Strategies to Promote Information-Based Teaching Design of Deep Learning

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Abstract: With the rise and continuous development of learning science, deep learning has increasingly become the goal of education and teaching. In today's era of exploring the integration of information technology and curriculum, how to design technology to promote the teaching of deep learning has become a problem that needs to be paid attention to and considered. Based on the concept and connotation of deep learning, this paper analyzes the difference between deep learning and shallow learning, constructs the teaching design framework of deep learning, and specifically describes the key points and strategies of information-based teaching design to promote deep learning.

1. Introduction

It is an important task for higher education to promote the integration of information technology and teaching and cultivate students' learning ability under the information environment. This requires us to start from the characteristics of information technology, re-examine its multidimensional impact on the development of human thinking, and reflect on the current situation of information-based classroom teaching supported by technology from the perspective of innovative talents.

Technical tools can promote the change of learning environment and enable learners to construct knowledge actively. However, in normal teaching, the function of information technology is still mainly "presenting facts" at a low level, followed by "creating situation" and "providing demonstration", and in particular, there is a lack of "explanation principle" and "speculation" at a higher level. Even the application of resources is not appropriate, the effectiveness of the phenomenon is not high. How to use information technology to promote learning and accelerate the integration and innovation of education information has become one of the important topics for modern educators. Deep learning theory will play an important role in this process and gradually become the object and target of people's research.

2. The Concept and Connotation of Deep Learning

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2.1. A Review of Deep Learning

Deep Learning was proposed by American scholars Ference Marton and Roger Saljo in the article "essential differences in Learning: results and processes" jointly published in 1976 after they conducted an experimental study on students' reading academic articles. It is a concept opposite to Surface Learning of isolated memory and non-critical acceptance of knowledge. It emphasizes

learners' active Learning and flexible and skillful use of knowledge to solve practical problems.

Amsden (1988), Entwistle (1997) and Biggs (1999) have developed relevant theories of shallow learning and deep learning. With the development of information technology, foreign scholars have gradually started to study deep learning supported by information technology in recent years. Since 2002, a number of papers on in-depth study of deep learning have been published, discussing such aspects as deep learning supported by technology, deep learning in virtual environment, the impact of formative assessment on deep learning, and the impact of learning environment on students' deep learning.

The research on deep learning in China started late. The research results are scattered in journal papers, and the research mainly focuses on the theoretical descriptive level of deep learning, such as the understanding and characteristics generalization. 2005, our country scholar professor jia-hou li in the context of "deep learning to promote students" points out: on the basis of deep learning refers to the understanding of learning, learners will be able to critically learning new ideas and facts, and put them into the original cognitive structure, can communicate between many ideas, and be able to existing knowledge migration to the new situation, make decisions and solve problems. This definition is accepted by domestic scholars.

2.2. Basic Features of Deep Learning

Deep learning is mainly characterized by five basic features, including critical understanding, information integration, knowledge construction, transfer and application of intention, and problem-solving, as shown in figure 2. These five basic characteristics can be further explained as follows.

2.2.1. Critical Understanding

Deep learning is a kind of comprehension-based learning, which emphasizes that learners critically learn new knowledge and ideas, integrate them into the original cognitive structure, and establish multiple connections among various viewpoints (Warren, 2004). This requires learners to be good at questioning and discriminating on the basis of understanding things, to view things with a skeptical eye, to conduct theoretical evaluation and objective evaluation with sufficient rationality and objective facts, and to deepen their understanding of knowledge at the same time.

2.2.2. Information Integration

Information integration includes content integration and process integration. Among them, content integration refers to the connection between various knowledge and information, including the integration of multidisciplinary knowledge and the connection between old and new knowledge, integrating it into the original cognitive structure. Process integration refers to the formation of cognitive strategies and metacognitive strategies for content integration, which are stored in long-term memory. Such as the use of charts, concept maps and other ways to more conducive to combing the old and new knowledge between the relationship.

