An Activity Architecture of Deep Learning for Students in Smart Classroom

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Abstract: *The core of smart classroom is to promote students' deep learning. In order to ensure that smart classroom can effectively achieve "quality and efficiency improvement" and cultivate students' problem-solving and innovation ability, it is very important to study deep learning in smart classroom. This study discusses the elements of students' deep learning activities, and points out that the transformation of teachers' teaching concepts, the embodiment of digital literacy, the intelligent optimization and iterative upgrading of information technology are the necessary conditions for implementing deep learning in smart classroom. Based on cognitivism learning theory and deep learning strategy, with knowledge acquisition, transformation, application and evaluation as the main line, it has effectively realized the path exploration of deep learning in smart classroom through four stages: sufficient thinking processing of perceptual experience, transition from "active learning" to "deep learning", improvement of knowledge transfer and problem solving ability, and transformation from knowledge to literacy. Along this path, guided by "problem-solving", a content framework of deep learning activities is proposed, which includes pre-learning, research and differentiation as the main links, and aims to cultivate students' independent thinking and dialectical thinking ability as the process, so as to achieve comprehensive learning goals and develop students' higher-order thinking ability.*

Keywords: *Smart Classroom, Deep Learning, Activity Architecture, Acquisition Approach*

1. Introduction

At present, the digital transformation of education led by intelligent education opens the prelude to the rapid development and reform of education in our country in the intelligent era. In the part of "Implementing the Strategic Action of Education Digitization" of the Ministry of Education's 2022 work Points, it is clearly pointed out that "exploring the construction of smart classrooms in primary and secondary schools", pushing the construction and application of smart classrooms to a new stage. As the core goal and ultimate direction of wisdom classroom is to promote the occurrence of students' deep learning [1], the occurrence of deep learning affects the construction of external environment and the selection of internal mode of wisdom classroom. Therefore, the study of deep learning in the field of smart classroom plays an important role in accelerating the digital transformation and intelligent upgrading of education. For the research on deep learning, on the one hand, current researchers design the framework of smart classroom based on deep learning activities to facilitate the effective realization of deep learning [2]. On the other hand, researchers construct the teaching evaluation dimension of smart classroom to support deep learning, and design the evaluation index of smart classroom from the perspective of deep learning [3]. However, less attention has been paid to the activity design of deep learning in the field of smart classroom. Based on this, the study attempts to take students' deep learning as a starting point, analyze the acquisition path of students' deep learning, and explore how to promote students' deep participation in learning through the design of learning activities in smart classroom, in order to provide beneficial references for the development of students' core literacy in the new era.

2. Interpretation of related concepts

2.1 Smart classroom

Smart classroom is a new demand for reshaping teaching in the era of artificial intelligence [4]. Some scholars believe that smart classroom is based on media tools and intelligent environment, and through the integration of intelligent technology and teaching, it can promote the optimization of classroom

operation status, so as to achieve the teaching goal of cultivating intelligent competent personnel [5]. Others believe that smart classroom is a location in which learners participate in problem solving and explore learning practices through the use of materials and technologies to promote their own wisdom development [6]. IBM believes that the role of smart Classroom is its ability to improve student achievement by providing resources and collaborative tools in an open environment based on students' individual needs, preferences, and abilities; Create a dynamic, clear and flexible desktop environment based on the cloud service platform and build an intelligent environment on top of advanced technology, software and integrated services to provide students with more automated functions to obtain learning resources; The learning data generated by the smart classroom environment provides teachers with real-time information, insights and strategies [7].

From above perspective, smart classroom is a location that is based on digital media tools, using technology to realize the automatic push of teaching resources, supporting the data generated by teaching activities to provide teachers with real-time information, insights and strategies, and assisting students to immerse themselves in the environment to learn and promote their intelligent development.

