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Rational Analysis of Deep Learning in Mathematics

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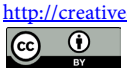

Abstract

Under the background of talent training requirements and classroom teaching in mathematics, this article compares the differences between shallow learning and deep learning, and finds the characteristics of mathematical deep learning: unity of shallow processing and deep processing, unity of multiple understanding and overall construction, unity of master knowledge and promotion ability, unity of independent learning and cooperative learning, and unity of active learning and lifelong learning. Accordingly, it puts forward the rational understanding to promote deep learning in mathematics: rational understanding of deep learning, dealing with dialectical relations, and giving full play to the guiding value of teachers.

Keywords

Deep Learning, Shallow Learning, Understanding and Construction, Migration Application

1. Introduction

Since the new century, the concept of deep learning widely recognized by scholars and line teachers, gradually into the practice of classroom teaching, in addition to the general strategy, integration of deep learning and specific disciplines had become the focus of researchers (Shen, Zhang, & Zeng, 2019). The specific representation, promotion strategies, and application effects of deep learning are different under the background of different disciplines. As far as mathematics teaching is concerned, as an emerging educational concept and model, how is deep learning put into the mathematics classroom and how is it effective? What measures can math teachers take to promote students achieve deep learning? These problems need to be solved urgently, so it is necessary and important for the deep learning study in mathematics.

Deep learning means that on the basis of understanding learning, learners can critically learn new ideas and facts, integrate them into the original cognitive structure, connect among many ideas, transfer existing knowledge to new situations, make decisions and solve problems.

The main questions studied in this article are: 1) What are the characteristics of deep learning in mathematics? 2) How to promote deep learning of Mathematics in Math Classroom Teaching?

This article compares the differences between shallow learning and deep learning, and finds the characteristics of mathematical deep learning: unity of shallow processing and deep processing, unity of multiple understanding and overall construction, unity of master knowledge and promotion ability, unity of independent learning and cooperative learning, and unity of active learning and lifelong learning. Accordingly, it puts forward the rational understanding to promote deep learning in mathematics: rational understanding of deep learning, dealing with dialectical relations, and giving full play to the guiding value of teachers.

2. The Necessity for Deep Learning in Mathematics

2.1. The Great Changes of the Times Require Deep Mathematical Learning

With the rapid development of science and technology and the continuous adjustment of the social division of labor, the specifications of talents required by the times have also undergone earth-shaking changes, As a social activity for cultivating people, education is facing unprecedented changes: the storage, transmission, and accumulation of knowledge is no longer the only task of education. Education pays more and more attention to people's subjectivity, and the ultimate goal is to cultivate the all-round development of learners.

Deep learning advocates that learners grasp the essence of mathematical knowledge based on deep understanding, construct the organic connection between old and new knowledge, examine mathematical knowledge and thought from an overall perspective, and base on mathematical problem solving and knowledge transfer. In this sense, mathematics deep learning not only includes the understanding and mastery of mathematics knowledge and ability, but also pays more attention to students' learning process, paying attention to students' thinking ability, questioning consciousness, learning motivation and will, and even lifelong learning quality, which coincides with the educational purpose of "cultivating people with all-round development", Deep learners can better meet the talent requirements of social development. It can be said that promoting mathematics deep learning is the purpose and way of mathematics education in the information age.

2.2. Classroom Teaching Calls for Deep Learning of Mathematics

Looking at the current situation of mathematics classroom teaching in primary

and secondary schools rationally, it is true that under the guidance of the new round of basic education curriculum reform, schools pay more and more attention to quality education, and teachers pay more and more attention to students' subjectivity and autonomy. However, there are still contradictions between cultivating students' core literacy and giving consideration to the overall teaching of the class in educational practice: many teachers believe that constructiveness, holistic and Critical high-order thinking can only be mastered by a few students. In order to give consideration to all students and coordinate the teaching progress, they can only selectively ignore the cultivation of students' high-order thinking; The mastery of mathematical knowledge and skills is still based on mechanical memory and a large number of exercises, and the exercises are mostly aimed at the consolidation of basic knowledge and single type questions, which is difficult to reflect the hierarchy, pertinence, and development of exercises; Mathematics learning attaches importance to examination results, and takes it as the standard to test learning and the purpose to improve teaching. Process evaluation is irrelevant.

Deep learning means understanding learning. Learners connect new knowledge with existing knowledge, critically understand and memorize new knowledge, and bring it into the original cognitive structure to realize the mastery and application of knowledge, and can transfer the knowledge in their mind to a new situation and solve new problems (He & Li, 2005). Therefore, deep learning is an effective way to solve the above problems.

3. The Characteristics of Mathematics Deep Learning

From a cognitive perspective, deep learning usually appears as a higher level of shallow learning. Compared with shallow learning, "depth" not only refers to the hierarchical mining of knowledge content in the learning process but also represents the degree of learners' learning participation and investment. Therefore, by comparing the differences between the two learning processes and learning characteristics (**Table 1**), it can help us to better understand the characteristics of mathematical deep learning.