2.2.3. Constructive Reflection

Constructive reflection refers to the process in which learners achieve knowledge assimilation and adaptation through the two-way interaction of new and old experience on the basis of information integration, adjust the original cognitive structure, and examine, analyze and adjust the results of construction. This not only requires the learners understanding and judgment of information voluntarily, original knowledge of using the new concept (principle) or problem analysis, identification, evaluation, form the self understanding of knowledge, build new knowledge sequence, but also need to constantly look at the result of the self construction of reflection, and keeping the formation of learning active inspection, evaluation, regulation, the transformation, the science of uniting the. It can be said that constructive reflection is the essential difference between deep learning and shallow learning.

2.2.4. Transfer and Application.

Deep learning requires the judgment and grasp of key elements based on an in-depth

understanding of the new context, the analysis of the complexity and difference of judgment concepts in the new context, and the recombination and transfer of principle ideas.

2.2.5. Problem Solving.

Another important difference between deep learning and shallow learning is the ability to use knowledge to solve problems in new situations. The problem referred to here is not the well-structured Domain that can be solved by applying rules and methods, but the problem that can be solved by analyzing the ill-structured Domain on the original basis, and learning to solve the complex and ill-structured Domain is the embodiment and only way of learning depth. In fact, in our country in the new curriculum reform advocated by anchored instruction, based on the problem of learning, project-based learning, based on the design of the study, and many other modern teaching mode, to some extent, also has the concept of deep learning, these learning modes all require learners to meaningful learning, critical of higher-order thinking, active construction of knowledge, positive reflective learning, effective knowledge transfer and real problem.

2.3. Comparative Analysis of Superficial Learning

Deep learning is based on such cognitive theories as constructivism, distributed cognitive theory, meta-cognitive theory and situational cognitive theory. Through literature review, a comparison is made between deep learning and shallow learning in terms of memory mode, knowledge system, focus, learning motivation, learning involvement, reflective state in learning, thinking level and migration ability of learning results.

Through the comparison of the above differences, we can draw the following conclusions from the perspective of the audience. (1)Deep learning is a kind of cognition of high-level and higher-order thinking, a state of advanced learning, and closer to the essence of knowledge and wisdom. Shallow learning is limited to the lower level of learning, the acquisition of data, one-way acquisition of information. (2) Deep learning and shallow learning are not completely opposite. We advocate deep learning but do not completely deny shallow learning. In other words, shallow learning is the foundation and premise of deep learning, and deep learning is the deepening and sublimation of shallow learning. We must have a certain amount of superficial knowledge (such as facts, procedures, and definitions) in order to carry out deep and meaningful learning.