2.2 Deep learning

In 1992, Valerie Malhotra Bentz first proposed deep learning and gave a definition. She believes that deep learning is a communication process to explore the truth, through which students' emotional, intellectual and interpersonal skills continue to mature, and learners' emotional and rational expression tends to be consistent. This enables the intellectual fusion of body and emotion to facilitate the acquisition of new insights and solve new problems [8]. Chinese researcher Wu Xiujuan et al., believe that deep learning is a learning method and concept oriented to real social situations and complex technical environments, advocating deep processing of knowledge information, deep understanding of complex concepts, and deep mastering of internal meanings, so as to actively construct personal knowledge system and transfer and apply it to real situations to solve complex problems. Ultimately, it will promote the achievement of comprehensive learning goals and the development of higher-order thinking ability [9]. Professor He Kekang summarized three characteristics of deep learning: dynamic knowledge construction, diversity of teaching and learning strategies, and practicability of students' problem-solving and innovation [10]. Professor Zhu Zhiting introduced deep learning into the field of wisdom education, advocated the combination of deep learning and wisdom education, and sought to explore the teaching strategy of cultivating talents by "promoting depth with wisdom" [11].

To sum up, this study believes that deep learning is a "meaning generation" learning mode that pursues knowledge transfer and application on the basis of knowledge understanding, emphasizes the use of diverse learning strategies to transfer and apply knowledge to real situations, encourages students to deeply participate in learning, and further cultivates students' problem-solving ability and innovation ability.

3. The implementation conditions of deep learning in smart classroom

Smart classroom is an open structure composed of objective relationship network between different actors. In smart classroom, different actors take action around teaching and learning activities. The activities between teachers and students, students and digital environment constitute the complex interactive relationship in the smart classroom. Therefore, for the occurrence of students' deep learning in the smart classroom, the teachers and intelligent learning environment in the place must meet certain requirements.

3.1 The transformation of teachers' teaching concepts and the embodiment of digital literacy provide manpower support

In order to encourage students to participate in learning deeply, the teacher's guidance should not be underestimated. On the one hand, in the smart classroom, teachers' teaching ideas have been changed. Its teaching idea has gradually changed from "preaching, teaching and solving doubts" to "enlightening, indicating and differentiating", that is, from the traditional classroom concept of "teacher-oriented" to the unique value education concept of "teacher is the guide of students' learning" [12]. On the other hand, with the continuous breakthrough and innovation of science and technology, the atmosphere of intelligent education in the intelligent era has become stronger and stronger, and the digital literacy ability of teachers has been greatly improved. In the intelligent teaching environment, teachers have mastered the

method of using certain information technology tools to obtain effective digital learning resources; Be able to skillfully use multimodal digital technology to integrate, improve and innovate learning resources, and share these high-quality resources with the new generation [13]. In addition, according to scientific standards, teachers can apply digital evaluation tools to conduct data-based analysis of learners' learning strategies, learning progress and learning performance, excavate the teaching and learning rules behind visual dynamic distribution data, plan collaborative paths between teaching and learning, and provide learners with targeted feedback and personalized guidance. It also provides external condition support for learners' deep learning.

3.2 Intelligent optimization and iterative upgrading of information technology provide environmental support

Intelligent technology will be introduced into education, and education will be covered with the coat of "intelligence". Compared with traditional information technology, intelligent technology has a higher level of functional potential in information collection, information processing and information transmission. First, learning tools are intelligent. Intelligent technology is used to optimize classroom learning tools, promote the division and cooperation between learners and tools in learning practice, and then improve the efficiency of students' tool use and enrich their learning experience perception. Second, learning resources are diverse. Intelligent technology is used to integrate learning resources and assist learners to obtain diversified learning materials, thus improving the effectiveness of learners' resource acquisition and enriching their knowledge reserve capacity. Third, learning interactions are dynamic. Intelligent technology is used to improve classroom interaction means, build online interaction platform, realize "online-offline" integrated teaching, expand the scope of students' learning cooperation, and provide convenient conditions for students to share learning sentiment, experience and results timely; The "double interaction channel" of teacher-student interaction and student-student interaction is opened to enhance the dynamic of students' cooperation, interaction and group construction, and improve the initiative of students' social interaction; Students' deep participation in cooperative learning is guaranteed, so as to pursue the optimization of problem solving effect and promote the development of students' problem-solving ability and innovation ability.

