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2025 Volume 3, Issue 5
Lecture Notes in Education, Arts, Management and Social Science
ISSN(Online): 2705-053X

# Application and Exploration of the Mind Map in Professional Course Teaching

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**Abstract:** The mind maps are effective in enhancing the teaching and learning outcomes in basic and integrated practice courses in university engineering majors due to their logical clarity and intuitive display features. This paper takes the application of mind maps in the professional foundation courses and the graduation design of the Building Environment and Energy Application Engineering major as an example to show the auxiliary and enhancement effects of mind maps on building the course system, knowledge framework, logical flow, and the connection between knowledge points in the teaching process. Students can achieve the learning effect of seeing both the trees and the forest during their studies with the help of mind maps, which is of great importance in creating a good classroom atmosphere, cultivating students' autonomous ability, innovative ability, and logical thinking.

**Keywords:** Mind map; Course system; Logical flow; Professional Teaching

***Online publication:*** June 26, 2025

## 1. Introduction

The Mind Map is a kind of expression that uses graphics and words to cooperate with each other to explain the content. It was first developed by Tony Buzan, a famous British psychologist, by referring to the brain structure and thinking characteristics. It is a learning tool that can deeply inspire thinking and assist learning and memory [1]. The major of Building Environment and Energy Application Engineering was selected as a new engineering major in 2016, which provides new and unprecedented opportunities for the development of the major, and also puts forward new challenges and requirements for professional teachers [2-3]. The graduates of the major should also have the ability to adapt to the needs of socialist modernization construction, have a high sense of social responsibility and professionalism, be able to develop morally, intellectually, physically, the United States and labor in an all-round way, have a broad vision, and be able to serve the national "double carbon" strategy. At the same time, it is required that teachers need to work in a limited period of time. To improve the efficiency of professional teaching and students' mastery of knowledge [4]. Mind mapping is a very effective auxiliary teaching method to improve college students' learning efficiency because it can integrate and expand their thinking, help students to organically integrate new and old knowledge, establish knowledge network through concrete images and words, and stimulate their learning interest [5,6]. It is also an important teaching method to improve the overall teaching effect in the theoretical [7] and practical courses [8] of the major of built environment and energy application.

This paper takes the professional theory course “Fluid Transmission and Distribution Pipe Network” and the professional practice course “HVAC Course Design” as examples to discuss the application of mind mapping in professional teaching, so as to provide a research basis for the teaching reform and practice of professional courses.

## 2. The application of mind mapping in the learning of professional courses

Take the course “Fluid Transmission and Distribution Pipe Network” as an example to specifically explain the application of mind mapping in professional course learning. In the course of teaching, it is necessary to use many nouns, symbols, formulas, standards, norms and parameters related to fluid transmission and distribution pipe network engineering. There are many knowledge points in the course, and also many knowledge points have a certain engineering background, which is difficult for students to accurately understand. Some students also reflect that they understand each concept, but they cannot grasp the logic between knowledge points. They feel that the learning content is disorganized, and easy to lose interest in learning. In the course of teaching, teachers can use the mind map to build the course knowledge framework and logical theory system, and establish effective connections to the vertical knowledge points in the textbook, so that students can have a clear and intuitive understanding of the course learning.

At the beginning of the course, the whole knowledge system of the course is constructed through mind mapping, so that students can quickly understand and grasp the course content. In the first teaching, teachers can first show students the position of this course in the professional training system, the goal to be achieved, and the logical relationship between other courses and knowledge points related to the course before and after the course through the course block diagram in the professional training plan, so as to help students quickly understand the learning objective of this course. At the same time, it is also a review of relevant knowledge points. Fluid transmission and distribution pipe network, as a core professional course of building environment and energy application engineering, mainly solves the problem of energy transmission, distribution and collection from source to sink in the learning process. The course content mainly includes three parts, the first part of the course is the theoretical basis and calculation method of hydraulic calculation of pipe network. The second part is the characteristics of the power source of the pipeline network and the design and calculation principle, the third part is the regulation and control of the pipeline network operation process, of which the third part is the application and improvement of the knowledge of the first two parts, the knowledge block diagram of the course is shown in **Figure 1.**

Through this knowledge block diagram, students can have an overall understanding of the course, and have an overall concept and grasp of the knowledge points, important and difficult points involved in the course. Then in the next course teaching and learning process, based on the knowledge structure diagram, solve the knowledge points one by one, which is equivalent to peeling the cocoon and drawing the silk, while learning the independent knowledge points to improve the overall grasp and learning of the course. The knowledge structure chart can also clearly show the key and difficult chapters contained in each part of the content, and the numbers behind the chapters represent the knowledge points involved in the chapter. After learning a part of the content, students can mark the end of the content, and expand and develop the content on the mind map. When all the content is completed, each student can build a course structure chart containing specific knowledge points, and mark the mastery of knowledge points and the logical structure between knowledge points. The knowledge points of the course can be integrated into a knowledge structure chart to realize the process of reading the textbook from thick to thin.