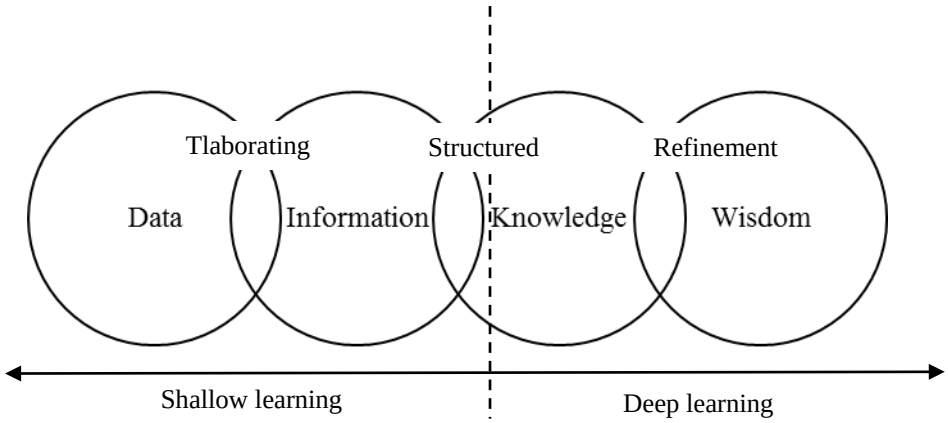

Figure 1. The process of changing from shallow learning to deep learning

3. Promote the Construction of Deep Learning Teaching Design Framework

There is no doubt that deep learning theory to teaching put forward higher request, under this update change, the goal of teaching design, content, strategy, media and evaluation factors will have corresponding change on the micro level, and the changes of problem solving, we need to based on the relevant theoretical framework of teaching design and practice verification for parsing. Teaching design is mainly to promote the learning of learners, and to use systematic methods to

convert the principles of learning theory and teaching theory into specific plans of teaching objectives, teaching contents, teaching methods and teaching strategies, teaching evaluation, etc., so as to create a systematic "process" or "procedure" for teaching and learning. (hogg kang, 2002) according to the connotation and theoretical basis of deep learning, we can construct a teaching design framework that promotes deep learning

According to the design framework, the following aspects must be paid attention to to promote deep learning.

First, the goal positioning is not limited to knowledge memorization, but to promote learners' development of higher-order ability, especially higher-order thinking ability. Second, the teaching content is not a simple information combination, but a multi-dimensional knowledge integration based on the problem. Third, teaching strategies focus on learning-oriented strategies, such as leadership, scaffolding, modeling, reflection, metacognitive strategies, etc. Fourthly, information technology serves as a learning tool, which is targeted at Learn WithIT, which will be discussed further in the future. Fifth, we should pay attention to the development of metacognition and the evaluation of thinking quality. Sixth, the roles of teachers and learners must go beyond traditional role positioning. Teachers are facilitators while learners' learning is constructive learning.

4. Key Points and Strategies of Information-based Teaching Design to Promote Deep Learning

This paper takes the framework of deep learning teaching design as the model and combines the functions and characteristics of information technology to analyze the information-based teaching design that promotes deep learning.

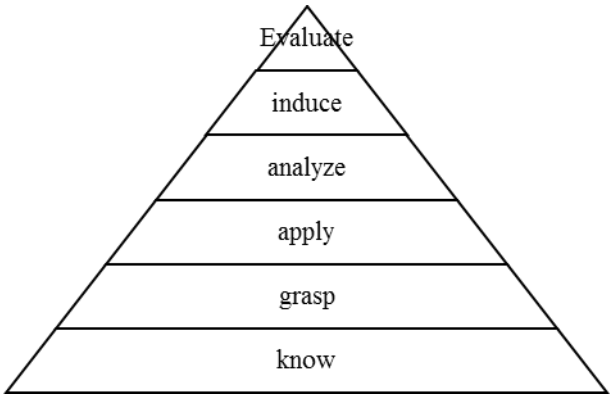

Figure 2. The relationship between cognitive goal classification and deep learning

4.1. Determination of Goals -- Development of Higher-order Thinking Ability

Bloom et al. (1956) divided the learning results/goals in the cognitive field into six levels of "knowing, grasping, applying, analyzing, synthesizing and evaluating". The two levels of "knowing and grasping" were mainly the description, memory and preliminary understanding of facts. Deep learning, on the other hand, corresponds more to the four levels of "application, analysis, synthesis and evaluation". It focuses more on the development of advanced cognitive level and the acquisition of Skills on the basis of memory and understanding, and is the embodiment of higher-rderthinking Skills.

It can be said that high-level thinking ability is the core feature of deep learning. The development of advanced thinking ability is conducive to the realization and promotion of deep learning, while deep learning is conducive to the improvement of learners' thinking quality and learning efficiency. To achieve the success of deep learning design, we should first pay attention to whether it can promote the development of learners' high-level thinking. The standard of each new course in our country regards the cultivation and promotion of learners' advanced thinking ability as

an important development direction. Therefore, from the perspective of goal setting, the teaching goal should not only stay at the first two levels, but should be determined from the perspective of developing learners' higher-order thinking ability. For example, in the design of teaching objectives of mathematics, in addition to paying attention to students' calculation and proof and other basic knowledge and skills, but also pay attention to analytical thinking, creative thinking and practical thinking, expand the content of mathematical thinking.