4. The acquisition approach of students' deep learning in smart classroom

Generally speaking, the process of knowledge acquisition is the concrete manifestation of intelligent behavior which combines dynamic and logic. From the perspective of cognitive theory, there are different stages in the process of knowledge acquisition. Bruner believes that the essence of learning is to actively form cognitive processes, which are knowledge acquisition, transformation and evaluation [14]. In the book Seven Powerful Strategies for Deep Learning, Eric Jensen et al. divided the implementation process of deep learning into seven steps, namely, designing standards and courses, pre-assessment, creating a positive learning culture atmosphere, preparing and activating previous knowledge, acquiring new knowledge, deeply processing knowledge, and evaluating students [15]. To sum up, this study will explore the acquisition path of deep learning in smart classroom from different stages of knowledge acquisition, transformation, application and evaluation.

4.1 Knowledge acquisition: adequate thinking processing of perceptual experience

Knowledge acquisition is a stage in which the perceptual experience is fully processed, in which the validity of knowledge provides the supporting conditions for the deep learning of knowledge. In the smart classroom, information technology is used to organically link "online" and "offline", create a deep learning environment, and achieve autonomous access to ubiquitous learning resources at any time and anywhere. With the use of ubiquitous learning resources, learners can obtain sufficient perceptual experience, and they need to fully process the acquired perceptual experience. From the perspective of cognitive theory, knowledge acquisition is a process in which the newly acquired information is connected with the existing cognitive structure and knowledge experience through the simultaneous and co-existing development of assimilation or accommodation, and then the cognition is formed and the understanding is deepened. From the perspective of teaching activities, after students acquire learning resources, they use different types of resources such as physical intuition, modular intuition and verbal intuition to analyze and sort out the characteristics of objects and form the objective cognition of knowledge. Then they use the correct method to scientifically compare the acquired symbolic representation with the existing symbolic reflection in the cognitive structure, so as to strengthen the

generalization and understanding of the new knowledge.

4.2 Knowledge transformation: Promote the transition from "active learning" to "deep learning"

The process of knowledge transformation is the key to the learners' transition from "active learning" to "deep learning" in smart classroom. From the perspective of cognitive theory, learners' knowledge transformation is manifested in the ability to go beyond the given information and use various methods to objectively and substantively integrate the new knowledge represented by appropriate concepts and symbols in the cognitive structure, so as to carry out meaningful knowledge construction. New and old knowledge can be transformed in a meaningful way to realize the integration of knowledge, promote the creation of knowledge, and achieve a deep understanding and mastery of new knowledge. From the perspective of teaching activities, students use intelligent technical means or tools to meaningfully construct the new knowledge they understand and summarize with the old knowledge in their minds, generate new questions and conduct exploratory thinking. Finally, they will make certain learning diagnoses in order to better realize their actual development level, so as to realize the transition from "active learning" to "deep learning" in the smart classroom.

4.3 Knowledge application: Improve knowledge transfer and problem solving ability

Knowledge application is an important process to promote learners' knowledge transfer ability and problem solving ability, and it is also an important stage in the acquisition approach of deep learning. Smart classroom creates a real situational classroom environment for students, and exercises students' ability to solve practical problems in the "virtual-real combination" classroom. From the perspective of cognitive theory, learners in smart classroom apply the constructed meaningful knowledge to practical problems through cooperation, inquiry, discussion and other methods, thus promoting the deepening of cognition and the occurrence of deep learning. From the perspective of classroom activities, knowledge application stage begins with students' given task situation; After that, based on the understanding of the task, students drive the in-depth analysis of the problem through active thinking about how to solve the problem, and guess the solution to the problem; Then, by connecting and activating thought processes such as existing knowledge and experience, they conceive solutions to problems and think about the knowledge involved in such solutions. Finally, they implement problem solutions, go through the process of problem solving, and form conclusions and explanations. Students personally experience the complete process of problem solving, so students' cognitive ability to solve complex problems, communication and cooperation interpersonal skills have been developed.

