Exploration of Computer Software Teaching in Material Science

Xinggang Chen and Yanqing Cai(✉)

College of Materials Science and Engineering,
North China University of Science and Technology, Tangshan 063210, China
caiyanqing126@126.com

Abstract. To meet the needs of training diversified and innovative outstanding engineering talents in the future, a series of computer software teaching in material science have been carried out, which play an important supporting role in improving college students' ability to solve practical problems. Guided by the new development concept, this paper puts forward five teaching modes of computer software teaching in material science and introduces some experience and inspiration for curriculum reform. The progressiveness of innovative teaching means, the integrity of coordinated teaching content, the sustainable development of green teaching resources, the effective management of open teaching process, and the suitability of sharing teaching resources can improve the professional computer software application ability, the comprehensive engineering quality and the practical innovation ability. We look forward to providing a useful reference for the curriculum reform of relevant colleges and universities.

Keywords: computer software · material science · teaching exploration · online and offline learning

1 Introduction

At present, with the development of industrial digital transformation and upgrading, the wide application of computer software and network technology provides new ideas and more macroscopic and effective tools for strengthening the training of high-quality talents. It is difficult for any industry to move without computer software, and the professional technology of materials is also inseparable from the assistance and promotion of computer software [1]. Traditional theory teaching often lacks the cultivation of this ability, especially the practical application of computer software in material science is also very insufficient. Combining computer-assisted instruction with the training of talents of materials specialty can strengthen the close relationship between theoretical knowledge, experimental data, digital analysis, and simulation of material science research. Students apply the ideas, methods, and principles of computer technology to solve the research problems of material science, which can promote the sustainable development of the first-level discipline of material science, and provide a reference for cultivating students' comprehensive ability in an all-around way [2].

C. F. Peng et al. (Eds.): EIMT 2023, AHSSEH 8, pp. 521–528, 2023.
https://doi.org/10.2991/978-94-6463-192-0_68

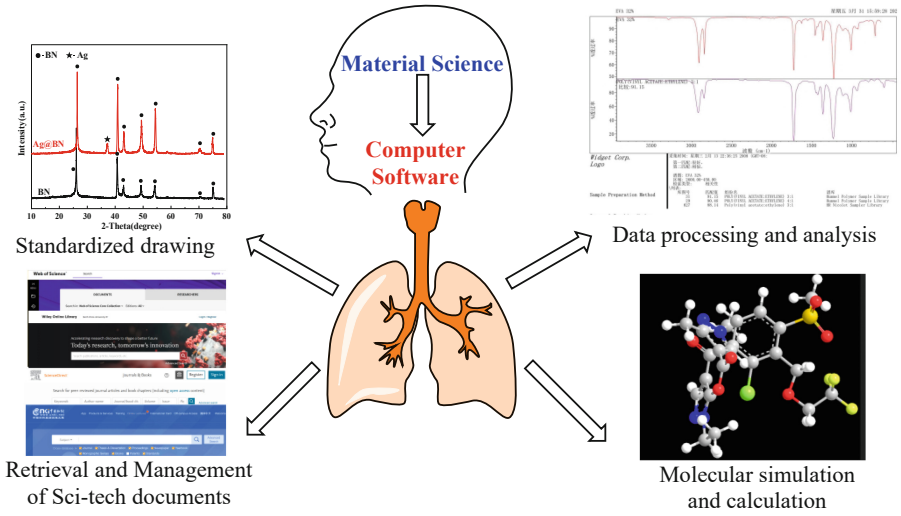

Fig. 1. The Framework of computer software teaching in material science (Self-drawing)

Combined with the supply-side reform of talent demand in the material industry in the new era, this paper adopts the method of questionnaire survey and teaching practice design, combined with the characteristics of computer software in material science. This paper carries on the teaching exploration and practice of computer software in the process of material application from the five aspects of innovation, coordination, green, openness, and sharing. By innovating teaching means, coordinating teaching contents, green paperless teaching, open teaching process, and sharing educational resources [3], students can use origin, Visio, jade, omnic, chem office, and other software to carry out standardized drawing and predicting the structure of materials and their products, and solve practical problems in material science. Figure 1 is the Framework of computer software teaching in material science.

