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Design of Postgraduate Study Activities Based on Deep Learning Theory

Wang Huanbin[1,*], Wang Cuilu[2]

[1]Air Force Engineering University, School of Equipment Management and UAV Engineering, Xi'an, Shaanxi, China
[2]School of Art, Xijing University, Xi'an, Shaanxi, China
Author mailbox: *whbkgd@163.com

Abstract: *In terms of deep learning, learners conduct in-depth mining and processing of information and experience in real learning situations, realize the transformation and transfer of knowledge, improve the ability to solve problems, and ultimately promote the realization of learning goals and the development of advanced thinking ability. This paper first analyzed the concepts and characteristics of deep learning, and compared deep learning with surface learning. Secondly, according to the connotative characteristics of deep learning theory, the general process of deep learning was given. Finally, a deep learning activity design with four stages was proposed. The four stages constitute the cyclic chain of the deep learning process. The learning process is highly operable and can provide practices for teachers in specific teaching classes.*

Keywords: *Deep learning, advanced thinking, knowledge transfer, evaluation and reflection*

1. Introduction

With the in-depth development of teaching practices such as MOOC and micro-classes, problems such as insufficient participation of students and lack of targeted guidance in daily course teaching have gradually emerged. These problems result in the students'surface learning, lacking active exploration, critical understanding, knowledge transfer and the ability to solve practical problems, that is, unable to reach deep learning. Under the background of education reform with the all-round application of information technology, deep learning ability has become an important criteria for measuring learning effects, especially in the field of postgraduate teaching. Therefore, how to build a scientific and efficient postgraduate deep learning classroom is an important and difficult issue facing the postgraduate education of many colleges and universities.

2.Overview of Deep Learning

In the field of education, Deep Learning was first proposed by Swedish educational psychologists and professors Marton and Saljo, University of Gothenburg [1]. They found when testing the learning strategies used by college students in the process of reading prose and the results of comprehension and memory, that students' different learning results are related to the use of surface learning or deep learning. This discovery has attracted many scholars in the education field to continue research on deep learning.

2.1 The basic meaning of deep learning

After a series of experimental studies on the learning process of students, in the article "The Essential Difference between Learning: Results and Process" published in 1976, Marton and other scholars, based on the information processing methods of the students, pointed out there are deep learning and surface learning for the first time[2]. Later, scholars such as Entwistle, Ramsden and Biggs conducted more in-depth research and developed deep learning theories. Deep learning is understanding-oriented, applying methods and strategies to promote self-understanding, and finally gaining an effective understanding of core knowledge and successfully migrating and innovatively applying learning in a new environment. This includes the ability to perceive the value of the course and critical thinking, the ability to solve complex problems, the ability to collaborate and communicate,

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the ability to learn to learn, and the ability of transferring and applications.

2.2 The basic characteristics of deep learning

After research and analysis, the characteristics of deep learning can be summarized into several aspects.

Firstly, focus on critical learning. Deep learning emphasizes that there is no absolutely correct knowledge, and it is necessary to have a questioning attitude towards everything. It is believed that students should be good at asking questions and questioning on the basis of understanding.

Secondly, pay attention to the integration of knowledge and information. The integration of knowledge information includes two aspects [3].One is the convergence and fusion of multidisciplinary knowledge and information; the other is the connection between new and old knowledge and information. Deep learning emphasizes the effective integration and processing of activated previous knowledge and acquired new knowledge.

Thirdly, pay attention to the understanding and construction of knowledge. The understanding and construction of knowledge means that on the basis of information integration, students are required to actively identify, analyze and understand new knowledge, and then through the interaction of new and old knowledge, realize the transformation of knowledge and construct a new cognitive structure.

Fourthly, emphasize the transfer and innovation of knowledge. Different from the mechanical surface learning, deep learning not only emphasizes the mastery of knowledge, but also emphasizes the need to "infer one's inferences and learn from one another," and apply the learned knowledge to new situations.

Finally, solve real problems. An important purpose of deep learning is to require students to solve real problems, learn, comprehend and improve in practice. The real problem here does not refer to simple well-structured problems, but refers to complex Ill-structured problems.

2.3 Comparative analysis of deep learning and surface learning

Deep learning is fundamentally different from surface learning in terms of theoretical basis, learning objectives, knowledge connections, learning strategies, thinking levels, transfer ability, learning attitude, and learning reflection [4] as shown in Table 1.