In the specific teaching process, teachers can also establish knowledge block diagram for key chapters according to the learning difficulty of chapters. When explaining, the teacher first sorts out the logical relationship between various knowledge units and knowledge points. Then, for each knowledge point explained, the knowledge tree will be drawn at the corresponding position, and when all the content is finished, students can get a complete chapter knowledge tree, which can effectively help students to understand and master knowledge.

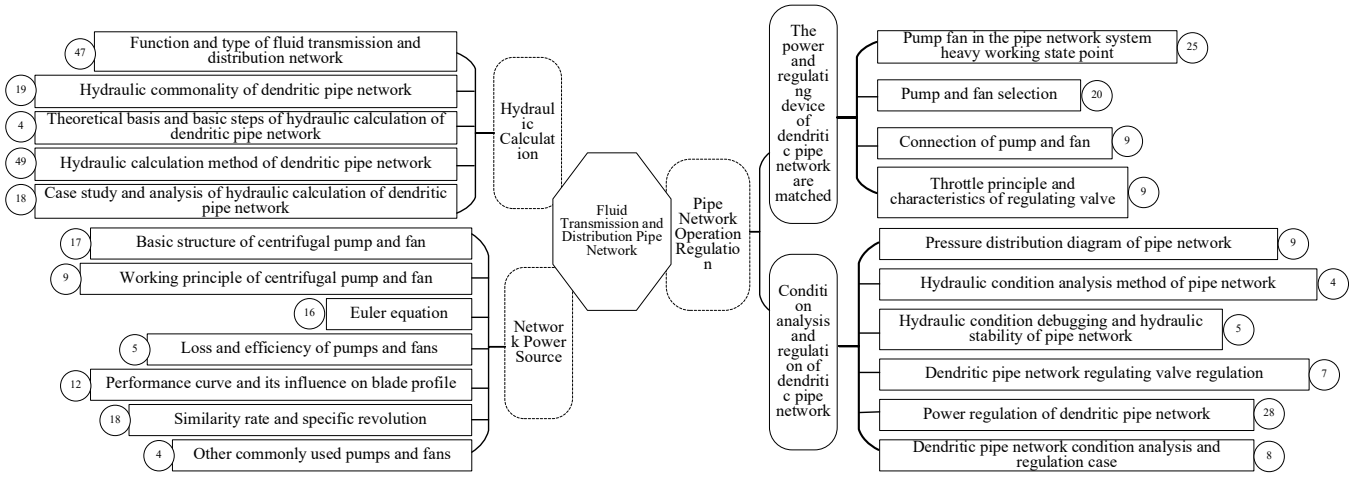


**Figure 1.** Knowledge structure diagram of course

## 3. The application of mind map in the study of graduation design

Graduation design is an important practical teaching activity for the architectural environment and energy application engineering major, which requires students to complete the design of a public building air conditioning system, prepare the design specification, draw the engineering design and construction drawings, so that students can master the HVAC engineering design scheme and the correct expression of design ideas. At the beginning of the graduation design, the instructor can use the mind map to show the core content and calculation logic of the air conditioning system design clearly and intuitively. The operation of the air conditioning system is to rationally distribute energy (cold or heat) from the cold and heat source (energy source) to the end user (sink) through the fluid transmission and distribution system and regulation system. However, the design of the air conditioning system is generally carried out in reverse, and the logical relationship between the design and operation is difficult for students to grasp in the learning process. With the help of the mind map shown in **Figure 2**, The logical relationship can be clearly displayed with the help of the mind map shown in **Figure 2**. In the design, first of all, according to the building thermal parameters, the needs of air conditioning users, under the premise of meeting national standards and design specifications, determine the energy required by the end user (sink) and the time and space characteristics of the energy, including the size and characteristics of cold, heat, humidity and fresh air volume. Then, according to the characteristics of the energy needed to design the air conditioning system scheme and related calculations, including air conditioning supply system scheme, water system scheme, fire and smoke exhaust scheme and related air supply state parameters, air flow organization, pipe network hydraulic calculation. Finally, according to the energy characteristics and pipe network system design of air conditioning cold and hot source, including cold and hot source system, machine room system, auxiliary equipment and air conditioning system operation regulation and control scheme. In the process of operation, the cold and heat source provide energy, which is transported to the end users through the pipe network system. Through the flow chart, students can establish the overall concept of air conditioning system engineering design and operation and maintenance, so that students can have an overall understanding and construction of professional knowledge.

