A Deep Learning-oriented Practical Training Course for Computer Application Skills

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Jiang Guiwen(✉)
Guangxi Technological College of Machinery and Electricity, Nanning, China
jgw998311038@126.com

Abstract—With the rapid development of computer technology and constant advance of teaching information reform in the field of higher education, how to cultivate qualified computer talents in teaching seems particularly important. However, the current computer teaching is still based on theoretical teaching, the application form of teaching methods is unitary, and the teaching effect is not ideal. In this study, based on Moodle platform, a teaching mode of deep learning was constructed using the guiding concept of multiple intelligences theory. This model was mainly performed in three stages through three links, which corresponded to three levels of deep learning. In this study, 100 students majoring in computer science were taken as research objects for teaching practice, and students' learning ability was measured and assessed through numerous methods, such as questionnaire survey, classroom observation, work assessment, and interview. The validity of this model was verified through an analysis and summary of experimental data. Results suggest that deep learning mode can effectively develop students' computer ability and improve their learning initiative and innovation. This study verifies that online teaching mode based on deep learning is effective and is of certain significance and implication for the development of the course of computer technology.

Keywords—deep learning, computer, application skill, practical training course

1 Introduction

The revolution of new science and technology and industrial changes, such as big data and artificial intelligence, have accelerated the innovative development of the global economy. Under this background, the requirements for engineering talents have also grown accordingly. Cultivating engineering students with strong practical and innovation abilities has become one of the teaching goals of higher education at present. Today, the scope of engineering higher education keeps expanding, including not only emerging industries, such as artificial intelligence, intelligent manufacturing, robotics, and cloud computing, but also the upgrading and transformation of traditional engineering major [1]. With the continuous development of information technology and artificial intelligence, the education and teaching of computer application skills is always ongoing. The training of computer talents not only requires professional theoretical knowledge

but also practical operation ability. Particularly, the practical training course of computer application skills can effectively improve practical ability and give full play to a person's superiority in expertise [2]. Nevertheless, during actual teaching activities, the practical training course of computer application skills is still relatively traditional; there exists a gap from the actual needs of talents and requirements of market environment for talents; and the teaching effect is undesirable. For this reason, the objective of the practical training course of computer application skills must be clarified, the teaching reform and innovation of the practical training course of computer application skills should be facilitated, and the teaching mode of deep learning should be implemented, which are also necessary to promote the practical ability of computers.

2 State of the art

With the advent of the era of knowledge economy, the training of talents by international education has also changed. Deep learning is a fundamental element for citizens to head for lifelong learning or a learning-oriented society, advocated by the international community today. As a type of machine learning algorithm, deep learning made its debut in the research of the technical field of machine learning. Later on, it was used for the research of education and teaching and became a hot topic in the education circle. García et al. applied deep learning to geography teaching and proposed a geography competence-oriented fieldtrip assessment framework. Through an analysis of students' learning effect, the authors proved that this method can help facilitate the mastery of knowledge [3]. Marques et al. held that the teaching process of deep learning should pay attention to teaching design, such as attaching importance to students' subject activities and creating situated learning. Teachers can utilize some new teaching technologies to better foster students' learning [4]. Boufenar et al. proposed the idea of deep learning. They investigated the applicability of Deep Convolutional Neural Network (DCNN) using transfer learning strategies on two datasets, a new expanded version of our recently proposed database for offline isolated handwritten Arabic character, referred to as OIHACDB and AHCD. Practice has proved that such learning idea can heighten students' interest in learning [5]. With respect to the evaluation method of deep learning, in a deep learning research project in the United States, teachers set up a diversified evaluation system to evaluate the teaching effect of deep learning, including evaluating students' communication and cooperation abilities by speech and assessing students' deep learning abilities in three dimensions: personal, cognitive, and interpersonal domains [6]. By using a concept map, Mashhadi assessed students' attainment in deep learning and divided students' learning results and quality into three levels: deep learning, shallow learning, and no learning, according to their changes before and after learning [7]. Khalid et al. evaluated the effect of deep learning with video editing technique, and they were trained to estimate categorical outputs, such as performance level and surgical actions. The efficacy of these models was measured using precision, recall, and model accuracy [8]. Various deep learning-related teaching model frameworks have been well-established, and the design process of activities is detailed. However, correspondence between teaching goal and evaluation indicators is lacking. In this study, on the basis of Moodle platform and in view of the characteristics of deep

learning mode, a teaching process was designed according to the computer practical training course, and a corresponding evaluation system was developed, in the hope of providing objective reference for the reform of computer deep learning mode.

