A Practical Study of Knowledge Mapping Empowering the Construction of Engineering Costing Software Application Courses in Undergraduate Colleges and Universities

Hongmei Wang*, Ying Lin, Xiaolin Gan

Chongqing Institute of Engineering, Chongqing 400056, China

*Corresponding author: Hongmei Wang, whm84120@sina.com

Abstract: Relying on the talent cultivation program of Chongqing Institute of Engineering, this paper combines the characteristics of the Engineering Costing Software Application course with its current status quo, analyzes the existing problems and teaching pain points, and introduces knowledge mapping. The course construction is carried out in terms of the combing of knowledge points, the optimization of the course structure, the innovation of the teaching method, and the evaluation and feedback of the teaching in order to improve the systematicity and structural nature of the teaching content, enhance students' learning experience, and enhance their learning effect. It is conducive to the formation of students' knowledge systems and provides a basis for discussion and reference for improving the quality of teaching and cultivating application-oriented talents who meet the market demand.

Keywords: Knowledge mapping; Curriculum construction; Structure optimization

1. Introduction

With the rapid development of "Internet+" and information technology, digital transformation has become the new engine of social and economic development. In traditional engineering costing professional training, there are many shortcomings in practical teaching, such as insufficient practical hands-on skills, limited innovation ability, and difficulty in forming a knowledge system. The application of knowledge mapping, as an important achievement of modern information technology, in the field of education is becoming more and more widespread. In the construction of Engineering Costing Software Application courses in undergraduate colleges and universities, the introduction of knowledge mapping not only helps to improve the systematic and structural nature of teaching content but also enhances students' learning experience and effect [1]. The purpose of this paper is to discuss how knowledge mapping empowers the construction of Engineering Costing Software Application courses in undergraduate colleges and universities, in order to improve the quality of teaching and

cultivate application-oriented talents who meet the market demand.

2. Course characteristics and current situation analysis

2.1. Course characteristics

Taking the talent training program of Chongqing Institute of Engineering as an example, Engineering Costing Software Application is a professional core course for engineering costing majors, with a credit of 2.5 credits and a total of 40 hours (all of which are practical hours). It is mainly aimed at construction projects, based on the knowledge of map reading, manual measurement and pricing, and the study of how to correctly use building information modeling (BIM) technology to carry out measurement and pricing activities in construction projects.

2.1.1. Targeting industry needs and focusing on practical teaching

The course is closely related to the actual needs of the construction costing industry, and the software and operation methods taught are widely used in the current market. Focusing on practical operation, students can master the use of engineering costing software skills through a large number of cases and simulation projects. Students in the course will learn how to use the software for quantity calculation, quota application, cost calculation, and other practical operations, so as to cultivate practical operation skills. Students can quickly adapt to the requirements of the industry and improve the competitiveness of employment.

2.1.2. "School-enterprise cooperation and collaborative education" training mode

The course includes regular visits to enterprises to grasp the job requirements, introducing the actual production projects, academic frontier development, the latest technological achievements and industrial innovation, and practical experience into the curriculum teaching, and implementing the cultivation mode of "school-enterprise cooperation and collaborative cultivation." Students are encouraged to develop innovative thinking and problem-solving skills through software applications [2]. Students independently explore the advanced functions and potential applications of software, put forward their own insights and solutions, apply what they have learned, enhance entrepreneurial ability, and establish a sense of innovation.

2.1.3. Close integration of software application and theoretical knowledge

The course not only teaches the operation method of the software but also focuses on the explanation of the basic theories and principles of engineering costing, so that students can better apply the software for practical operation on the basis of theoretical understanding. This combination helps students form a complete knowledge system and improve their comprehensive problem-solving skills.

