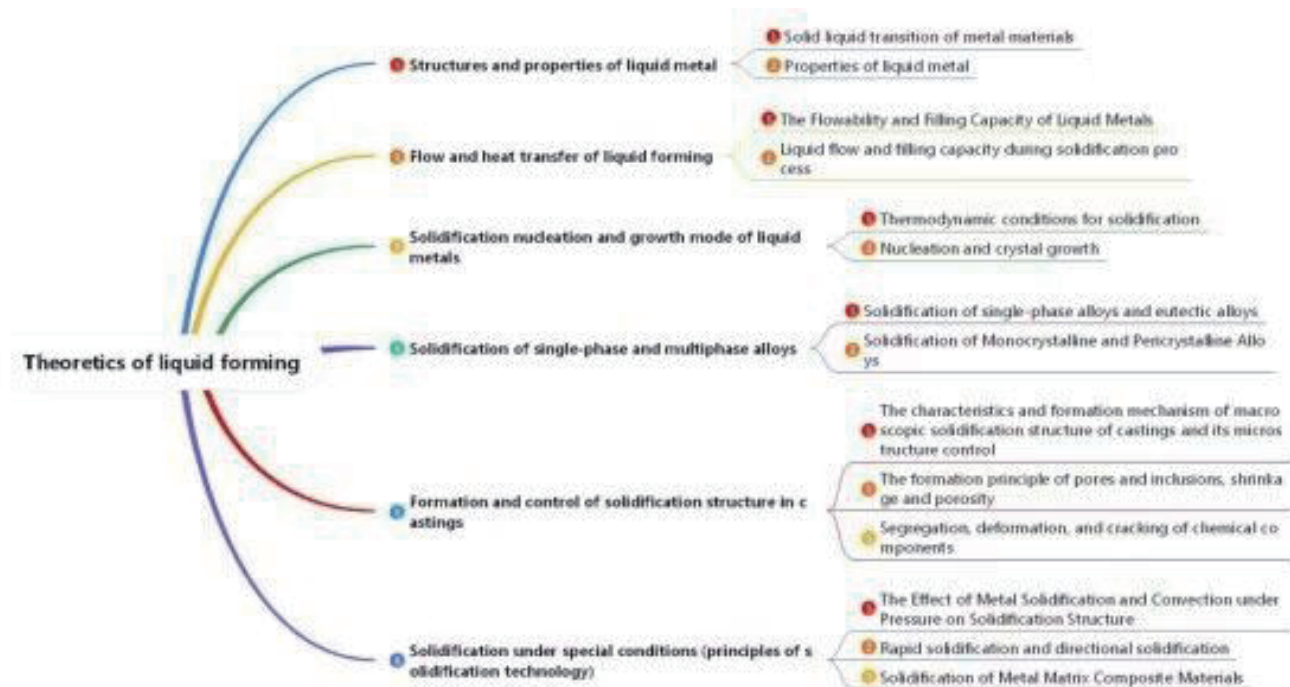


FIG. 1 Knowledge mind map of the basic chapter of “Liquid Forming Theory”

2. Mind mapping teaching of key and difficult contents

There are many knowledge points in the course “Principle of Material Forming”. Class time is limited, classroom teaching is mainly to teach the key points, difficult points, and cultivate students’ ability to solve comprehensive problems. In class teaching, according to the context of mind mapping, for important knowledge points, the teacher adds cases, teaching color paintings, teaching videos to expand. At the same time, students are guided to take notes in the way of mind mapping to refine knowledge points.

Take “Properties of Liquid Metals” as an example, students need to memorize and understand the concepts in this chapter, master the basic formulas of viscosity and tension of liquids, and calculate capillary problems. When the teacher talks about the first point of knowledge, “viscosity”, he adds an item after “Properties of liquid metals”, such as “viscosity (η)”. The first knowledge point of “viscosity (η)” is “the definition of η ”, the second knowledge point is “the influence factors of viscosity”, and the third knowledge point is “the significance of viscosity in the process of material forming”. The four knowledge points of “viscosity influencing factors” are “chemical composition”, “temperature”, “non-metallic inclusions” and “metallurgical treatment”. The three knowledge points of “The significance of viscosity in the process of material forming” are respectively “affecting liquid metal purification”, “affecting liquid alloy flow resistance” and “affecting liquid alloy convection during solidification”. While listening to the lecture, students draw the mind map as shown in Figure 2 to form the knowledge vein of “the properties of liquid metals”. The teacher talks about the second knowledge point of “properties of liquid metals”, “surface tension (σ)”, and adds a term after “properties of liquid metals”, such as “surface tension (σ)”. Continue to expand, and organize the course knowledge at a glance on the mind map. In this way, the teaching context is both clear and easy to remember. As the saying goes, a good memory is better than a good pen. The process of students’ hand-drawn mind map is also the strengthening of the memory of the knowledge points of the course. By reviewing the mind map, students know that the “properties of liquid metal” affect the material forming process, and which influencing factors affect the “properties of liquid metal”. The level development of knowledge can establish an overall knowledge system framework based on the teaching, and then realize the overall control of the teaching, and can form a comprehensive thinking method about regulating the material forming process by controlling the properties of liquid metal. Analyze and evaluate the mind map drawn by the students, and select the best map to present on the multimedia display in the next class, which not only completes the review in the class, but also shows the results of the students’ careful review and grasp.