The research on deep learning in the field of education in China started late. Researchers indicated that emphasizing student-centered teaching strategies in deep learning can better mobilize students' initiative and have argued that students' deep learning can be stimulated by triggering cognitive conflict, providing a learning framework and promoting teacher–student dialogue. Combined with students' learning characteristics, Guo [9] built a teaching mode of deep learning, that is, "establishing a challenging theme and goal → planning and preparing for the theme → deep learning activities → evaluating and reflecting." Practice has proved that it can improve students' performance perfectly. In view of the essence and characteristics of deep learning, Li et al. [10] developed a deep learning evaluation scale for college students, with four elements as dimensional indicators: knowledge transfer, innovative thinking, embodied interaction, and learning environment. Zhou [11] established a practical model for performance assessment and emphasized that performance assessment should be combined with situated teaching, which can better cultivate students' cognitive thinking ability, autonomous learning ability, and problem solving ability. Although studies on deep learning have grown in China, few studies have investigated how to integrate deep learning with online learning platform, and none have looked into its practical use in computer teaching. To this end, this study corresponded to three levels of deep learning: cognition, practice, and emotion analysis; combined deep learning with online learning platform; and conducted pedagogical research on computer practical training course.

Today, information technology has been updated rapidly. Without outstanding innovative thinking ability and practical application ability, computer professionals will be easily weeded out by times. With the help of an analysis of computational linguistics model, Delbio held that it was necessary to enhance learners' cognitive engagement and learning motivation in the teaching process, which was more conducive to the improvement of teaching effect [12]. According to a computer teaching framework of CMU in the United States, the CMU course was a progressive teaching process from simple to complex. CMU showed more regard for students' autonomy in choice and operation, was highly concerned about the training of students' practical ability, and made teaching more pragmatic and purposeful (Aravind) [13]. In a survey, the Chinese curriculum system of computer major mainly used CCC2002 and CC2005 (Computing Curricula 2005). CC2005 was mainly composed of computer design, introduction to computer, algorithm and data, operating system, artificial intelligence, graphics, database, compilation, digital logic, professional ethics, composition fundamentals, discrete structure, computer network, and system architecture. It was an essential part of the cultivation of computer professionals. At present, there still exist some problems and difficulties in the teaching activities of computer major, such as traditional teaching concept, lack of relevance between courses and experiments, single form of teaching practice, absence of teaching resources, and the need to keep increasing teachers' professionalism. Taken together, according to the literature review, the training process of computer talents is mostly dominated by teachers, learners learn passively, and no learner-centered teaching method is available, which is not beneficial to the development of students' metacognition. On this basis, this study attempted to introduce deep learning mode into

computer teaching and shift students from passive learning to active learning through the development of high-order thinking.

Thus far, some problems still exist in computer education, which warrant further development. Specifically, these problems include the following: the practical training course is not well-directed, the teaching effect is unsatisfactory, the content of practical training course of computer application skills needs to be refined, and the application form of practical training course of computer application skills is monotonous. At the same time, the evaluation method for computer teaching in colleges is single and cannot evaluate the overall learning level of students objectively. On this basis, this study focused on deep learning and combined with the requirements of the development of engineering major in the new era to construct a new practical teaching method for computer, with a view to provide reference for the reform of computer teaching.

3 Teaching mode after the reform of practical training course of computer application skills

The practical training course of computer is a course that places equal emphasis on knowledge and ability. Students should not only understand theoretical knowledge but also perform a large number of computer operations. Although students can validate the results of practical operations by themselves, testing whether these operations are innovative is difficult for them. The teaching mode in the past was a combination of theory and confirmatory experiment, dominated by theoretical teaching and supplemented by experiment. Most of them were theoretical courses and had high difficulty. Moreover, teaching time in the classroom was insufficient. As a consequence, many studies had learning obstacles and emotions and low learning enthusiasm.

During the lead-in of the course, teachers can present knowledge related to the existing lesson by playing a video, elicit the role and value of this lesson on this basis, throw out questions, arouse students' interest, and guide them to inquire knowledge.

