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Research and Application of Computer Network Course Teaching Based on Deep Learning

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Abstract: ***With the introduction of new engineering disciplines, the classroom teaching methods for computer related majors have shifted from traditional theoretical teaching to advanced classroom teaching that cultivates students' thinking development. The focus is on cultivating students' higher-order thinking abilities, with the core teaching philosophy of improving hands-on skills. This includes exercises in critical and creative thinking, which can enhance students' cognitive and non cognitive abilities. Effectively combining deep learning with advanced classrooms and applying it to comprehensive practical courses in new engineering disciplines such as computer network courses can enhance students' ability to solve complex problems hands-on. For example, incorporating new technologies related to artificial intelligence (AI) into the experimental content of network security classrooms, and using various virtualization technologies to build network simulation platforms to verify the effectiveness of technology applications. These methods can fully stimulate students' interest in learning, allowing them to complete practical course content in an immersive learning manner. Through graded and progressive experimental stages, students can gradually improve their hands-on abilities. Through effective course practice, it has been proven that this method is not only beneficial for teachers to have more detailed control over the teaching process, but also to improve students' classroom participation and exercise their hands-on abilities, fully improving the teaching quality of comprehensive practical training courses.***

Keywords: Deep learning; Advanced courses; Computer network; Professional comprehensive practice; Artificial intelligence.

1. INTRODUCTION

At the National Conference on Undergraduate Education in the New Era held by the Ministry of Education, it is necessary to fully implement General Secretary Xi Jinping's emphasis on cultivating innovative, versatile, and applied talents in universities, and to lead the reform of higher education with the construction of new engineering disciplines. The comprehensive practical courses that occupy a very important position in applied universities are also undergoing curriculum reform. Combining theoretical knowledge with engineering practice projects is the goal of new engineering majors such as computer science, and it is also the main teaching task of comprehensive practical courses. The overall idea is to enhance students' hands-on and project practice abilities, laying a solid foundation for their future employment and further studies. This article will focus on exploring the comprehensive practical courses of new engineering majors in network engineering, using advanced classrooms to improve teaching effectiveness, deepen students' practical abilities, provide good practical conditions and technical environment for students' deep learning in the professional direction, fully tap into students' strengths, and enhance their cognitive development. At the same time, through the careful design of practical activities by teachers, students' non cognitive abilities are fully reflected, and the improvement of comprehensive quality is put into practice. The main guiding principle of practical teaching design is "three-stage progression", which divides teaching into three stages of objectives. The low-level objectives focus on solving "knowledge ability", the mid-level objectives focus on solving "application ability", and the high-level objectives focus on solving "innovation ability". The entire practical course will be guided by the realization of students' creative thinking, incorporating deep learning ideas, tracking students' entire learning path and learning status, improving students' learning efficiency, achieving knowledge internalization and two-way growth of abilities, and enabling talent cultivation to leap from the stage of "mastering information" to the stage of "mastering knowledge", realizing the development of students' low-level thinking to high-level thinking and high-level abilities. The three-level progressive professional comprehensive practical teaching philosophy and objectives are shown in Figure 1 below:

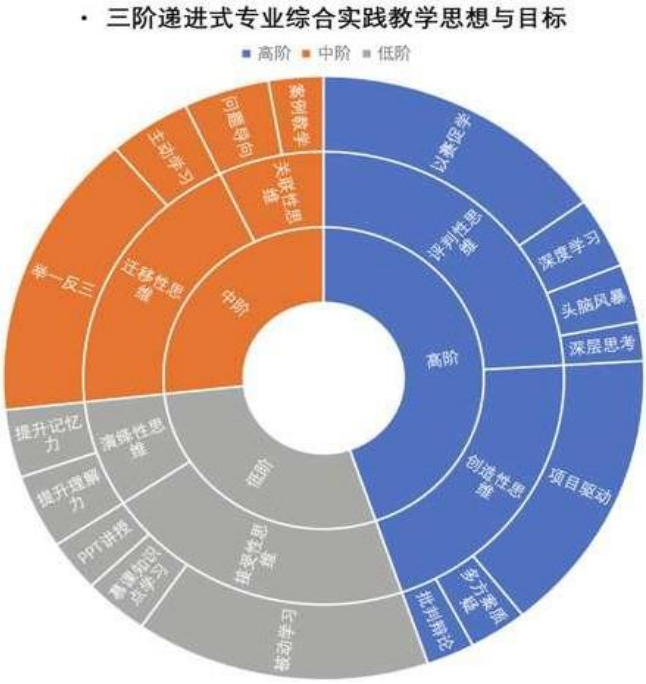

Figure 1: Three stage progressive professional comprehensive practice teaching philosophy and objectives