Based on the comparison between shallow learning and deep learning processes and learning characteristics (**Table 1**), the numbers can be found Mathematical deep learning has the following main features:

3.1. Unity of Shallow Processing and Deep Processing

Deep learning is not so much a new way of knowledge learning as a deep expansion of the original way of learning. Shallow learning and deep learning are inseparable learning unity. Benjamin Bloom divides the educational objectives of the cognitive field into six levels: knowledge, comprehension, application, analysis, synthesis, evaluation. Most scholars generally believe that shallow learning stays in the first two levels, and the latter levels correspond to deep learning (An, 2015). The shallow processing to deep processing of learning is a continuous progressive process from shallow to deep, from outside to inside, and from

Table 1. Comparison table between shallow learning and deep learning.

		shallow learning	deep learning
Learning process comparison	The question put forward	Not sensitive to the problem situation, it is difficult to find mathematical problems, and the problems are of low quality	It can find mathematical problems from complex real situations and put forward a large number of problems with high quality
	Knowledge discovery	Knowledge acquisition depends on passive acceptance, and the active inquiry process becomes a mere formality	Under the guidance of teachers, student purposefully discovers knowledge independently and emphasizes the initiative of learners
	Knowledge understanding	Emphasize reciting memory and ignore knowledge understanding	Understand knowledge in many aspects, at a deep level and in a wide range of connections, and memorize based on understanding
	Trouble shooting	Emphasize problem-solving steps, ignore thinking methods, and know it but don't know why	Based on standardized problem solving, pay attention to thinking training, method migration, know its what, and know its why
	Knowledge summary	Scattered summary, difficult to form a system, it is not conducive to the consolidation of knowledge	Adopt the way of classification, connection, and logical criticism to construct an accurate, complete, and systematic knowledge system
	Knowledge application	Through imitation training, it aims to solve a problem	Pay attention to knowledge transfer and use it flexibly in order to solve a kind of problems
Learning characteristics comparison	Learning motivation	Mainly with external motivation, they passively accept learning as influenced by external rewards and punishments, and have a low interest in the learning content itself	Mainly with internal motivation, they actively participate in learning, learning is to meet the internal needs of the individual
	Learning engagement	Invest less time and energy, and have less enthusiasm	Focus, high learning investment, and can independently plan the learning tasks and progress
	Thinking characteristics	The One-sided, isolated, mechanical view of knowledge	View knowledge overall, connected, and critically
	Learning scope	Learning in class, the depth and breadth of learning is limited to the textbook	The time and space, depth, and breadth of learning are greater than the shallow learning
	Memory characteristics	Mechanical memory, mainly by recitation	Understand memory, memory mode diversity
	Learning form	Mainly to accept learning, Lack of cooperation, communication, and independent exploration	Rich learning content, diverse ways, and pleasant experience

simple to complex. Deep learning represents the unity of shallow processing and deep processing. The piecemeal and local knowledge acquired by shallow learning is the basic unit of deep learning thinking integration. Only after the shallow processing of knowledge is completed, can deep processing have a foothold. For example, students need to determine the symbols and values to carry out the multiplication of rational numbers. Memorizing the 99 multiplication table is the basis for the multiplication of the absolute values of rational numbers. Previously, they learned to remember the 99 multiplication table through mechani-

cal recitation and a lot of training. On this basis, they can master the algorithm of rational number multiplication. Therefore, deep learning does not mean the complete abandonment of shallow learning (Fan, Wang, Wang, & Tang, 2015).

3.2. Unity of Multiple Understanding and Overall Construction

One of the important differences between deep learning and shallow learning lies in the understanding and construction of knowledge. Most shallow learners are in a state of half understanding, knowing it but not knowing why, so it is difficult to build a knowledge system according to the logical relationship between knowledge. First of all, in understanding knowledge, deep learners explore the appearance of knowledge in many aspects, deeply grasp the essence of knowledge, widely link the old and new knowledge, and strive to understand knowledge from multiple angles, both know its what and know its why; Secondly, in the construction of knowledge system, deep learners bring new knowledge into their cognitive structure, take understanding as the basis and knowledge as the node, grasp the countless links between knowledge, realize the organic integration of old and new knowledge, constantly update the original knowledge system and build a complete knowledge network; Finally, the cognitive structure in the mind, as a unity of knowledge, supports deep learners to transfer and apply existing knowledge at different times, in different situations, and even across disciplines.

3.3. Unity of Mastering Knowledge and Improving Ability

One of the purposes of mathematics learning is to solve mathematical problems in complex real situations. Problem-solving is based on mastering mathematical knowledge and focuses on the improvement of mathematics core literacy and ability. Deep learning is also based on the unity of mastering subject knowledge and improving ability and quality. With the deepening of learning, it is guided by mathematical problems. Mastering knowledge and improving ability show the characteristics of spiral rise.