3.1 Design of the teaching process of moodle platform

As a type of common software for making online courses, Moodle platform is widely applied in computer teaching, which fully combines market demands and makes a design drawing for the practical training course of computer (as shown in Figure 1). In this study, the efficiency of practical training course of computer can be improved through three links: before, during, and after teaching, and a teaching mode that combined online and offline was implemented. Specifically, the three links are as follows.

First, before teaching, teachers should prepare teaching materials according to the content of computer textbook and upload these materials to the Moodle platform, arrange pre-class learning tasks, and design tests according to these resources. Meanwhile, students should clearly define their learning goals and plans for the next step, and they should adequately prepare for class according to the teachers' arrangement.

Second, during teaching, teachers are the subject of teaching activities. Teachers need to guide students to get involved in the study of this lesson, comprehend theoretical knowledge, and become involved in practical training, fully based on the

content of preview before class and important and difficult points in teaching. In this process, teachers should not only return the classroom to students but also give timely management and guidance. As a student, one should follow the development of classroom teaching; dare to think, say, and do; and summarize in study and grow up in summarization.

Third, after teaching, the learning outcomes also vary from student to student. At the end of a class, teachers should solve students' problems in time and consolidate their classroom knowledge. At the same time, teachers should also rethink the teaching content, keep optimizing the teaching scheme and teaching ideas, and achieve mutual growth with students. Students should also promote themselves constantly through question discussion, students' logs, and group peer review to find learning styles that work for them.

When designing teaching process for computer practical training course based on Moodle platform, teachers should focus on students' assessment. The core of teaching assessment is to fulfill students' learning goals and promote their sustainable growth. To realize effective teaching evaluation, a scientific and effective evaluation system must be constructed, and the principles of consistency, operability, and comprehensiveness should be observed through the following steps.

First, an evaluation set was defined as follows:

$$U = \{U_1, U_2, U_3, U_4, U_5\}, U1 = \{U_{11}, U_{12}, U_{13}\}, U2 = \{U_{21}, U_{22}, U_{23}, U_{24}\},$$
$$U3 = \{U_{31}, U_{32}, U_{33}\}, U4 = \{U_{41}, U_{42}\}, U5 = \{U_{51}, U_{52}, U_{53}\}$$

Second, the weight vector was calculated as follows.

To begin with, on the basis of experts' judgment results, the geometric mean of the vector was calculated as

$$W_j' = s\sqrt{w_{f1} \times w_{f2} \times \cdots \times w_{fs}}$$

Third, the geometric mean was normalized. w_j was defined as the result of the normalization of the geometric mean of evaluation indicator j at a certain layer. The calculation formula is as follows:

$$w_j = \frac{w_f'}{\sum_{j-1}^{n} w_f'}$$

Fourth, the single factor indicator matrix is

$$R = \begin{bmatrix} R_1 \\ R_2 \\ \vdots \\ R_m \end{bmatrix} = \begin{bmatrix} r_{11}, r_{12}, \cdots r_{1n} \\ r_{21}, r_{22}, \cdots r_{2n} \\ \vdots \\ r_{m1}, r_{m2}, \cdots r_{mn} \end{bmatrix}.$$

The formula above indicates that when one of the m indicators was evaluated, an evaluation indicator matrix R could be formed.

Fifth, the comprehensive fuzzy evaluation is

$$B' = W \circ B = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_5 \end{bmatrix}^T \circ \begin{bmatrix} b_{11}, b_{12}, \cdots b_{15} \\ b_{25}, b_{25}, \cdots b_{25} \\ \vdots \ \vdots \ \vdots \ \vdots \\ b_{51}, b_{52}, \cdots b_{55} \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_5 \end{bmatrix}^T.$$

Through the above calculation model, the computer practical training course based on Moodle platform was evaluated to provide a necessary assurance for constant improvement of the teaching effect.