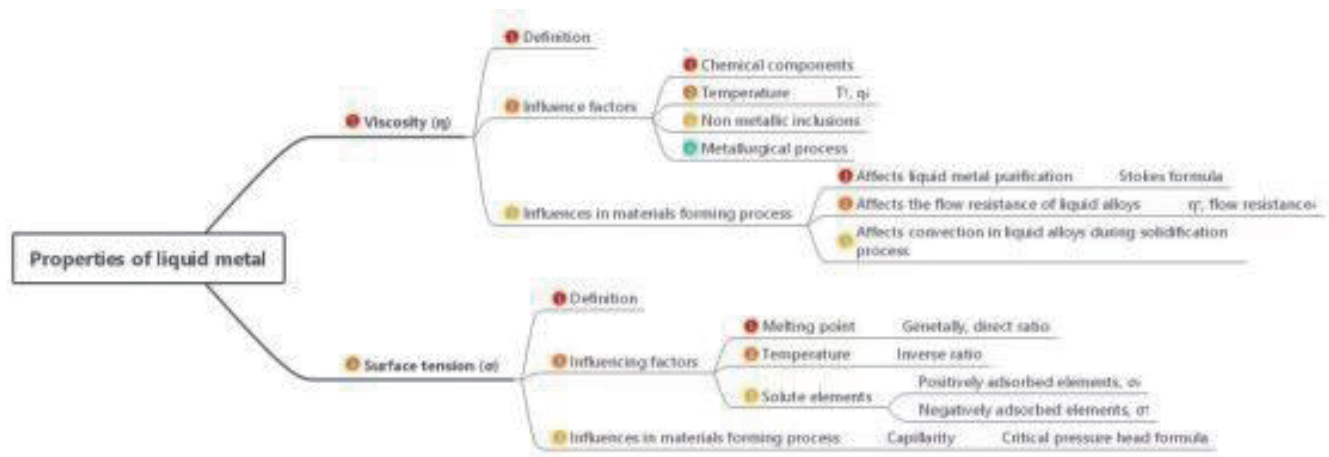


Figure 2 “The properties of liquid metals” knowledge mind map

3. Mind mapping method for self-study of knowledge points in textbooks

There are many knowledge points in the course of Material Forming Principle. Due to the limited class time, classroom teaching is only to teach the key and difficult points, or only talk about the difficult points, it is difficult to cover all the content of the textbook. With the help of the self-study assignment of mind mapping, students are guided to complete the textbook content of appropriate difficulty in the form of self-drawing mind maps to complement the mind maps of this chapter. This can improve students’ self-study ability and greatly make up for the lack of knowledge in classroom teaching. For example, in the chapter “Structure and Properties of Liquid Metals”, “Structure and Analysis of Liquid Metals” and “Rheology and apparent Viscosity of semi-solid metals” require students to complete by themselves. The mind maps drawn are handed over to the teacher for review.

4. Assign online and offline course work

Students will complete online and offline homework after class. For online homework, students watch micro-videos, read video related questions and give answers. The offline work is divided into three parts. The first is the course work for the key and difficult knowledge, which is to train the students’ application ability of the knowledge point. For example, for the critical pressure head formula knowledge point of surface tension, assign the following after-school questions. “The liquid steel does not infiltrate the mold, $\theta=180^\circ$, the gap between the sand grains of the mold is 0.1cm, the surface tension of the liquid steel at 1520°C is $\sigma=1.5\text{N/m}$, the density ρ liquid $=7500\text{kg/cm}^3$. What is the allowable indenter h value to make the molten steel not immerse in the mold and produce mechanical clay?” The second is the course work of self-learning content. This part of the work is assigned in the bound problem set. The third part is the practical work. The “Material forming law and properties comprehensive experiment” of 12 hours of related courses is opened at the same time. Set up template question

bank, or encourage students to ask questions and write answers. Exercise the students' comprehensive application of knowledge points. The students' review group will review each other at random, and give the scoring basis. Teachers spot-check student review records.

5. Course review

At the end of the course, mind mapping teaching has helped students to sort out the knowledge of this course well and connect the knowledge learned in the whole book to form a systematic knowledge network. The students took full notes of the lecture, were logical and reasonable, the exercise books were standardized, the completion quality was high, and the examination results were good.

VI. Conclusion

Under the background of engineering education certification, the traditional classroom teaching mode of Material Forming Principle needs to be reformed and innovated. Mind mapping method can fully mobilize students' participation in the course, and help students to complete the preview, classroom study and review better. Students' systematic grasp of knowledge has been significantly improved. Combined with online and offline training, students' ability to comprehensively apply knowledge to solve complex problems has been significantly improved. Reasonable teaching design will effectively realize the efficient integration of classroom theoretical knowledge and application ability, and help the training of applied talents in material forming and control engineering.

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