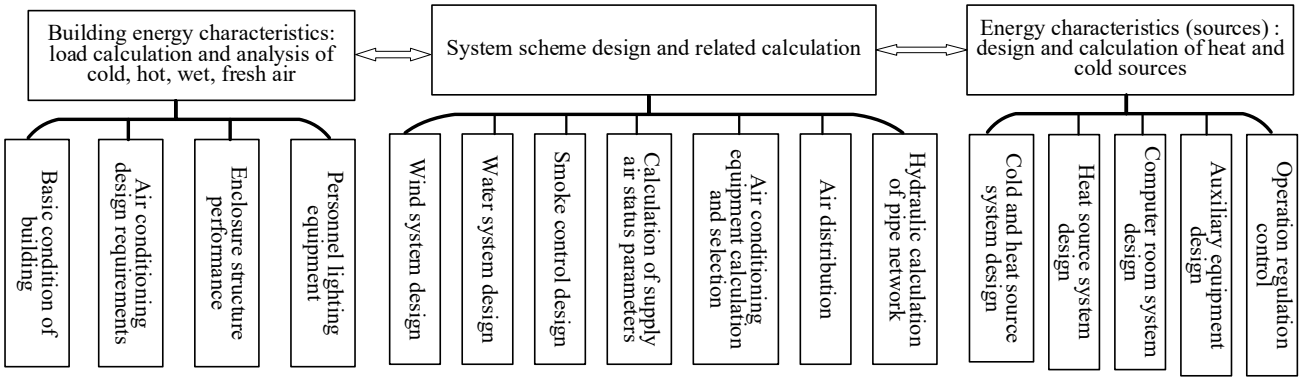


**Figure 2.** Flow chart of air conditioning system design

Graduation design is the last ability exercise related to the major before students leave school, and it is also the last period for students to summarize what they have learned. Students can be guided to build their own knowledge block diagram. Since students have some basic professional knowledge at the beginning of graduation design, the construction of this part of the thinking block diagram can be carried out in the way of guidance and progression with students. For example, before the lecture, the question is thrown: What parameters need to be used when calculating the heating and cooling load of a building? What are the sources and significance of these parameters? Guide the students to think about the basic situation of the building, the design requirements of the air conditioning system, the thermal performance of the envelope structure and the influence of the internal heat source characteristics such as personnel lighting equipment on the cold, heat and humidity load of the building, and then analyze, expand and think about these influence parameters one by one. Finally, guide the students to think, how to obtain these parameters in the design process? In the learning process, students are no longer targeted at an independent knowledge point, but according to the design process, all knowledge points are connected and formed, so that they can clearly know the source, significance and use of each parameter in the design process, so as to achieve the purpose of combining theory with practice and building their own knowledge network.

## 4. Conclusion

Compared with traditional blackboard writing and PPT, the mind map can realize the interconnection and deep logical relationship between multiple knowledge points through simple words and lines, which can play a very good auxiliary role in sorting out the knowledge structure and consolidating the recall of knowledge points. In the process of teaching practice teachers can combine with the characteristics of different courses, properly use mind maps to establish a set of systematic, coherent logical thinking. It can cultivate students' dialectical thinking ability and logical thinking ability, and also guide students to establish connections between knowledge points of various disciplines. Training innovation ability and comprehensive analysis ability to solve engineering practice problems can greatly improve the efficiency of teaching and learning, effectively improve students' learning interest, and effectively improve the atmosphere and effect of classroom teaching.

## Funding

1. The Young Backbone Teacher Training Program in Colleges and Universities of Henan Province "Research on the Coupling Heat Transfer Mechanism of boiling and condensing in Variable Section Slab Heat Sink"(Project No. : 2020GGJS078).
2. Graduate education reform project of Henan University of Science and Technology "Research and Practice of Innovation and Entrepreneurship Education for Graduate Students with One Body and Two Wings" (Project No.:

2020YJG004) .
3. 2023 Postgraduate Education Reform and Quality Improvement Project of Henan Province“Advanced fluid mechanics” (Project No.: YJS2023SZ10)

## Disclosure statement

The author declares no conflict of interest.

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