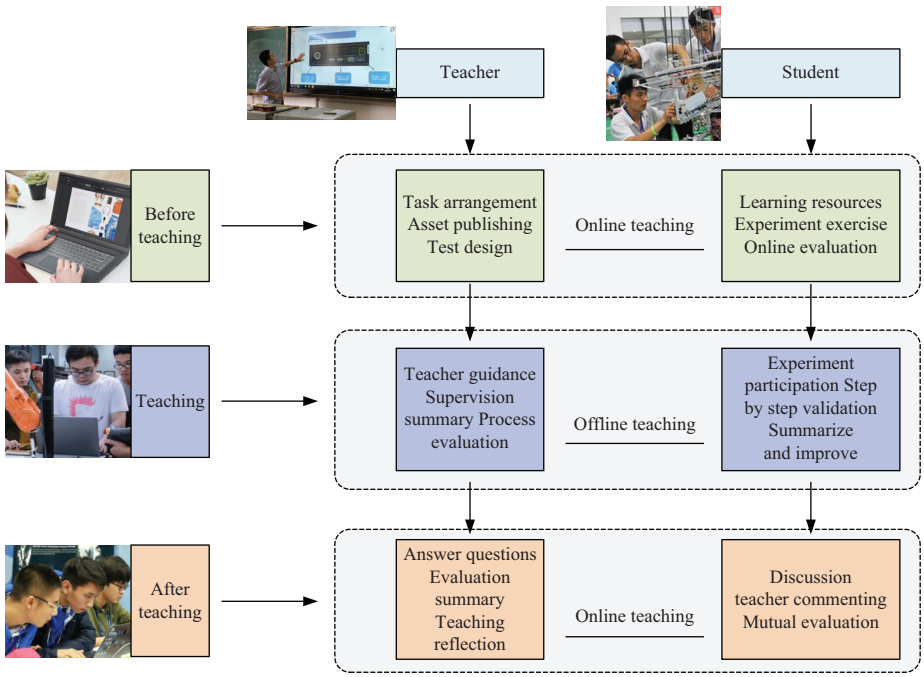

Fig. 1. Design of practical training course of computer

(1) Envisagement of online teaching platform

According to higher education, the core basic element of education, colleges, and universities should take the initiative to introduce "Internet+" technology to intensify the construction of Internet information engineering and increase the scientific and technological content. The economic support brought by the Internet+ technology is extensive, involving cloud computing, Internet of Things, mobile Internet, and big data analysis technologies. With respect to educational elements, what schools mainly adopt are cloud computing and big data analysis technologies. First, in terms of cloud

computing technology, schools can take this technical means to set up a cloud platform for the education and teaching of the school, which covers a series of teaching cloud platforms (e.g., teaching demonstration, online production of textbooks, online examination platform for teachers, teacher information interaction, vocational skill training, distance education for teachers, and education office) to provide more guarantee for online teaching in colleges and universities.

(2) Construction of online teaching platform

Online teaching platform is a modern teaching mode in colleges and universities. Under the background of the rapid development of network technology, the practical training course of computer lays more emphasis on functionality, and online teaching platform plays an important part in expediting this possibility. During the construction of network platform, the following should be done.

First, during curriculum setting, attention should be paid not only to the course content but also to its evaluation. The setting of course content should fully center on the development needs of the computer industry and the requirements of industry competition, and the computer practical training course that conforms to the development needs of times should be selected. At the same time, through collective review by professional teachers, the course content is evaluated, such that the courses on online teaching platform can be scientific, pertinent, and premium. Second, personnel are set according to department, specialty, course, and identity. In this manner, different loggers can have suitable permissions. Third, information related to the school and development of professional industries is published, and the content is checked. Fourth, the uploaded content and functions are previewed and pilot run. Other settings are as follows. The functions are expanded according to the needs of computer practical training course, and functions such as integration, application, interaction, evaluation, feedback, and hyperlink are implemented.

(3) Setting of experimental teaching process-based on online teaching platform

The online teaching platform needs to establish computer practical training experiment. The following steps should be taken in this process.

1) Setting of basic information: Course name, course description, application scope, training objective, and so on.
2) Selection of course and template: According to the actual needs of courses and teaching, the course and teaching template are matched to improve the teaching effect.
3) Select the course column: During the setting of the course on the network platform, one can add, modify, and delete the content of teaching section according to their actual needs by setting the teaching plan sections manually. At the same time, detailed information should be set to make sure that the teaching plan is scientific and efficient.
4) Design the after-class homework and preview materials: Preview before class and homework after class are important contents of the design of an online teaching platform. In the design process, links such as must-learn items, optional items, extended learning items, learning guidance, and interactive feedback should be formulated.