The teaching of computer network courses based on deep learning is an important direction in the development of educational technology[1]. It combines advanced technologies in the field of artificial intelligence with traditional computer network courses, aiming to improve teaching effectiveness, enhance students' learning interest and practical abilities[2][3]. This teaching model not only focuses on imparting knowledge, but also emphasizes the cultivation of students' understanding and application abilities of knowledge, achieving personalized learning and intelligent tutoring through deep learning technology. In terms of course content design, computer network courses based on deep learning typically cover a comprehensive range of knowledge points, from basic network protocols and data communication principles to advanced network architecture and network security[4]. Unlike traditional teaching, these courses utilize deep learning algorithms to mine and analyze massive network data, extract key information, and present it to students in a more intuitive and vivid way. For example, by demonstrating the working process of TCP/IP protocol through animation, or using virtual reality technology to simulate scenarios of network attacks and defenses, students can gain a deeper understanding of theoretical knowledge through practice[5]. In terms of teaching methods, deep learning technology can implement intelligent recommendation systems that dynamically adjust teaching content and difficulty based on students' learning progress, interests, preferences, and ability levels, providing personalized learning paths[6]. Through natural language processing and machine learning techniques, the system can provide real-time feedback on students' learning progress, intelligently analyze incorrect answers, and provide targeted problem-solving suggestions, thereby improving learning efficiency. The computer network course based on deep learning also encourages students to participate in project-based learning, using deep learning frameworks such as TensorFlow and PyTorch to develop simple network applications or perform network data analysis, transforming theoretical knowledge into practical skills. This way of applying knowledge not only deepens students' understanding of network principles, but also cultivates their innovative thinking and problem-solving abilities[7]. The teaching of computer network courses based on deep learning represents the development trend of future education. Through the integration and innovation of technology, it has brought revolutionary changes to traditional teaching models, not only improving teaching quality, but also providing students with richer, more efficient, and personalized learning experiences, laying a solid foundation for cultivating high-quality talents that can adapt to the needs of the future network era[8].

Deep learning has become a research hotspot in the field of artificial intelligence, bringing revolutionary progress to many important application areas[9]. Large language models have been a prominent highlight in the field of deep learning in recent years, with models such as GPT-4 demonstrating unprecedented abilities in image and text understanding, generation, and processing of complex problems[10][11]. Deep learning has become a core technology in fields such as computer vision, natural language processing, and speech recognition[12]. In the field of healthcare, deep learning is used for tasks such as medical image diagnosis and gene sequence analysis,

improving the accuracy and efficiency of diagnosis Deep learning has also been widely applied in fields such as finance, intelligent transportation, medicine, and pharmaceuticals, driving the intelligent development of related industries[12][13][14]. Although deep learning has achieved significant success, it still faces challenges such as insufficient data volume, imbalance, overfitting, and poor generalization ability[15]. Researchers have addressed these challenges by using techniques such as transfer learning, adversarial training, and data augmentation to improve the accuracy and generalization ability of models. The future development trend of deep learning is the continuous advancement of technology, the expansion of application fields, and the coexistence of challenges and opportunities[16][17][18].