2 Present Situation of the Teaching of Computer Software in Material Science

In the process of teaching exploration and practice of computer software in material science, it is found that there are still the following problems, such as complicated knowledge but weak relevance, strong practicality but low utilization rate of computer software knowledge.

2.1 Complicated Knowledge but Weak Relevance

After the cross-border integration of computer teaching content and the field of materials, the content covers scientific and technological literature retrieval, experimental process design, test data processing, standardized mapping, molecular structure simulation, material thermodynamic calculation, literature management, scientific paper

writing, etc. [4] The knowledge system covers many fields, but the relationship between courses and chapters is weak.

2.2 Strong Practicality but Low Utilization Rate

According to the general law of material science research, the computer teaching content needs to introduce the computer software and application knowledge needed in each link comprehensively and systematically. The teaching is usually carried out by the combination of basic theory and computer practice, but the time limit of students' operation and practice in class. The poor interaction between teachers and students leads to a lack of subjective initiative in learning. In addition, the knowledge system of material science research and the cultivation of computer operation ability can easily lead to a two-layer skin phenomenon. To better understand the current situation of students' learning of computer software teaching, the authors investigated and researched previous students' learning situations in 2020. A total of 240 questionnaires were distributed and 221 questionnaires were collected, of which 218 were valid, with an effective rate of 91%. The main results of the questionnaire are shown in Fig. 2, 30% with better learning initiative and 24% with a better learning effect. Therefore, it is impossible to effectively train students' ability to analyze and solve problems in the process of teaching, which makes the goal of training applied talents become empty talk [5].

3 Teaching Exploration on the Application of Online and Offline Computers in Material Science

Given the problems in the computer software teaching of material science, a series of teaching practice exploration of cross-border integration of computer software teaching content and material subject field has been carried out. Under the guidance of the new development concept, this paper puts forward five teaching modes of computer software teaching: the advanced nature of innovative teaching methods, the coordinated integrity of the teaching contents, the sustainable development of green computer software teaching resources, the effective management of open computer software teaching process

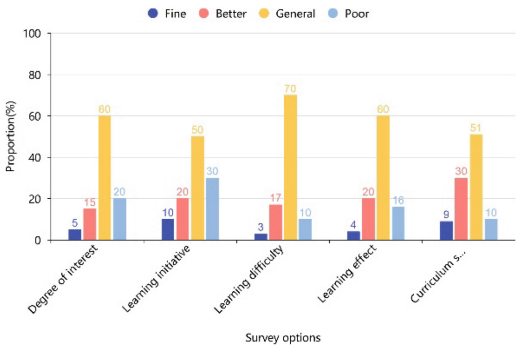

Fig. 2. The questionnaire on the overall situation of computer software teaching (Self-drawing)

and the appropriateness of sharing computer software teaching resources. In this way, the application ability of computer software can be improved, and the comprehensive engineering quality and practical innovation ability can be cultivated.

3.1 Advanced Nature of Innovative Teaching Methods

The content of computer software teaching in material science has a large span, so it is necessary to innovate teaching methods and enrich students' classroom activities. Nowadays, the main carriers of online and offline learning are smartphones, tablets, laptops, and other mobile devices, which require the corresponding massive MOOC classes, pan-elegant learning, rain classes, etc., to provide richer teaching content and more advanced technical support [6] Interesting teaching content such as literature retrieval, material database query, molecular formula drawing, and image processing can enhance students' interest and confidence in learning. The practical teaching content such as data processing and analysis and molecular simulation can make students feel the charm of computer software and increase their desire to learn. Through the explanation and study of the software, we can cultivate students' steady, step-by-step, meticulous, and serious learning attitude. At the same time, students should carry out a large number of practical exercises offline, and initially form the ability to use computer means to solve some basic problems in material science.