3.2 Construction of Teaching Method for Practical Training Course of Computer Based on Deep Learning

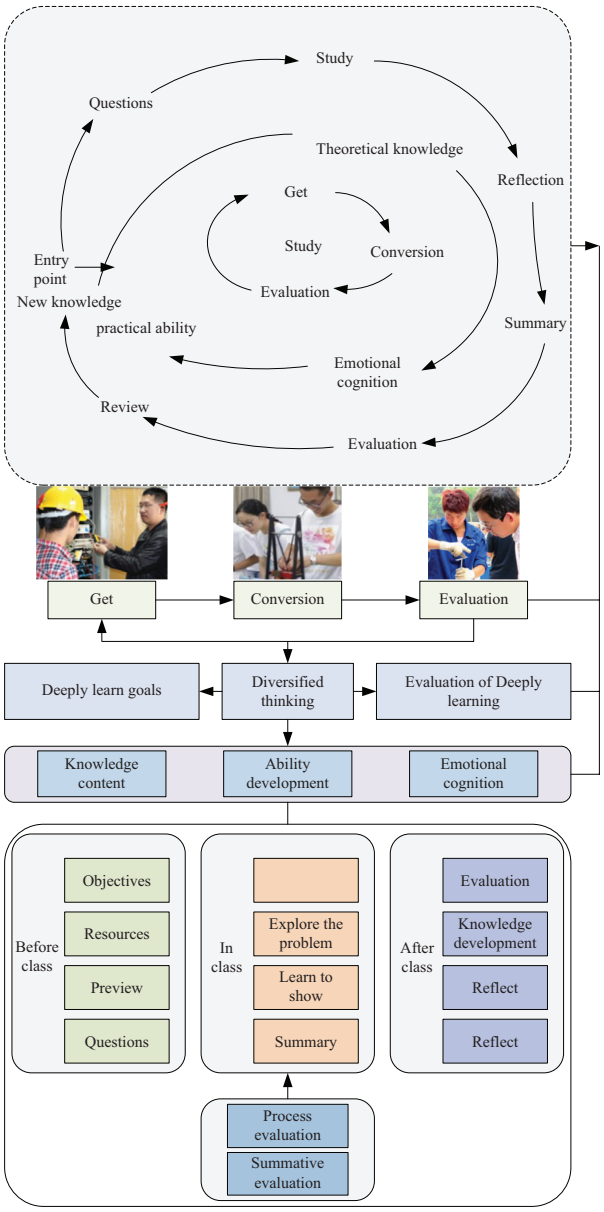

Fig. 2. Teaching mode of computer practical training course combined with deep learning

As shown in Figure 2, deep learning is fully associated with network technology through creative and scientifically integrated educational concept. Creativity is also a

quality required by computer learning. Under the concept of deep learning, the practical training course of computer and computer teaching mode should fully center on the teaching concept of pluralistic thinking. The deep education and teaching concept is fully applied to all links before, during, and after class, focusing on internality and expansion.

4 Teaching example and effect

4.1 Teaching example

On the basis of the needs of talent training, this study set up a deep learning teaching mode and applied it to the practical course of computer major. The teaching objects were first-year college students majoring in engineering and the specific practical training course was arranged as follows.

1) Practical training program: Student management system. Through a complete program design, with the list and dictionary as background data management, a simple student management system was produced to realize the addition, deletion, modification, query, and other functions of data.
2) Network data collection and visual data analysis: Through the 2020 spring semester data of the College of Mechanical and Electrical Engineering (January–June), the number of files issued by each department in the past six months was counted to analyze the visual data.
3) Specific practical training development task: Students previewed before class according to the content and asked questions in the questionnaire distributed by their teacher. The teachers lectured in class and discussed according to representative questions proposed by students. In this process, all types of solo and group exercises were interspersed, and a topic discussion was designed. The course assignments included concept tests, thinking questions, algorithm design, and programming exercises. All assignments were released, submitted, and corrected on the Moodle deep learning platform, except for programming exercises that were completed on the Online Judge system, as shown in Figure 3. The teachers can input homework, tests, exercises, and other questions into the platform's question, homework, or test paper bank in advance. After students submitted their homework, the correction forms included system automatic scoring, the teachers' online correction, peer review between groups, and teachers' participation in assessment, depending on different types of homework. Given that the algorithm design was difficult and the workload was heavy, it can be designed to work in groups, and each group conducted peer review after submission. To make the peer review of homework objective and accurate, evidence-based evaluation criteria should be constructed. The teachers would first give an example of the evaluation scale; ask each group to re-answer in class or readjust the angle and content of classroom presentation according to the content characteristics of questions asked by the students; release them on the "topic discussion" for everyone to discuss; or add corresponding exercises to increase the pertinence and effectiveness of classroom.