3.4. Unity of Independent Learning and Cooperative Learning

The deep learning of mathematics is oriented to all students, it recognizes that each student is a learning individual with development potential, cultivates students' independent and deep learning ability, and is committed to the overall improvement of students' comprehensive quality. Deep learning should be a process of self-awakening, self-generation, self-creation and self-transcendence (Wu, 2019). Autonomous learning is the main form of mathematics deep learning, but cooperative learning also occupies a place in the process of realizing deep learning. Autonomous learning exercises individual intelligence, while cooperative learning is the collision of group wisdom. Individual wisdom depends on the communication between students and between teachers and students. Therefore, learners' mathematics deep learning is not only to complete learning tasks independently and master knowledge and ability but also to realize the

all-around improvement of thinking, emotion, will, motivation and, even socialization in the learning community. Mathematics deep learning is the unity of independent learning and cooperative learning.

3.5. Unity of Active Learning and Lifelong Learning

From the learning characteristics of learners, the initiative and engagement of deep learners are much higher than that of shallow learners, mainly because deep learners have a strong interest in learning activities themselves, rather than from external pressure, that is, internal motivation is dominant. The initiative is one of the main characteristics of deep learning. Due to learners' own knowledge needs and the attraction of future success, they are prompted to actively invest time and energy in mathematics learning. The rapidly changing modern society requires learners to study all their life and constantly improve their quality. Knowledge possession is one of its standards. Deep learners can actively absorb new knowledge, new ideas and new methods, and deeply process, transfer and apply them to meet the requirements of the times for individuals. In this sense, deep learning is the unity of active learning and lifelong learning. Deep learners are lifelong learners, and lifelong learners must also be deep learners.

4. Measures to Promote Deep Learning in Math Classroom Teaching

4.1. Rational Understanding of Deep Learning

First of all, fully understand the educational value of mathematics deep learning. Mathematics deep learning is the refinement and sublimation of educational laws and practical experience. It breaks through the barriers of shallow learning: from paying attention to learning results to learners and learning activities themselves, from only knowing what it is to knowing both what it is and why, from solidifying problem types and methods to transferring mathematical knowledge in an integrated, creative and critical way, From Improving test scores to cultivating core literacy.

Secondly, treat the practical application of mathematics deep learning rationally. Deep learning is a young research field, and its specific integration with mathematics still needs to be explored. Therefore, the generality and effectiveness of mathematics deep learning still need to be tested in practice. Moreover, The object of education is toward humans, When promoting students' deep learning, teachers should also grasp the viewpoint of "specific analysis of specific problems", adjust teaching strategies in time according to different learning contents and students' characteristics, and realize real deep learning, rather than in the name of deep learning.

4.2. Dealing with Relevant Dialectical Relations

By analyzing the characteristics of mathematics deep learning, it is found that there are five pairs of relationships: shallow processing and deep processing,

multiple understanding, and overall construction, mastering knowledge and improving ability, autonomous learning and cooperative learning, active learning, and lifelong learning. Teachers should look at these relations from a dialectical and holistic perspective: each pair of relations exist correspondingly. From a holistic perspective, they are symbiotic relations that check and balance each other and promote each other.

In the design and implementation of Mathematics classroom teaching, teachers should pay more attention to coordinating these characteristics in order to promote students' deep learning of mathematics. For example, the activity of deep learning should be challenging, which is the knowledge that students can jump to reach. However, if teachers overemphasize the word "deep" and blindly pursue high difficulty and deep level, they not only ignore the shallow units of thinking and understanding, but also students will feel confused and tired. What about deep learning? Similarly, repeated processing of superficial knowledge will be counterproductive. These practices are contrary to the connotation of deep learning. Therefore, the dialectical characteristics of mathematics deep learning can not be confused, nor can we ignore one and lose the other. The degree of deep learning needs teachers to figure out and grasp.

4.3. Give Full Play to the Guiding Value of Teachers

The deep learning of mathematics advocates taking students as the main body and emphasizes the role of teachers. Teachers' teaching consciousness and ability level determine whether students can have deep learning (Guo, 2016). If students are compared to a small tree, learning is the growth process of a small tree day after day, year after year. Self-awareness is the root system deeply buried in the soil. It determines whether students take the initiative to participate in learning activities. Teachers' guidance is like warm sunshine, and small trees with sunshine will naturally flourish.

The deep learning of mathematics is inseparable from the guiding role of teachers. In the mathematics classroom to promote deep learning, While completing teaching tasks, teachers should pay more attention to the guidance of students' mathematical thinking, cultivate the transfer of students' mathematical knowledge, stimulate and exercise students' Autonomous Learning. In fact, they have higher requirements for teachers' own quality. The roles of teachers in and after class are rich and challenging: designers, organizers, guides, Expositor and Introspection.

5. Conclusion

Deep learning as a young research field, its organic integration with mathematics still needs to be explored. The standards, models, strategies, and values of mathematics deep learning need to be supplemented by relevant theories. The rational examination of existing research also needs the efforts of successive researchers.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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