2.1.4. Organic integration of civic and political education and professional cultivation

Civic and political education is integrated into the teaching of the course and is organically integrated with professional training. This course introduces localized software Guanglianda BIM civil construction measurement platform and Guanglianda cloud pricing platform for three-dimensional measurement and pricing, which enhances students' cultural self-confidence and national pride. At the same time, from the three aspects of knowledge, emotion, and behavior, the course content delves deeply into political elements and cases, integrating them organically with professional knowledge. This approach broadens the scope of the course content, providing students with subtle yet impactful behavioral training. Additionally, it guides students ideologically by addressing worldview and methodology, playing a critical role in their successful completion

of later professional courses and shaping their future life paths. Ultimately, this method achieves the goal of civic and political education through literacy and character development [3].

2.2. Analysis of the current situation

The course has been offered in our university for 7 years, and with the standard of first-class course construction, a set of mature course teaching materials has been built, such as syllabus, lesson plans, courseware, case library, exercise library, homework library, etc. Based on the Smart Learning-Superstar Learning Platform, an online course on Engineering Costing Software Application was built, which has initially formed a set of online and offline mixed course resources.

Meanwhile, relying on this course, two university-level teaching reform projects have been completed, and one university-level first-class course has been set up:

(1) Research and practice on practice teaching mode of engineering management courses under the background of new engineering disciplines, which has been submitted to the final acceptance data (Project No.: JY2020317);

(2) Research on blended teaching mode based on engineering costing software course, which has been submitted to the final acceptance data (Project No.: JY2020318).

2.3. Problems and pain points

Although the teaching and research group has recognized the importance of practical teaching in engineering costing, carried out teaching reforms, and achieved certain results, such as turning the course into a purely practical class where students can complete the modeling and arithmetic of small projects, challenges remain. There is still a lack of a well-structured knowledge system and integration between courses, which hinders the development of students' problem-solving skills. As a result, the reforms have not yet significantly improved students' practical hands-on skills.

After five rounds of traveling classes, combined with enterprise research and student feedback, we sorted out the pain points in course teaching as follows:

(1) Unclear teaching objectives: In software operation courses, teachers are used to adopting a closed mindset of teaching, i.e., directly demonstrating students to follow the operation, and informing students of the solution to the problems encountered. Teachers often lack clear goal orientation throughout the teaching process, which leads to difficulty in capturing students' attention. This results in superficial teaching, where students may learn what to do but not understand why they are doing it. Such an approach undermines the overall quality of education, stifles deeper comprehension, and negatively impacts students' long-term development and growth in the subject.

(2) Outdated knowledge system: The teaching methods used in the past did not fully consider the characteristics of the learning situation, teaching objectives, and teaching content, resulting in the form has been teaching reform, the essence of the unteaching reform, the use of subject knowledge and professional cutting-edge technology, teaching design, implementation and evaluation of the lack of ability to realize the depth of teaching and learning. Although students are able to remember relevant knowledge points through mechanical memory, they are unable to construct a knowledge system, only know how to operate according to the steps, and have poor ability to analyze and solve problems.

3. Application of knowledge mapping in curriculum construction

As an important achievement of modern information technology, knowledge mapping has been increasingly

and widely used in the field of education. In the construction of Engineering Cost Software Application courses in undergraduate colleges and universities, the introduction of knowledge mapping not only helps to enhance the systematic and structural nature of the teaching content but also improves the learning experience and effect of students.

Knowledge mapping is a series of graphs showing the process of knowledge development and structural relationships, which describes the knowledge resources and their carriers through visualization technology, mining, analyzing, constructing, drawing, and displaying knowledge and the interconnections between them [4,5]. In the field of engineering costing, knowledge mapping can show the relevant knowledge and skill points of engineering costing software applications and the logical relationship between them to help students better understand and master their knowledge [6].

3.1. Knowledge point sorting

Relying on the knowledge mapping technology of Smart Learning-Superstar Learning Platform, the knowledge points of the Engineering Costing Software Application course are sorted and summarized to form a systematic knowledge system. This helps teachers to clarify the teaching key points and difficulties and make a reasonable teaching plan.