Students' enthusiasm for independent learning and positive thinking was stimulated, implying that students were willing to take part in learning interaction as long as a proper platform was available. In the section of "Course feedback," students of computer language course said that after discussion, a complete algorithm design evaluation scale was designed. An illustration of a student's homework is shown in Figure 4 and Figure 5.

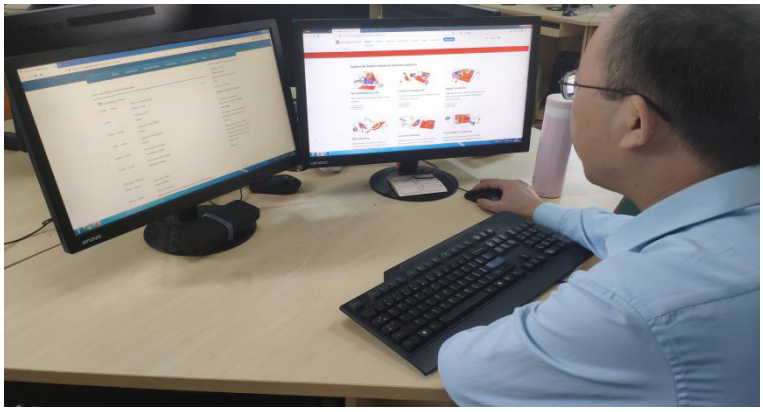

Fig. 3. Teachers' corrected homework on the moodle deep learning platform

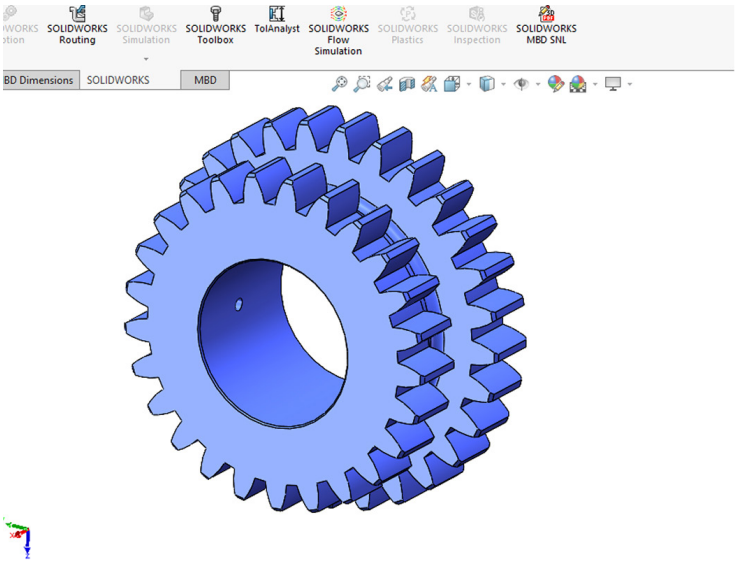

Fig. 4. Display of homework tasks accomplished by students through deep learning mode (I)

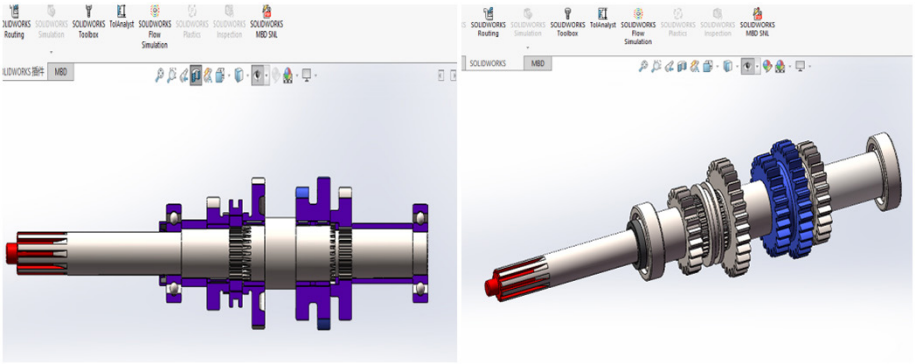

Fig. 5. Display of homework tasks accomplished by students through deep learning mode (II)