3.2 Coordinated the Integrity of the Teaching Contents

The teaching of computer software in material science is carried out in the form of a professional elective course. The follow-up teaching contents are closely related to the computer software teaching of material science, so it is necessary to coordinate the teaching content to ensure the integrity of teaching. The integrity of online and offline hybrid teaching is measured by the learning state of students in the whole learning process and the final learning results. To coordinate the content of teaching, the difficulty of teaching, the number of tasks, and the rationality of evaluation, the coordination is not comprehensive but targeted. The teaching content should coordinate the relationship and proportion among pre-class content, real classroom content, and after-class content, which provide students with realistic interactions, exercises, and thinking questions. In the aspect of learner analysis, we should do software learning needs, learners' attitudes, learning model analysis, etc [7]. In terms of learning goals, it is also necessary to coordinate the priorities of multi-dimensional goals of knowing, feeling, and doing, such as cultivating daily communication ability for students and setting the goal of reading scientific research papers.

3.3 Sustainable Development of Green Computer Software Teaching Resources

The use of green teaching resources promotes the gradual optimization of the teaching process so that the online and offline teaching process is reasonable and easy to manage. The organic integration of online and offline teaching is to improve the quality of computer software teaching in material science. The integration is green and sustainable.

Fig.3. The home page of the course teaching website and the monitoring of learning effectiveness (Self-drawing)

On the premise of ensuring the perfection and rationality of the teaching video, it can be used indefinitely. An online green course teaching platform is established by using pan-elegant learning, which monitors students' learning effectiveness in real-time, as shown in Fig. 3. Students can learn paperless on their mobile phones, and review computer software teaching resources at any time. Online videos, test questions, and links as supporting materials also have the characteristics of green environmental protection. To use the green guarantee offline classroom resources harmoniously, it is required that the offline classroom and online materials connect seamlessly. Therefore, it is necessary to achieve the harmonious coexistence of media with different learning styles, considering students' specific learning levels and attitudes.

3.4 Effective Management of the Open Computer Software Teaching Process

Online and offline hybrid teaching is an open system, and the management involves the transmission of different computer equipment and complex mobile network teaching mode, which is more difficult than a single in-class teaching mode. The management of the classroom and computer system of the computing center should be open, that is, to ensure the compatibility of the system and support continuous software and system upgrades. Nowadays, with the rapid upgrading of science and technology, the technology that online and offline hybrid teaching depends on is constantly changing, which also puts forward open requirements for the designer of teaching and the teacher. The teaching designers and teachers are open to the whole process, that is, extensive research, flexible adjustment, teacher-led and student-oriented. To ensure the extensiveness of evaluation with openness is to pay attention to the evaluation of the learning process and to have a comprehensive and accurate understanding of the learning effect of college students before, during, and after learning.

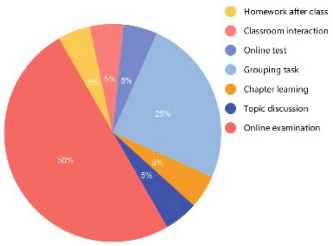

Fig. 4. The evaluation methods of mixed teaching (Self-drawing)

3.5 Appropriateness of Sharing Computer Software Teaching Resources

The shared teaching resources are used to ensure the appropriateness of the mixed teaching resources, such as MOOC classes, pan-elegant learning, rain classroom, school cloud, and so on. It provides customized teaching for students of different majors, so they can communicate in the same discussion area. Cross-disciplinary sharing in the form of professional elective courses breaks down professional barriers and helps students of different majors broaden their knowledge. The sharing of teaching resources is very important in computer software teaching. Online resources must have a large number of network information queries and use, and meet to watch the real operation video at the mobile terminal and computer terminal, key and difficult points analysis, and directional one-to-one personalized answer. Online teaching resources are effectively managed and synchronously updated, and then shared through the official account of WeChat and Tencent. Online and offline mixed teaching also includes diversified evaluation methods, as shown in Fig. 4, including online tests, topic discussion, group tasks, offline practical operation tests, online and offline interaction, etc. The rich resources of mixed teaching can help students realize the diversity of science, the integration of majors, and the commonality of knowledge, which is especially important for computer software teaching.