Table 1 Comparison of deep learning and surface learning

Items	Deep learning	Surface learning
Theoretical basis	Constructivism, situational cognition, distributed cognition, metacognitive theory	Behaviorist theory
Learning objectives	Knowledge transfer and practical application	Knowledge memory and preliminary understanding
Knowledge connections	To establish a connection between old and new knowledge	Less connection between old and new knowledge
Learningstrategies	The instructor is the instructor of the students' learning, and the students learn independently under the guidance of the instructor	The instructor conducts indoctrination teaching, and the students learn passively
Thinkinglevel	Advanced thinking	Low-level thinking
Transfer ability	Able to apply the learned knowledge and skills to new situations	Inability to integrate and use the knowledge learned flexibly
Learning attitude	Active learning	Passive learning
Learning reflection	Reflect on the process of learning and understanding	Failure to reflect on the learning process

Through the above comparison, the conclusions can be drawn.

Firstly, surface learning emphasizes the memory and simple understanding of knowledge, which is a lower level of learning. Deep learning aims to guide students to get rid of mechanical learning and cultivate students' knowledge transfer, practical problem solving and innovation ability. It belongs to high-level learning and is a kind of advanced-thinking understanding and cognition.

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Secondly, deep learning and surface learning are not absolutely opposite. Deep learning is developed on the basis of surface learning. From the classification of learning goals, Bloom divides the learning goals in the cognitive domain into six stages: knowing, understanding, application, analysis, integration, and evaluation. Among them, knowing and understanding are the memory and preliminary understanding of knowledge. It belongs to surface learning; application, analysis, integration, and evaluation are advanced cognitive activities based on the initial understanding of memory and knowledge, and belong to deep learning. Therefore, deep learning is the inheritance, development and transcendence of surface learning.

3. The general process of deep learning

Based on the understanding of the connotation and characteristics of deep learning, a general process model of deep learning is constructed as shown in Fig.1. The model is mainly composed of three parts [5]. The first part includes the two processes of "learning objectives and content introduction, learning of new knowledge" and "recalling what has been learned". It mainly presents learning materials to learners and learners learn new knowledge content. It belongs to the learning introduction stage and is the most important part of learning, a necessary process, also an important foundation of deep learning. The second part includes the three major processes of "connecting new knowledge", "critically constructing knowledge", "transfer and application" and "problem solving".

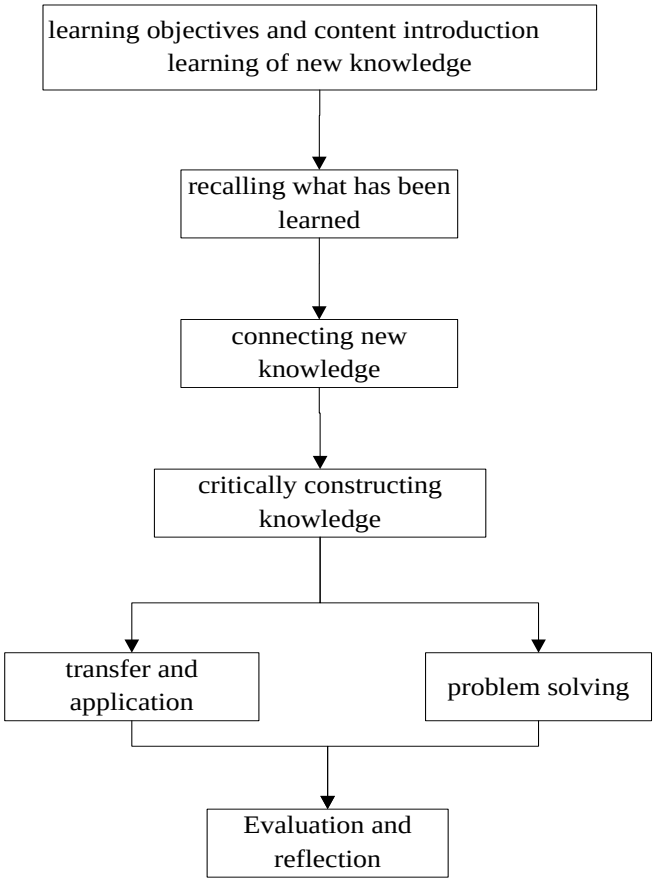

Figure 1 Schematic diagram of the deep learning process

This part highlights the characteristics of deep learning. Deep learning not only requires learners to use critical thinking to construct knowledge, but also emphasizes the transfer and application of knowledge and the solving of real problems. The two links of "transfer application" and "problem solving" are in a parallel relationship, which is an important condition for judging whether deep learning occurs or not, and an important basis for judging the level of deep learning. Generally, transfer and application refers to internalizing the learned knowledge and applying it in a new situation. This new situation is not necessarily a well-structured real environment, while problem solving mostly refers to using the learned knowledge to solve a specific questionin a real and complex environment. Therefore, deep learning is also realized, but the level of problem solving is higher than the transfer and