4.4 Knowledge evaluation: Realize the transformation from knowledge based to literacy based

Deep learning emphasizes that students should learn to use knowledge to solve practical problems, and then develop core qualities in the process of knowledge transfer and application. The development of core literacy is the final analysis and judgment of the deep learning process, and is also the key to testing the quality of knowledge storage and flexible practical application. Knowledge evaluation of deep learning is to summarize the problems encountered in the learning process and make a certain basis for inference. By checking whether learners have generated more abstract concepts and new problems of higher level in the process of knowledge processing, whether they are able to analyze problems in depth, explain problems from a theoretical height or propose related solutions, and reflect on whether the proposed solutions are properly applied and suitable for new tasks. In addition, the evaluation content of deep learning not only focuses on the ability to construct new knowledge and effectively use the learned knowledge, but also pays attention to the perseverance of students in facing challenges and the evaluation of learner literacy as a performance of lifelong learning. Finally, with the help of the evaluation process, the knowledge system and method system are summarized and formed, the thinking experience is accumulated, and the intelligent learning ability is developed to promote the development of the core literacy of deep learning.

5. The activity architecture of deep learning for students in smart classroom

Guided by "problem-solving", this study aims to guide students to deeply participate in learning in smart classroom, promote their knowledge internalization and meaning construction, realize the transformation of knowledge into intelligence, develop their core qualities, and achieve the purpose of wisdom cultivation. Combined with the exploration of the essence of each link of deep learning, this

study constructs the structure and content of promoting students' deep learning activities in the smart classroom with pre-learning, research and differentiation as the learning scaffolding, as shown in Figure 1.
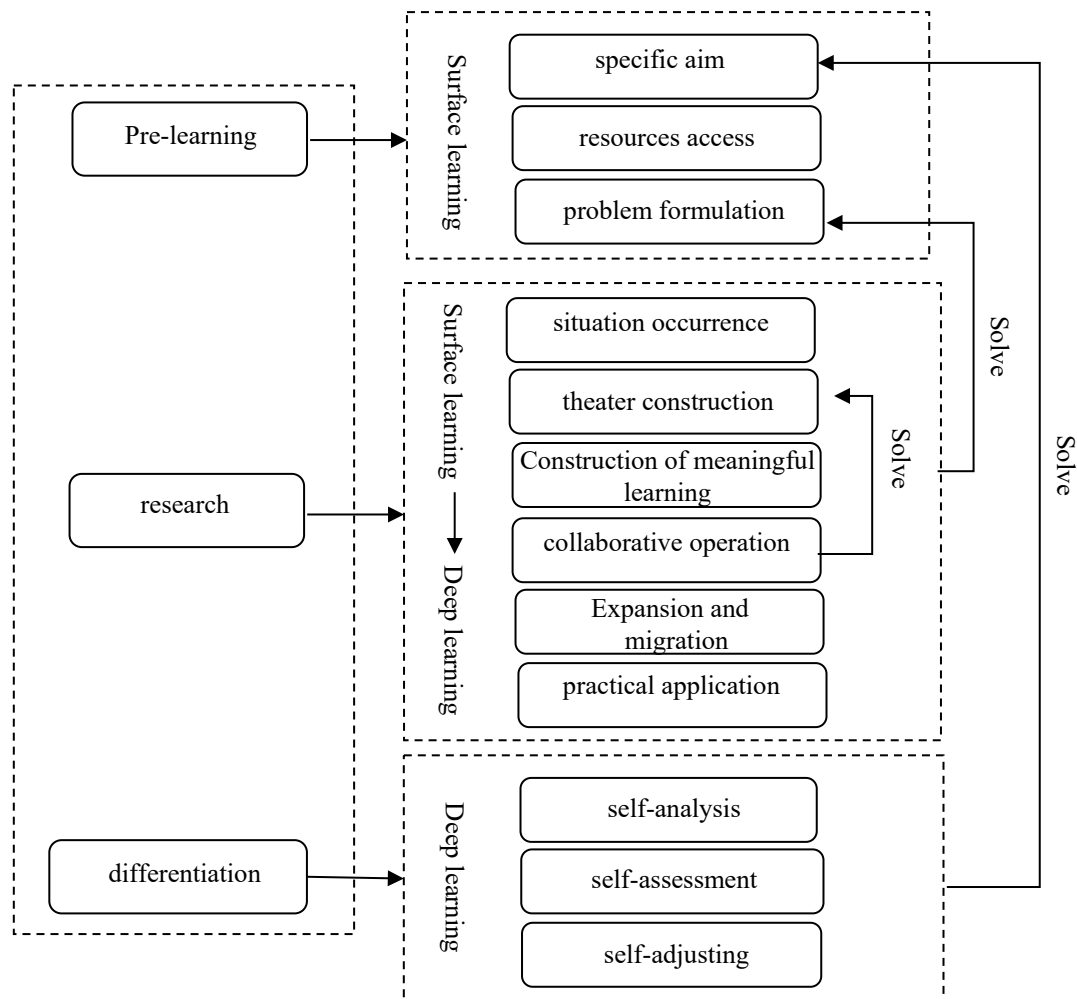