3.2. Course structure optimization

Through the knowledge mapping analysis, the intrinsic connection and logical order between courses are found, and the course structure is optimized to ensure systematic and coherent teaching content.

Based on this, the concept of outcome-based education (OBE) is introduced into teaching. Through three rounds of iterations of teaching reform practice, the "immersion inquiry" teaching mode based on the OBE concept is summarized, which is outcome-oriented, starts with teaching objectives, reconstructs teaching content, designs teaching activities based on learning conditions, and ends with the degree of goal achievement. The teaching content is reconstructed into two progressive levels: basic operation and comprehensive experiment. The basic operation is based on a real engineering project, and the modeling, measuring, and pricing operations are completed by components, with a total of nine topics; the comprehensive experiment is designed to strengthen the integration of students' knowledge, while the difficulty of the case is upgraded to be challenging for students, transforming from "student" to "apprentice," from "simple calculation" to "accurate calculation," and to improve the ability to analyze and solve problems.

3.3. Teaching method innovation

(1) Personalized teaching: The personalized teaching system based on knowledge mapping can provide customized learning paths and recommended resources for each student according to the student's learning progress and mastery. This helps to meet students' individual needs and improve the teaching effect.

(2) Intelligent Q&A system: Using knowledge mapping technology to build an intelligent Q&A system can quickly and accurately answer questions raised by students. This helps to reduce the burden on teachers and improve the efficiency and quality of question-answering.

3.4. Teaching evaluation and feedback

(1) Multi-dimensional evaluation: The teaching evaluation system based on knowledge mapping can evaluate students' learning from multiple dimensions, including the mastery of knowledge points and the ability to apply skills. This helps to comprehensively understand students' learning status and

provides a basis for teaching improvement.

(2) Real-time feedback: Through knowledge mapping technology, students' learning progress and mastery can be tracked in real time, and timely feedback and suggestions can be provided to students. This helps students adjust their learning strategies and methods in a timely manner and improve their learning results.

4. Conclusion and prospects

The application of knowledge mapping in the construction of Engineering Costing Software Application courses in undergraduate colleges and universities shows that knowledge mapping technology has a broad application prospect in the teaching field. In the future, with the continuous progress of technology and the expansion of application scenarios, knowledge mapping will play a more important role in the field of education. Colleges and universities should actively explore and practice the application of knowledge mapping in teaching, continuously improve the quality and effect of teaching, and cultivate more application-oriented talents that meet the market demand. At the same time, colleges and universities should pay close attention to industry dynamics and technology development trends, and constantly adjust and optimize the curriculum construction program to meet the needs of social and economic development.

Funding

Disclosure statement

The authors declare no conflict of interest.

References

[1] Qiu G, Gao H, Wu T, 2017, Advances in Knowledge Graph Research. Intelligence Engineering, 3(1): 4–25.

[2] Zhang F, Xie S, Zhou G, et al., 2022, An Analysis of the Innovative Path of Collaborative Education Through Industry-Teaching Integration in Colleges and Universities. Education Informatization Forum, 2022(2): 84–86.

[3] Gao Y, 2017, Key Issues and Solution Paths of Curriculum Civics Construction. China Higher Education, 2017(Z3): 11–14.

[4] Gao J, Liu Q, Huang W, 2021, Research on Automatic Generation of Learning Path Based on Knowledge Graph. Modern Educational Technology, 31(7): 88–96.

[5] Chen P, Wu Z, 2019, Construction of Practical Teaching System Focusing on the Cultivation of Students' Ability to Solve Complex Engineering Problems. Experimental Technology and Management, 36(6): 201–203.

[6] Zhang J, Zhang G, Dong H, et al., 2022, Project-Based Teaching Management Based on Knowledge Mapping: An Example of Innovative Practice Program for College Students. Research on Higher Engineering Education, 2022(2): 58–62.