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# Discussion on the Teaching Reform of the Course "Application of Computer in Materials Science"

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***Abstract:*** *The development of computer technology has brought revolutionary changes to the material industry. As an indispensable part of the curriculum system of materials science and engineering, the application of computer in materials is an effective docking and integration between materials and computer applications. In order to improve the teaching effect and cultivate students' comprehensive ability of analyzing and solving problems, a good teaching model takes the brunt. In view of this course, this paper puts forward several suggestions on how to reform the teaching content, teaching method and examination and evaluation system.*

***Keywords:*** *Materials science and engineering; Application of computer in materials science; Teaching reform*

## 1. Introduction

"Application of computer in materials science" is a basic course of material science and engineering which is closely related to the application of computer. The purpose of this course is to enable students to systematically understand the application of computer technology in material science research and preliminarily grasp the ideas, methods and principles of better application of computers in the field of material science research[1]. On the basis of strengthening students' mastery of basic knowledge and methods, and based on the application of new methods and new technologies in the field of material science research, the paper focuses on cultivating students' ability to solve practical problems with computers, and cultivating and guiding students' innovative consciousness. At the same time, it provides a theoretical basis for developing new material design and improving material manufacturing process. In addition, through the opening of this course, we can cultivate successors for the development of new materials and the development of new technology of material manufacturing.

The theoretical basis of this course is at a broad range, including mathematics, physics, chemistry, mechanics, fundamentals of material science and fundamentals of university computer, etc. It requires a lot of preliminary knowledge, which is very important in the curriculum system of material science and engineering.In order to improve the teaching effect and truly cultivate students' comprehensive ability of analyzing and solving problems, a good teaching model is the key[2]. According to the talent training program of materials science and engineering major of Guizhou University, combined with the author's long-term teaching experience of computer application courses in materials and related professional courses of materials science and engineering major, as well as his thinking on the talent training of materials, this paper aims at this course. This paper puts forward some suggestions and thoughts on how to reform the teaching content, teaching methods and assessment system, and puts these ideas into practice in ordinary teaching. According to the feedback of students' learning situation, the teaching of this course is further improved.

## 2. Optimize teaching content and emphasize knowledge system

Computer simulation technology can not only accurately predict the actual behavior of materials, but also provide a unique perspective for the design of new materials and the development of new processes. At present, with the development of computer technology, computer simulation technology is playing an irreplaceable role in practical engineering application and scientific research.Therefore, in most of the engineering colleges in China, materials in different directions and closely related to computer simulation technology physics, chemistry, machinery, civil engineering and other related majors have set up this course, but each school or each major has different requirements for this course,

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some are professional elective courses, some are school elective courses.

The different nature of the course has different requirements for the teaching content. For example, the major of materials science and engineering in Guizhou University focuses on metal materials, emphasizing the mechanical properties and engineering service behaviors of metal materials as structural materials, such as tensile, fracture toughness and fatigue properties, as well as the evolution and local mechanical analysis of closely related material defect behaviors [3].

The major of polymer and non-metallic materials in our school emphasizes the mechanics and service behavior of non-metallic materials, such as aging and creep of polymer materials and wear resistance of ceramic materials. Therefore, for students of different majors or directions, the specific teaching content is that teachers should teach the key points and difficulties of the course in combination with the characteristics of their respective majors, and the rest of the content needs students to take computer training and practice after class.

## 3. Improve teaching methods and assessment system

The purpose of education is to cultivate students' learning ability. The role of education is only to trigger students' desire to explore the unknown, and students' self-active learning is the fundamental of education. Therefore, in class, teachers should mainly impart effective methods to learn the course, inspire students' interest in autonomous learning of the course, and maximize students' integration into the course. However, in the current teaching process, most of the teachers are solo performers, and the students just sit in or don't stop.

In my opinion, this is not only related to the difficulty of the course, but also related to the teaching methods and examination system. In view of the problems in the current course teaching method, the course teaching depends entirely on the teacher, the students are not active in learning, the assessment method is too little proportion of ordinary grades and the single form of assessment, the author puts forward the solution ideas and methods.

### *3.1. Teaching methods*

(1) The teaching process of this course involves the learning of a variety of computing software, including the use of computing software and the theoretical mechanism behind the computing method. It is a course that pays great attention to students' theoretical foundation and practical operation. The main learning content of the course and related software include: data processing software Origin, document management software NoteExpress, finite element calculation software ANSYS and first-principles calculation software Materials Studio. Taking the finite element simulation as an example, as shown in Figure 1, it is the simulation process of a contact switch of a part. Taking the first-principles calculation as an example, as shown in Figure 2, it is the steps of modeling, parameter setting, and result analysis. In the process of learning software, students should not only learn the principles and operations involved in the software, but also operate the actual cases on the computer, and analyze and evaluate the final results. Therefore, in the classroom learning, it is necessary to fully mobilize the enthusiasm of students to learn, and require students to complete the preview of theoretical knowledge before class and the preview related to the use of software.