4.2 Teaching effect

Table 1. Statistics of students' feedback results before and after the implementation of practical course

Survey Items/Recognition	Strongly Agree	Agree	Fair	Disagree	Strongly Disagree
I am aware of the practical training course of computer.	20(12)	8(3)	4(3)	11(9)	7(23)
The practical training course of computer is consistent with my personal expectation.	33(11)	9(2)	2(5)	4(7)	2(25)
The practical training course of computer application skills is very effective.	39(16)	4(5)	5(3)	1(17)	1(9)
I enjoy the practical training course of computer.	32(26)	10(6)	2(5)	3(8)	3(5)
The practical training course of computer application skills can improve my memory.	40(23)	4(6)	4(9)	1(11)	1(1)
The teachers' teaching activities can go deep layer by layer.	19(6)	20(10)	9(7)	1(12)	1(15)
I've got something out of each practical training lesson of computer application skills.	40(17)	4(3)	5(21)	1(6)	0(3)
I like the teaching mode of computer teachers.	29(12)	10(11)	7(19)	4(5)	0(3)
The teacher replies the computer content I don't understand in time.	13(2)	18(6)	2(7)	8(20)	9(15)

As shown in Table 1, this study selected 50 students from the experimental class and 50 students from the ordinary class to answer the above questions. Particularly, those outside the brackets were the results of the experimental class, and those inside the brackets were the survey results of the ordinary class. The survey results in Table 1 indicated that through the innovation and reform of practical training course of computer application skills, students became more interested in this course, and their

needs and characteristics were satisfied. First, the online teaching platform created a permissive and pleasant learning space for students, such that every student can have an opportunity to give free rein to their creativity, their innovation ability and exploration ability can be cultivated, the all-round development of their integrated quality was promoted, and their learning initiative was also improved. Second, the deep learning mode allowed all resources to be shared among courses and reduced many repeated works of teachers. In this manner, teachers can invest more time in the course teaching discussion, the perfection of test paper bank, the update of electronic resources, and the innovation of teaching methods. Accordingly, the teaching quality and learning effect can be improved, especially with regard to students' practical operations. Through the deep learning teaching mode, the classroom practice ability in the experimental class was significantly heightened. According to the teachers giving this course, the practical abilities of students in the experimental class were visibly stronger than those in the control class, including involvement in classroom interaction, completion speed of tasks, and new ways to accomplish tasks and solve problems. That is, students' integrated abilities can be effectively improved through exploratory learning, topic discussion, and during-class outcome assessment in the deep learning model.

5 Conclusions

The practice of this study proves that teaching based on Moodle platform can build a learning mode for practical training course, combining online and offline modes. This study also realizes the diversification of computer teaching form, combined with the teaching mode of deep learning; respects students' learning characteristics and learning needs; and builds a teaching system with preview before class, study during class, and review after class. In this manner, students can improve their personal abilities by completing tasks, classroom interaction, cooperative discussion, and after-class consolidation. It is worthy of application and generalization in the computer practical training course of engineering major.

1) The teaching mode of deep learning can be fully associated with the characteristics and needs of students. It can also develop a teaching system that goes deep layer by layer, from theoretical study to practical exercise, evaluation and summary, and finally to improvement and promotion. It not only helps students grasp professional skills of computer practical training course but also stimulates their thinking and improves their autonomous learning ability.
2) On the basis of the Moodle teaching platform, this study adopts a new evaluation method for students. This type of evaluation not only pays attention to students' practical performance but also emphasizes on their command of theoretical knowledge and promotes students to truly grasp knowledge and skills through a reasonable evaluation system.
3) To sum up, under the background of modernization of educational information, the reform of computer practical training course should not only improve the laboratory course system and teachers' professional ability but also fully consider the needs of student training and the development of times during the construction of talent

training system. Especially in laboratory construction, educators should fully face the needs of the industry, create reasonable practical teaching conditions, implement the practical teaching mode of deep learning, and show regard for the common education of students' ability and quality to finally achieve the goal of cultivating talents for computer major.

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7 Author

Jiang Guiwen, Master, he is a senior experimentalist in Guangxi Technological College of Machinery and Electricity, Nanning, China. His research interests focus on Computer application and artificial intelligence service (jgw998311038@126.com).

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