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application [5]. The third part is "evaluation and reflection", these two links run through the entire deep learning process. In the process of deep learning, evaluation and reflection are needed at any time to judge the progress and effect of deep learning, so as to make corresponding adjustments in time to achieve the best learning effect. In general, these seven links are interrelated and affect each other, and do not necessarily occur in sequence. Some links may appear repeatedly throughout the deep learning process.

4. Design of learning activities based on deep learning theory

The entire learning activity process is divided into four progressive and cyclical stages [6], and the specific division is shown in Fig.2.

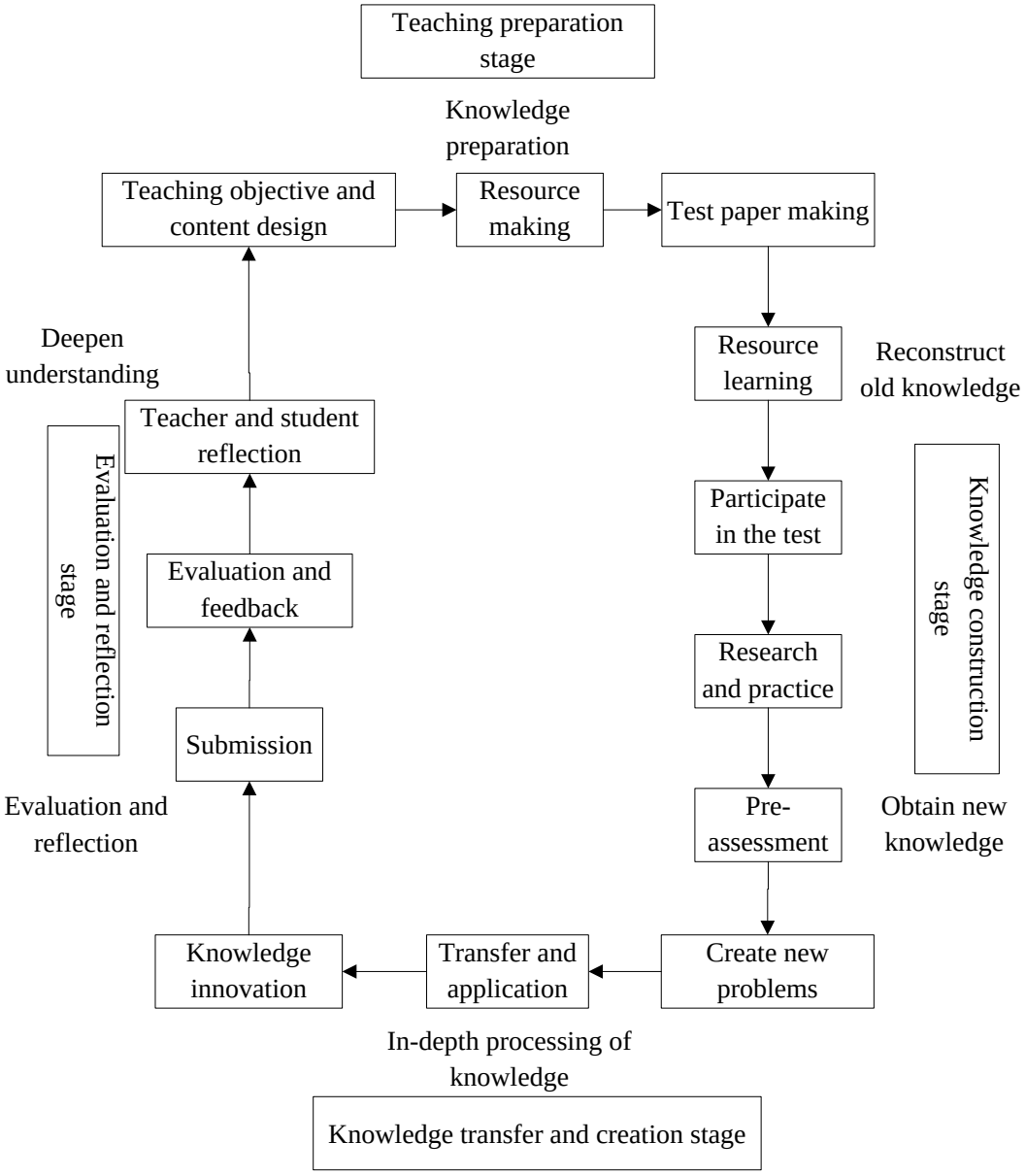

Figure 2 Learning activity model based on deep learning theory

4.1 Teaching preparation stage

Teaching preparation is the basis of the entire activity. The tasks at this stage mainly include teaching objectives and content design, resource production and test paper production. First, the instructors design teaching objectives, teaching content, syllabus and teaching plans, etc.[7]; then the instructors make relevant teaching resources, including MOOC, micro-videos, teaching courseware,

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quizzes, real case projects, etc.; finally, the instructors should maketest papers to test students' mastery of the teaching content.

4.2 Knowledge construction stage

The instructor should guide the students to activate the previous knowledge first, then actively identify and understand the new knowledge, and finally incorporate the new knowledge information into the original cognitive structure to complete the construction of the meaning of the knowledge. This stage is mainly divided into four links.

Firstly, resource learning. Students log on to the online teaching platform to watch learning resources, focusing on micro-video learning and cooperating with other courseware learning. In the micro-video, the instructor should design three types of questions [8]: guiding questions, testing questions and thinking questions. Guiding questions appear at the very beginning of the micro-video, and are based on the questions raised in the previous lesson. Students review previous knowledge to better connect new and old knowledge; test questions are questions embedded in the micro-video to test the learners' learning effect in time; thinking questions appear at the end of the micro-video, which are divergent problems to guide students to have a questioning attitude towards the knowledge they have learned.

Secondly, participate in the test. Participants test their own learning effects by completing the in-class quiz.

Thirdly, practice drills. The trainees participate in simple case projects prepared by the instructors for practical operations. If you have any questions during the practice, students can communicate with others online in the discussion area of the online teaching platform, or communicate with others face-to-face offline. In the process of communication and discussion, teachers should create a pleasant and active learning atmosphere and guide students to actively interact.