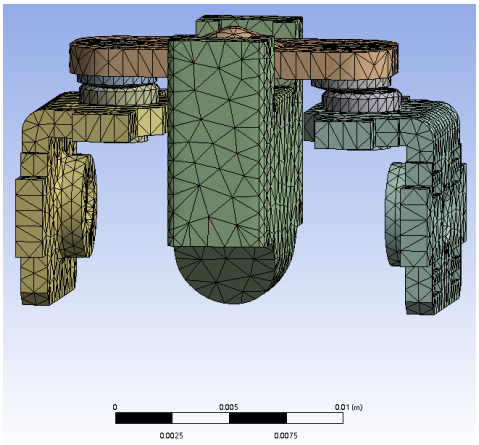


*Figure 1: The simulation process of the contact switch of a part by finite element calculation*

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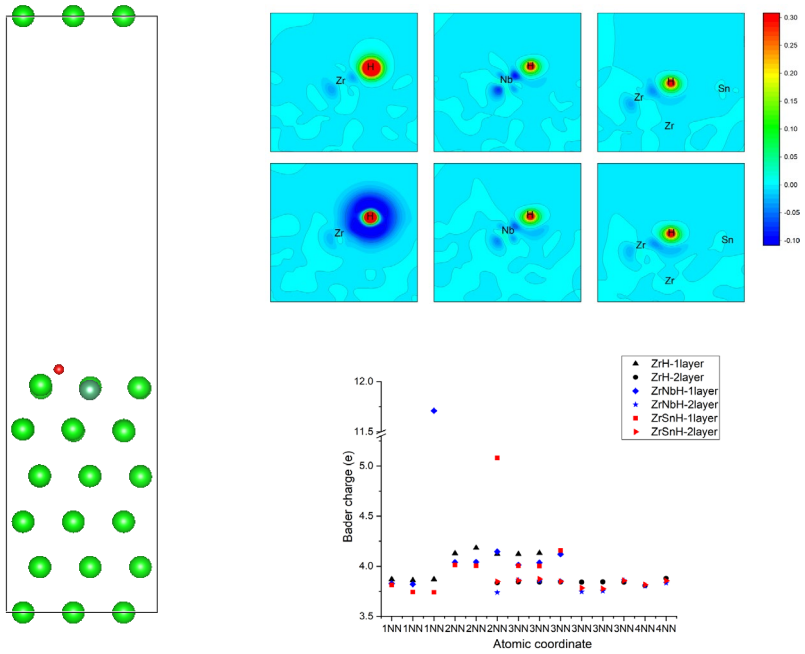


*Figure 2: The simulation process and results of the first-principles calculation for the adsorption of O atoms on the surface of ZrNb alloys*

This course has a total of 36 class hours, and the teaching time is stipulated as one class per week and two class hours per class. In terms of teaching content and link arrangement, emphasis is placed on the importance of heuristic teaching. The two-hour course mainly includes several links, such as group explanation, in-class routines, teacher teaching, and teacher Q&A summary. It is necessary to reasonably arrange the time proportion of each link, properly adjust each link, efficiently complete the tasks of each stage, and give full play to the advantages of heuristic teaching. In terms of teaching content, teachers should first try their best to let students understand the use of various software in the current scientific research, industrial applications and other fields, as well as future development trends. Using simple images to convey and observe inspiration allows students to easily grasp the general framework of the learning content and guide students to think deeply. After explaining the content and principles of the software, students are encouraged to discuss and think to deepen their understanding of the software content and their advantages in practical use. Taking students as the theme, enhance students' subjective initiative and inspire students' in-depth understanding of knowledge. In order to give full play to the initiative of the students, in addition to the teacher's explanation in the classroom, let the students practice the content explained by the teacher through discussion and practical exercises in the class according to the mode of group explanation. Encourage students to deepen their understanding of classroom content by searching for literature, watching video teaching, etc. And organize students to speak in class to express their experience and experience in the operation of examples, so that students can strengthen and improve the knowledge they have learned while listening. It provides a solid foundation and broad space for the cultivation and development of students' comprehensive ability.

Through random interviews with classmates in the class after the class, most of the classmates said that they were more proficient in the private use of the software, and their expression ability had improved. Through discussions between classmates and classmates and between classmates and teachers in class, the use of time is more efficient and the possibility of distraction is reduced. Because the students themselves have become the subject of study, they are more focused and concentrated on this course, and as a result, they have gained a lot of new knowledge and improved their knowledge level and ability. In the practice of examples after class, students are required to organize the calculation results of the examples into PPT, and 10-15 minutes before each class, students will come to the stage to explain the modeling, parameter settings, calculation results, and result analysis of the examples. Then the teacher makes corresponding evaluations and supplementary explanations. Through the flipped classroom method that allows students to participate more in teaching, it fully mobilizes students' good habits of previewing before class, studying seriously during class, and reviewing in time after class. It is guaranteed that one student will come to the stage to give PPT explanations in each class. Each group will take turns to give PPT explanations. Each member of the

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group will give at least one PPT explanation.