Figure 1: Three-loop activity architecture model of deep learning "problem-solving" for students in smart classroom

5.1 Pre-learning—promoting cognition

In order to achieve personalized learning and higher-order thinking ability of students, it is necessary to cultivate students' ability to construct knowledge and discover problems independently. As the "organizer" of deep learning, teachers take into account students' cognitive style, learning characteristics, existing learning experience and ability tendency, and the unique characteristics of subject knowledge under the guidance of learning goals, preliminarily draw up teaching materials, set course tasks and problems, and enable students to deeply participate in the learning process and improve their own abilities in a more appropriate way.

5.1.1 Setting up specific aim

In order to ensure the effectiveness of the learning process, identifying the learning objective is the first step in the whole process. The goal of deep learning is to enable students to achieve "four learnings": learning knowledge construction, learning problem solving, learning identity construction and learning higher-order thinking. Learning knowledge construction points to students' knowledge learning ability; Learning problem solving points to students' practical ability and innovative ability; Learning identity construction points to students' emotions, attitudes and values; Learning higher-order thinking is the core of deep learning, which is manifested in flexibility, depth, criticality and creativity of thinking, including problem-solving ability, independent decision-making ability, critical thinking ability of dialectical negation and creative thinking ability [16].

5.1.2 Accessing to resources to facilitate learning problems

In smart classroom, deep learning realizes man-machine collaboration through self-cognition and objectified learning with the help of the wisdom platform, enabling students to obtain multi-modal learning resources. Then the learning resources of different modes are analyzed and perceived independently. These perceptions conflict with the existing knowledge content in cognitive structure, which leads to the emergence of different learning problems. In addition, teachers' participation in solving deep learning problems in the smart classroom can help students to think and discuss the part of their own problems more intensively, so as to play a supervisory role in the classroom.

5.2 Research—promoting deepening

After the completion of pre-learning tasks, learners gradually develop into individuals with independent thinking ability and dialectical thinking. According to the next tasks of the smart classroom, the teacher will transform the materials related to the subject and students' life into teaching situations, and build task situations according to the actual learning requirements.

5.2.1 Creating the problem situation and building the task theater

Since true deep learning is a transition from a single memorization of knowledge to the exploration of the real world and the solution of real problems, the creation problem should be the first task of this part. The problems and obstacles encountered by individuals in the process of learning need to be solved by teachers with "scaffolding". Teachers need to help them complete knowledge construction and improve their thinking by creating problem situations that combine virtuality and reality. Finally, students are encouraged to achieve the goal of deep learning. As the guiding and auxiliary "scaffolding" of students, teachers build a multi-functional task theater that combines wisdom and practice, thereby reducing the distance between students and the nearest development area.