4.2. Reorganization of Content -- setting the Theme (or problem) of Knowledge Construction

Knowledge is an interrelated whole, but the traditional classroom has the problem of knowledge fragmentation. Such fragmented and decentralized learning is only suitable for the assessment of basic knowledge, not conducive to the in-depth promotion of knowledge. The content of deep learning is characterized by multi-dimensional knowledge integration based on questions, and knowledge construction is an activity suitable for students in various stages of deep learning. Knowledge construction in the form of subject (or problem/project) can effectively realize systematic learning of knowledge. The theme (or problem/project) is usually the key and difficult point to be learned in class, that is, the learning is set into the real complex and poorly constructed problem situation, and the result is usually contextualized, problem-oriented, task-based and multi-dimensional, such as simulation demonstration, multimedia display, contextualized learning, miniature world and virtual experiment (contextualized). Problem-oriented learning, thematic learning and thematic inquiry learning (problem-oriented); Multi-intelligence-oriented learning, multi-disciplinary comprehensive learning (multi-dimensional); Research, problem solving, work creation (task-based).

In the process of teaching content analysis and design, teachers are required to comprehensively analyze the teaching materials, dig the teaching materials in depth, and integrate the teaching materials flexibly. In other words, the contents of the teaching materials should be broken up and recombined, and core issues with the nature of problem exploration should be extracted, so as to make the content "flexible" and "frame". Some problems should also be noted when reorganizing and designing the teaching content.

First, what features of knowledge make it easy or difficult to learn, what content is more or less suitable for what type of learning, and what content of knowledge before modification can promote learners' deep learning rather than superficial learning. Second, whether the improved content has certain development to the learner's knowledge construction. Third, whether the design theme can effectively attract the attention of learners and give learners enough space to play freely? Whether it can reflect the wisdom and strength of the collective. Fourthly, whether the revised content enables learners to establish connections between old and new knowledge, concepts and experiences, whether it requires learners to summarize their knowledge into relevant conceptual systems, and whether it requires learners to find patterns and basic principles.

In the design of teaching content, the visual characteristics of teaching (learning) content design should be considered, and the multi-representation information in teaching materials should be designed as much as possible. A large amount of common sense information and other low-level knowledge can be considered to be embedded/distributed in the learning environment for random access by learners with the help of technical intermediaries, so as to reduce the external and internal load as much as possible and increase the effective load. We also pay attention to the information block principle, spatio-temporal proximity principle, consistency principle, dual channel principle and markedness principle.

4.3. The Use of Strategies -- Learner-Centered

In traditional classrooms, teachers are the holders of a large amount of declarative and procedural knowledge, and their job is to impart this knowledge to students. However, in classroom deep learning, teachers are more likely to play multiple roles such as subject expert, method guide and task consultant, and the following strategies should be paid attention to.

4.3.1. Leading Strategy.

The dominant strategy runs through the whole process of the activity, including task formulation, problem diagnosis, group establishment, providing feedback to students, challenges and rewards, as well as the process of doing things. What the teacher should do is to observe the students' behavior at any time, support the students when they have difficulties and the solutions deviate seriously, and withdraw after the students' ideas gradually get on the right track.

4.3.2. Stent Strategy.

A bracket is a frame that provides support. Teachers build a platform for learners to develop upward, guide the teaching process, enable learners to internalize the knowledge and skills they have learned, and build a platform for further development in the next stage. Erecting scaffolding includes putting up scaffolding, entering the situation, independent exploration, collaborative learning, and effect evaluation. The stent strategy is beneficial to improve the horizontal and vertical connection and connection of students' knowledge, to facilitate the flexible conversion of concrete and abstract problems and to form an effective thinking strategy to solve disciplinary problems.