Fourthly, pre-assessment. The trainees fill out the evaluation form and make a brief evaluation of the teaching resources and teaching content.

4.3 Knowledge transfer and creation stage

This stage is mainly for deep processing of knowledge. Knowledge transfer refers to the transfer of knowledge learned in one situation to a new situation. It is essential for deep learning, because knowledge transfer not only requires students to master the knowledge they have learned, but also requires students to transfer the knowledge they have learned, conduct integration, draw inferences from one another, and be able to flexibly migrate and apply in a variety of problem situations. The instructors design some complex learning cases for the students. The students participate in a wealth of practical activities for independent, collaborative, and exploratory learning, and apply the learned theories and skills to new situations and solve more complex problems. In the process of problem-solving, the trainees have created new results and deepened their grasp and understanding of new knowledge through further comprehension and thinking.

4.4 Evaluation and reflection stage

Evaluation includes self-evaluation by trainees and peer evaluation. First, students upload their works to the network platform, and the instructors encourage and guide the students to evaluate the works of themselves and other students in a specially set up online homework discussion area, and put forward targeted suggestions[9]; at the same time, evaluation can also be adopted. In the end, the instructor integrates the results of the students' self-evaluation and peer evaluation, and gives a more comprehensive and objective evaluation and summary of the students' work. As an important advanced thinking ability, reflection is one of the key strategies to promote deep learning. At the end of the course, teachers and students must reflect. On the one hand, teachers should guide students to summarize their own learning effects; on the other hand, teachers should also conduct self-reflection, and improve teaching based on test paper results, students' learning situation and evaluation results.

5. Conclusion

Deep learning promotes active, critical and meaningful learning, and expresses an understanding of

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the essence of learning. Deep learning requires learners to pay more attention to critical learning and reflection in real social situations and complex technical environments, and to process knowledge and information through deep processing, in-depth understanding of complex concepts, in-depth grasp of inner meaning, active construction of personal knowledge system and effective transfer and application to real situations to solve complex problems, and ultimately promote the achievement of comprehensive learning goals and the development of advanced thinking skills. The emergence and development of deep learning has a long ideological origin and a rich theoretical foundation. This paper focused on the study on the process of deep learning and the activities of deep learning, and aims to guide graduate students to carry out deep learning more effectively and improve the quality and effect of learning.

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