5.2.2 Constructing meaningful learning and collaborating

Problem solving is a kind of advanced cognitive process, which is to construct and organize the meaning of the difficult problems encountered by an individual in the process of deep learning through the problem context, so as to achieve a high degree of consistency between knowledge and thinking. In the task of meaning construction, the collaborative community is an organizational entity that carries out collaborative occurrence. The members of the community participate in learning activities to deepen the understanding of knowledge content, explore and establish the correlation between knowledge content, and discuss the flexible application of the constructed knowledge, so as to facilitate task solving. Cooperative learning activities realize the knowledge construction of each individual in the community through "knowledge exchange", which also provides standards and references for individuals to truly evaluate themselves.

5.2.3 Expanding and migrating knowledge to apply the actual place

The smart classroom allows learners to explore, collaborate, discuss, and meaningfully construct connections with things that are physically real, thereby developing the close relationship between students' ability to transfer and their ability to apply knowledge to solve practical problems. "Transfer and application" solves the problem of the transformation of knowledge into individual experience. In other words, the problem is to convert the learned knowledge into students' comprehensive practical ability. Only by transferring the knowledge acquired in textbooks to practical problems can students' knowledge be transformed into ability. The "migration" of deep learning is the expansion and enhancement of experience. "Application" is the process of externalizing and operationalizing the internalized knowledge, and it is also the process of converting indirect experience directly, transforming symbol into entity, from abstract to concrete.

5.3 Differentiating learning -- promoting higher order

In addition to relying on the evaluation of others and external society, self-analysis, self-evaluation and self-reflection can also promote students' active development and adaptive adjustment to expand and improve the final effect of deep learning. Through this adjustment, students can achieve their comprehensive learning goals and develop their higher-order thinking ability.

5.3.1 Self-analysis and evaluation

Learning analysis and evaluation can regulate the behavior of individuals in teaching activities and

arouse the enthusiasm of individuals to participate in learning tasks, which is a key part of the learning process. Self-evaluation refers to learners' self-judgment on specific learning tasks or learning processes in their own learning process. Effective learning self-evaluation enables students to develop good behavior habits, and constantly check, adjust and monitor their own behavior, forming an effective mechanism for self-reflection and self-adjustment, thus stimulating their internal learning motivation and actively planning their own growth.

5.3.2 Self-regulation promotes higher-order thinking ability

The ultimate goal of self-evaluation is students' self-regulation of their own learning. Self-regulation is when learners set goals for their own learning. And in order to achieve this goal, they will monitor, regulate and control their cognition, motivation and behavior. In other words, after making judgments on their own learning, students will return to the determination of evaluation standards, conduct self-reflection and self-induction, and formulate clearer and more demanding goals, standards or more detailed improvement plans for their future learning. In the process of self-regulation, learners should actively participate in their own learning process, use metacognitive strategies such as monitoring and adjustment, make goal-based changes to their learning, and adapt to their learning according to internal and external feedback [17]. Learners reflect on their own learning process and make adaptive adjustments to ensure that they have the ability to think at a high level.

6. Connclusion

Entering the era of intelligent Internet, intelligent classroom built on technology has become the target path for the future development of deep learning. In smart classroom, in order to lead students to deeply participate in learning, it is necessary to achieve the cultivation of students' core literacy and the improvement of students' high-level thinking ability, knowledge transfer ability and problem solving ability, and must focus on deep learning research. The relevant results of this paper provide theoretical and method-based support for cultivating students' subject core literacy in the era of intelligent Internet, and also provide reference for front-line teachers to lead students to participate in learning deeply. Follow-up studies will further validate and optimize the framework of activities, and apply it to different disciplines to promote the development of higher order thinking and ability of more students to meet the needs of personal development and social development.

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