4 Monitoring of Teaching Reform Effect

By increasing the proportion of the usual process assessment, the written examination is all changed to the computer operation examination. The monitoring of the effect of teaching reform is divided into two parts: peacetime learning monitoring (50%) and computer practice examination (50%). The usual process monitoring mainly examines the students' learning level of computer software, such as basic knowledge, online interaction, extracurricular exercises, case application, skill development, etc. The computer practice examination focuses on students' practical ability, software flexible application, data analysis and processing, and other comprehensive abilities, to comprehensively measure students' ability to use computers to solve practical problems [8]. The evaluation criteria of teachers' teaching effect are adopted as the evaluation criteria of teachers' teaching effect, such as school and college supervision and listening, students' online learning evaluation, etc. After nearly two years of continuous exploration and reform, the proportion of students who are interested in computer software teaching has increased

from 20.0% in 2020 to 72.8% in 2022, and the proportion of course satisfaction has increased from 39.0% in 2020 to 80.5% in 2022.

5 Conclusion

The reform of computer software teaching in material science is imperative, and it is a long-term and continuous improvement project. This paper aims to provide theoretical support and conceptual guidance for exploring mixed teaching in computer software teaching of material science based on innovation, coordination, green, openness, and sharing. It enables us college students to get familiar with the mixed online and offline teaching form and allows teachers to prepare and design teaching links more reasonably. The computer software teaching reform makes students increase their professional interest, realize the importance of computer software in material research, and improve their ability to analyze and solve some practical material science problems. This needs to be further explored and improved in practice in the future.

Acknowledgments. The authors acknowledge the Hebei Province Higher Education Teaching Reform Research and Practice Project (Grant No.: 2021GJJG213); North China University of Science and Technology Education and Teaching Reform Research and Practice Project (Grant No.: L2086).

References

1. Li Y, Wu MG. Exploration of the Application of Computer in Material Science and Engineering[J]. Guangdong Chemical Industry, 2019, 46 (16): 196-197.
2. Xia Q, Gu RS. The topic teaching design of "implementing the new development concept" [J]. Teaching Reference of Middle School Politics, 2019, (31): 48-51.
3. Guo YX. Research on the Teaching Reform path of ideological and political courses in Colleges and Universities under the concept of five Great Development [J]. Journal of Kaifeng Institute of Education, 2019, 39 (12): 217-218.
4. Zong ST, Guo Q. Exploration and Research of the Course of Application of Computer in Material Science[J]. Shandong Chemical Industry, 2020, 49 (21): 174-176.
5. Yang WJ, He X, Chen M, et al. Teaching Practice and Exploration of OBE concept in the Application of computer in material Science[J]. Science and Technology & Innovation, 2021, (2): 92-93.
6. Wang SY, Wang YB. Research on Blending Learning of Literature Search and the Application of Computer in Material Science based on Rain Classroom[J]. Guangdong Chemical Industry, 2019, 46 (16): 208-209.
7. Zhang Q. Exploration of Teaching Reform on Application of Computer Technology in Material Science under Engineering Education Certification[J]. Guangzhou Chemical Industry, 2020, 48 (2): 156-158.
8. Ma C, Yu Z, Wang T, et al. Teaching Reform and Exploration of “Computer Applications in Material Science” for Polymer Materials Specialty[J]. Chinese Polymer Bulletin, 2021, (07): 94-99.