2. CHARACTERISTICS AND TEACHING STATUS OF PROFESSIONAL COMPREHENSIVE PRACTICE COURSES

The rapid development of network technology has further increased the demand for automation and intelligent management of networks. The integration of new technologies such as SDN and AI has given rise to new intelligent network management and defense methods. This is bound to trigger a transformation in the comprehensive practical teaching content of network engineering majors. The analysis of professional comprehensive practice courses reveals the following characteristics:

2.1 Practical courses have strong operability

Unlike ordinary theoretical courses, professional comprehensive practical courses are project-based practical courses that students undertake based on the characteristics of their professional skills after completing professional theoretical courses. The professional comprehensive practice course is mainly project driven. Under the guidance of teachers, the practical process is similar to enterprise projects. Through centralized training and practical experience, students complete the project topic selection, network design, and experimental verification throughout the entire process. Teachers rarely provide theoretical explanations throughout the entire process. Professional comprehensive practical experience can effectively exercise the ability to connect theory with practice, solve practical problems with higher-order thinking, and accumulate professional practical experience in advance.

2.2 Late start of course

Professional comprehensive practical courses are generally offered in the second semester of the third year and the first semester of the fourth year. At this time, students have already completed theoretical courses, which is also the last course in their professional courses and has special significance and value.

2.3 High requirements for progress control

Professional practical courses usually only have one month of time, which is very tight. Students are required to complete requirement analysis, outline design, experimental verification and testing within the prescribed class hours, and finally complete the course paper. This requires teachers and students to scientifically arrange class hours, plan the schedule reasonably, and scientifically design courses at different stages.

2.4 High demand for student autonomy

The projects of professional comprehensive courses are jointly developed by teachers and enterprises, and students form teams to achieve project goals (with a team size of no more than 5 people). During the defense of professional comprehensive courses, the advantage projects are selected through competition to promote learning. This organizational method can give students higher autonomy, stimulate their learning enthusiasm, and unleash their enthusiasm, thereby improving the practical effectiveness of professional comprehensive courses.

At present, there are the following problems in the implementation of practical courses:

Due to the rapid updates of network equipment, a large number of practical courses will design and implement practical content on traditional network devices, making it difficult to update professional practical content.

At present, intelligent security defense technology pays more attention to the use and management of security devices. Practical courses should consider both emerging technologies and endogenous security. However, due to the integration of multiple technologies, there is a lack of technical depth in the design of practical content.

Due to limited class hours, there is a contradiction between the teaching objectives and the improvement of students' ability to solve complex problems, which affects the achievement of teaching objectives. At present, many professional comprehensive practice classrooms have consistently adopted methods such as Problem Based Learning (PBL), collaborative learning, project driven learning, and competition driven learning. However, these methods mainly emphasize student centeredness and weaken the role of teachers. In fact, in professional comprehensive practice classrooms, the role of teachers is more important than ever before. Teachers need to lead the implementation details of the entire teaching process like directors. If the teaching design is not in place, the classroom will not achieve good results.

3. CREATIVE COGNITIVE ABILITY CULTIVATION PLAN BASED ON ADVANCED CLASSROOM

In the current context of focusing on cultivating college students' innovation ability, it is urgent to carry out diversified teaching around the goal of deep learning for college students. The project-based advanced course teaching method has been recognized and valued by many educators. The depth of learning is no longer measured by the difficulty of the learning content, but by setting up an appropriate learning context based on project goals and students' personalized characteristics, ensuring that the practical content has a certain level of complexity and promoting the achievement of students' innovative abilities. Advanced classroom [4] is the construction of one or more project tasks to drive students' curiosity and thirst for knowledge, enabling them to actively learn and explore with specific task goals. Deep learning refers to a learning process in which students, guided by teachers, engage in wholehearted learning around challenging higher-order goals. Deep learning also prioritizes the cultivation of creative thinking, with stimulating students' independent thinking and judgment as important factors. In this process, students master the core knowledge of the subject, understand the learning process, grasp the essence and thinking methods of the subject, form positive and proactive learning motivation, and experience meaningful learning processes. The deep learning model based on advanced courses can fully stimulate students' exploratory consciousness, cultivate their deep participation ability, promote their deep understanding of knowledge, and ultimately cultivate their application and innovation abilities. The following figure shows the objectives of a practical teaching plan that integrates deep learning and higher-order thinking. The details are as follows: Yan Xixi et al. [6] used project-based teaching method and hierarchical goal teaching method to explore the arrangement of teaching content, the application of teaching methods, and designed project-based teaching content. They proposed a teaching mode suitable for new engineering majors, focusing more on cultivating students' creative thinking and problem-solving abilities.