4.3.3. Modeling Strategy.

Modeling can be divided into two different types, explicit behavior modeling and implicit cognitive process modeling. (Jonassen, 1999) behavior modeling is used to indicate which activities students should perform in learning activities and how to perform these activities. Cognitive modeling explains the reasoning methods that students should use when they engage in these learning activities. In the process of problem solving, through the study of several examples of similar problems, the fixed procedures and steps to solve a certain class of problems are summarized, and a problem solving model is formed.

4.3.4. Rethink your Strategy.

Introspection is learning introspection, which is an important strategy to cultivate advanced thinking ability to explore the process, sort out the new information and improve the cognitive structure. Teachers can make cognitive contradictions and conflicts, adopt open questions for training, and explore hypotheses and reflections to sort and summarize knowledge points, form general expressions or solutions, and improve students' ability of deepening cognition and understanding of problems, and refine their reflective ability of thinking methods. Self-reflection is a kind of learning quality. Teachers should guide and support students to reflect on their own learning, raise the thinking process of problems to a certain height, form a certain cognitive strategy, and finally achieve deep learning.

4.3.5. Metacognitive Strategy.

Meta-cognition is an important cognitive ability, the knowledge or cognitive activity that takes one aspect of various cognitive activities as its object or regulates it, also known as "Cognition about Cognition". That is to know when and what strategies are more effective to solve problems, and more importantly, what strategies are the most appropriate to use in what situations and the best to achieve goals. Metacognition is the core of cognitive activities and plays an important role in cognitive activities. In the teaching process, teachers should infiltrate metacognitive strategies, such as planning strategy, monitoring strategy and adjusting strategy, into students while acquiring knowledge. Namely not only teach students about the knowledge of the cognitive strategies, tell the students application strategy steps and the methods to solve the problem, and to teach students, make students understand teachers should constantly in the process of classroom teaching permeate metacognitive knowledge and strategies of training content, and make it become part of the students knowledge and ability training, causes the student to continue to improve their own cognitive process.

4.4. Whether the Design of Evaluation Promotes the Development of Metacognition

Metacognition includes three aspects: metacognitive knowledge, metacognitive experience and metacognitive monitoring (Dong Qi, 1989). Metacognitive development is reflected in deep learning, as shown in table 2. Metacognition and thinking quality are essentially two aspects of the same thing. They are both important components of the complete thinking structure. The quality of thinking is the external manifestation of the function of the overall structure of thinking, while metacognition is the internal organization of the function of the overall structure of thinking. Experimental results show that metacognition (metacognitive knowledge and metacognitive monitoring) is significantly or very significantly correlated with thinking quality (agility, flexibility, propogancy, criticality, originality), and the essence of this connection is causal connection.

In the design of evaluation link of deep learning, we should pay attention to the evaluation of thinking quality, with the purpose of developing students' metacognitive ability. Suitable for debate, situation test, observation, investigation, project evaluation, conversation evaluation, peer evaluation, etc. For example, in project evaluation, if the number of strategies reported by learners reflects the breadth of metacognition, the quality of strategies reflects the level of metacognitive skills, and the complexity of strategies reflects the metacognitive awareness of the problems or tasks raised by teachers.

5. Conclusion

Deep learning is a new concept proposed by contemporary scientific theories of learning, which provides a scientific basis for the implementation of effective teaching. It is also the basis for teaching design, the standard for observing classroom behaviors and the basis for evaluating teaching effects. The thought of deep learning provides a new fulcrum for information-based teaching to promote the development of students' quality and improve teaching quality. We believe that to effectively play the role of technology in promoting deep learning, we must grasp the connotation of deep learning, understand the metaphor and role of technology, and understand the framework of teaching design. Information-based teaching will be the foundation and key of pursuing the deep integration of information technology and subjects in recent ten years.

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