(2) Update the PPT content of the course in time, and appropriately add video content to facilitate students' understanding and learning. In addition, the relevant content of the course is explained by using similar phenomena in life to make the course explanation more lively and interesting. For example, the phenomenon of mobile phone falling in life is due to the elastic or plastic deformation of the metal structural materials that make up the frame of the mobile phone during the impact process, which squeezes the screen of the mobile phone or the internal parts of the mobile phone, resulting in damage to the mobile phone. The deformation behavior of the metal frame involved in this process can be realized by computer finite element simulation technology. These practical and professional classroom cases help to mobilize students' learning efficiency, inspire them to think, and improve the effect of knowledge imparting in the classroom.

(3) This course is rich in content. Although it only has 36 hours, it involves computational software such as material calculation and simulation, data processing, and image processing. It pays great attention to the practical aspects of learning. However, in the previous course teaching, due to the lack of hardware conditions, students' practice time and conditions were insufficient. Students' learning often only stays in the reception of the knowledge dictated by the teacher, and they do not have a clear understanding of the various problems encountered in the actual software practice, which greatly reduces the learning effect of this course. At present, with the popularization of students' personal computers, the practical teaching of this course is facilitated. Through the curriculum reform, practical teaching links will be added. First, students are required to install the computing software explained in the classroom on their personal computers in small groups, so as to better complete the pre-class preview and after-class example operations. To enable students to increase the opportunities for hands-on simulation examples to enhance their further understanding of the course. At the same time, in the classroom, students are allowed to use personal computers to practice the content of the classroom in the classroom discussion stage. The teacher answers various problems encountered by the students during the operation process, and mobilizes the enthusiasm and effectiveness of the students' learning. Finally, many software designed in this course are necessary professional software for future scientific research or work. The installation and use of these software on students' personal computers will lay the foundation for students' subsequent work related to graduation thesis and later scientific research.

### *3.2. Assessment methods*

The exam is not the goal, and the paper score does not fully reflect the student's knowledge of the course, but the paper test at the end of the course is required.In order to make the assessment more comprehensive to avoid students to rely on rote learning to cope with the exam, in order to emphasize the importance of daily learning and the cultivation of comprehensive ability, it is necessary to change the past final examination of a single paper to judge all, or the usual assessment of small proportion and single form of the status quo.

Combined with the reform of teaching, the proportion of ordinary assessment results can be increased to 50%. The ordinary assessment method is changed from the single attendance method to the comprehensive assessment and evaluation system of group study and discussion participation, PPT production, PPT explanation on the stage in class, written homework, attendance, example operation, mid-term test and other aspects.

In addition, according to the nature of this course and its importance in material analysis, we should increase the proportion of comprehensive analysis questions and reduce the number of pure theoretical knowledge points in the test content. The examination question type should be diversified, comprehensive examination students' comprehensive ability. For example, the material science and engineering major of Guizhou University requires 3 to 5 types of examination varieties for each course. The examination can be carried out in forms of nouns explanation, filling in the blanks, judgement, calculations as well as comprehensive analysis.

## 4. Conclusion

Combining with the characteristics of computer application in the field of materials science, the course not only considers the commonality of various research directions of materials major, but also takes into account the universality of the research field of materials science, and the interpenetration of

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various disciplines to the complexity and particularity of computer in the application of materials science and engineering. It is self-evident that it is important in the curriculum system of material specialty. Students' learning of this course knowledge is the key to master the chain of material specialty knowledge.In the course of teaching, the author improved the course teaching from the above aspects, which laid a solid foundation for students to work in enterprises and engage in scientific research after graduation, and also showed that the above reforms fit the teaching goal of comprehensively cultivating students' ability to a certain extent.

## References

*[1] Wang Yingtao, Rao Dejun, Teaching reform of structural checking course based on finite element analysis, Education and Teaching Forum, 2022(8): 69-72.*
*[2] Huang Zhongmei, Li Xin, Wang liyuan, Research on heuristic teaching in online teaching, Science and Technology Innovation Heraid, 2020(29): 181-184.*
*[3] Huang Chaowen, Lei Yuanyuan, Wan Mingpan, Li wei, Tan Yuanbiao, Zhang Xiaoyan, Problems and suggestions on cultivation of materials science and engineering talents in local universities, Education Teaching Forum, 2018(50): 31-32.*