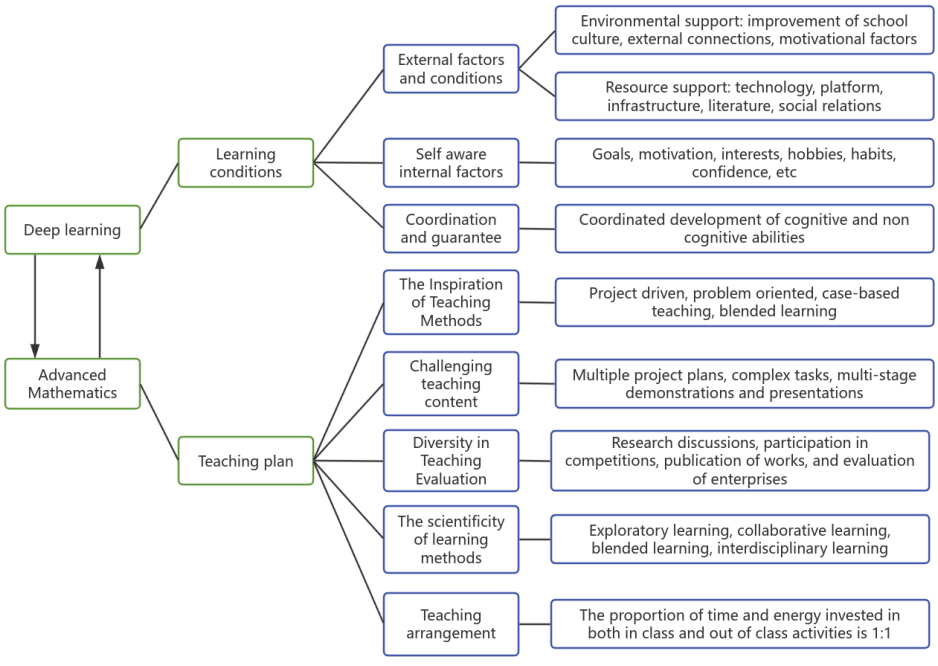

Figure 2: Objectives of the Practical Teaching Plan Integrating Deep Learning and Advanced Teaching

3.1 Effect and Evaluation

3.1.1 Design of teaching content

The use of easily deployable cloud experimental platforms for virtual network practical teaching is increasingly receiving attention from professional practical classrooms. By adopting a virtualization, multi fusion, and progressive experimental teaching content that integrates new technologies such as AI and SDN with professional basic knowledge, virtualization technology can be used to complete the construction, transmission, security boundaries, terminal applications, and other aspects of network architecture. This can solve the problem of difficult implementation of network topology construction and control plane defense strategies in existing professional practice solutions, and enhance the ability to simulate and test network engineering problems. Using artificial intelligence methods to solve virtualization and progressive practical content, integrating knowledge from multiple fields such as SDN network topology construction and artificial intelligence algorithms with new technologies, and combining AI and SDN with professional basic knowledge to verify security defense strategies such as boundary protection, web applications, and intrusion detection. This effectively promotes students to think about applying new technologies to solve existing network problems, and stimulates their interest and enthusiasm for learning new technologies.

3.1.2 Organizational aspects of teaching methods

Based on the characteristics and teaching content of specialized courses, course tasks are classified and designed according to the project objectives of different stages and categories of specialized courses. The categories of practical teaching plans include algorithm practice, scheme discussion, project practice, and achievement reporting. Classroom designs of different categories have differences in form, and can be planned reasonably according to the hierarchical situation of students. Facilitating scientific planning of classroom time, teaching content is effectively divided according to the length of time, and each time period is planned by the teacher to achieve hierarchical progression of teaching content. Rewards and punishments are given to students at appropriate teaching nodes to stimulate their learning enthusiasm.

3.1.3 Design of Teaching Plan

This type of classroom needs to fully mobilize students' participation in technical solutions. Students will discuss the relevant technologies, protocols, and deep learning algorithms needed in professional practice courses based on project tasks. In the design of the comprehensive plan, the principle of progressive task objectives is followed, and the tasks are divided into three stages: basic, advanced, and innovative. The basic stage requires the ability to build an SDN network topology based on logical topology; The advanced stage requires the ability to call artificial intelligence algorithms based on defense requirements to achieve the security protection capabilities of SDN networks; The innovation stage requires deeper design and optimization based on one's own abilities and interests. The comprehensive project plan requires the application of knowledge from multiple fields, enabling students to improve their diverse knowledge, methods, and technical abilities, and enhance their overall ability to solve complex problems.

3.1.4 Evaluation of Teaching Achievements

The report of achievements is the final stage of professional comprehensive practical training, and also the final stage of professional comprehensive practical training. Students are required to report their achievements and defend their projects, and ultimately complete the teacher's course summary through grading. The achievement report is mainly motivated by the defense score, which guides students in preparing for project reports and is also an important basis for teacher evaluation. The defense scoring table should be suitable for all aspects of the project, including project completion quality, report format, and problem-solving. The evaluation method of the project results can enable students to have a deeper understanding of professional knowledge. By jointly developing project report materials and sharing project results, students can effectively enhance their non cognitive abilities and improve their interest in professional learning. Teachers and students can grow together in this process.

The professional comprehensive practical training course based on the innovative ability cultivation mode has enhanced students' learning motivation, stimulated their enthusiasm and initiative for learning through course

teaching reform. After multiple discussions and reforms by teachers in the teaching and research group, there are several outstanding aspects of advanced classroom teaching activities based on deep learning:

(1) Task Design:

By refining, refining, and intricately designing the practical content of the three stages, we aim to stimulate students' interest in deep learning, awaken their desire to learn, fully engage in hands-on practice, and truly participate in course projects;

(2) Teaching process:

Students strictly follow the teaching mode of "design analysis improvement" to continuously optimize the teaching process, and teachers cooperate to guide difficult knowledge and key processes, so that students' innovation ability can spiral upwards;

(3) Teaching method:

Adopting diverse teaching methods such as advanced courses, group competitions, and flipped micro courses to cultivate students' deep learning abilities, enabling them to develop rich learning interests and enhance their ability to solve complex problems during the learning process;

(4) Course Reflection:

Teachers focus on cultivating students' reflective awareness, reflective ability, and reflective habits in the curriculum, guiding students to reflect after stage exercises and project reports, and improving students' knowledge and skills reserves and higher-order thinking qualities.

(5) Course achievements:

Through multiple progressive stages of professional comprehensive training courses, students can effectively improve their professional abilities and innovative qualities. The number of people participating in technology innovation competitions in the field of network engineering has been increasing year by year, and the types of competitions have also become increasingly diverse, which indicates that the cultivation of students' innovation ability has been effectively improved.

The curriculum reform guided by the cultivation of innovative abilities has fully reflected the teaching effectiveness of advanced classrooms, and the virtual simulation experiment platform has provided technical support for teaching reform. Advanced courses based on deep learning can fully mobilize the enthusiasm of teachers and students in the teaching process, further improving the teaching quality and effectiveness of practical courses in new engineering majors.

4. CONCLUSION

In recent years, application-oriented universities have been constantly exploring new methods to cultivate new engineering talents, and have been continuously reforming their courses to meet the needs of the times and society, with a particular focus on professional practical courses. These courses have strong applicability and are guided by the development of innovative abilities. In terms of optimizing the teaching mode, our college mainly uses high-level classrooms to improve the feedback mechanism of the teaching process, comprehensively formulates project tasks, breaks down the barriers between theory and practice, links professional comprehensive training with graduation projects, awakens students' learning motivation, organically integrates new technologies with virtualization practice platforms, and stimulates students' interest in exploration. Optimize the teaching mode by adopting a project task driven approach. Enable students to closely focus on the high-level task objectives of the project, use multi-stage objectives to assess and provide feedback on project tasks, and continuously improve and optimize them. The implementation of deep learning in this course system for professional comprehensive training starts from cultivating students' hands-on and practical abilities, integrating task driven and deep learning methods into the project design and teaching process of professional comprehensive practice, effectively improving the problem of one lesson one practice in traditional training courses, achieving a fundamental transformation from knowledge imparting to innovation ability cultivation, and having strong practicality.

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