

Intellectual View of Knowledge and Its Teaching Significance

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Abstract: The traditional concept of intelligence research is unclear and problematic, which is not conducive to guiding specific practical teaching. According to the generalized knowledge classification, modern cognitive psychology puts forward the concept of "intellectual view of knowledge". While admitting the concept of intelligence in psychometrics, the concept of intellectual view of knowledge calls on generalized knowledge to explain intelligence and restores all learned intelligence to knowledge. The comparative study of artificial intelligence research and Expert-Novice system has given strong support to the concept of intellectual view of knowledge. The intellectual view of knowledge has important pedagogy significance for practical teaching.

1. Introduction

The study of intelligence is an interesting subject and a challenging and difficult field. On the basis of summarizing the main viewpoints of intelligence research, this paper introduces the knowledge view of intelligence, and demonstrates the teaching significance of intelligence knowledge view, which is of enlightening and guiding significance to education workers.

2. Traditional Intelligence Research and Its Problems

Intelligence has always been the focus of psychology research, and it is also the breakthrough point of psychology for the education and teaching practice. However, the concepts of intelligence and intelligence research in psychology are unclear and problematic when being re-examined, which is not commensurate with the discipline status of psychology. In this case, not only the reputation of psychology is damaged, the theoretical study of psychology on intelligence hindered, the guiding role of intelligence research on teaching practice is also affected. The problems are mainly manifested in the following aspects (Zhang Jijia, 2001):

2.1 Definition of intelligence

In psychology, intelligence is an ambiguous concept with multiple definitions. In Chinese psychologists' views, the definition of intelligence can be summarized into at least four types: (1) intelligence is ability; (2) intelligence is a congenital quality, the result of cranial nerve activity; (3) intelligence is cognitive ability; (4) intelligence is adaptive ability. The definition of intelligence by Western psychologists is even more complicated. In 1921, the *American Journal of Educational Psychology* invited famous intellectual experts to define intelligence, and fourteen experts gave their diverse opinions.

2.2 Extension of intelligence

Due to the lack of a unified and recognized definition of intelligence, the extension of intelligence is extremely inconsistent and uncertain, and the perception of intellectual structure is also different.

2.2.1 Chinese scholars' views on the content and structure of intelligence

Most scholars in China believe that intelligence mainly refers to cognitive ability, including observation, memory, attention, imagination and thinking. Among them, thinking is the core. However, other people have put forward different views, considering that intelligence includes three

sub-structures of quality, cognition and motivation. Quality structure refers to genetic quality, cognition structure refers to cognitive ability, and motivation structure mainly refers to human non-intellectual factors, such as needs, motivation, emotion, will, etc.

2.2.2 Foreign psychologists' views on the content and structure of intelligence

Intelligence is referred to as the general ability in the psychology of the former Soviet Union; in the West, there is a dispute between factor theory and structure theory. Factor theory is the theory that clarifies the elements of intelligence, and structure theory emphasizes that intelligence is a structure.

In the 1980s, Gardner proposed the theory of multiple intelligence, which believed that intelligence includes seven kinds of intelligences: language, music, logic-mathematics, vision-space, body-motion, interpersonal communication and self-awareness. In the 1990s, natural observation intelligence was added.

2.3 The ambiguous boundary between intelligence and other psychological characteristics

First, the ambiguous relationship between intelligence and ability. In terms of intelligence, there are currently three main viewpoints: Western psychologists advocate that intelligence includes ability, while former Soviet psychologists advocate that ability includes intelligence. China's intelligence relative independence theory advocates that intelligence and ability are both distinct and interconnected, and they are both the psychological characteristics necessary to successfully solve problems. The difference is that intelligence is biased towards cognition and ability is biased towards activity, and the two are mutually constrained and cross each other.

Second, the relationship between intelligence and emotion. The concept of emotional intelligence is ambiguous, is it a kind of intelligence or is it parallel to intelligence? Or does it contain intelligence? In 1993, Salovey and Mayer believed that emotional intelligence includes the ability to recognize one's own and others' emotions, the ability to regulate one's and others' emotions, and the ability to use emotional information to guide thinking. It is not difficult to see that in the eyes of the founders of emotional intelligence, intelligence is contained in emotional intelligence.

Third, the relationship between intelligence and creativity. In 1988, Sternberg proposed a three-dimensional model of creativity, which believed that creativity consisted of three dimensions: creative application of intelligence, cognitive style and personality traits. Intelligence became a dimension of creativity hereby. The Chinese psychologist Zhu Zhixian believes that intelligence contains creativity and creativity is the highest performance of intelligence.

In addition, the relationship among intelligence, psychology and personality has also become ambiguous. For example, Piaget regards cognition, intelligence, thinking, and psychology as synonyms. Similarly, Wang Lei et al. proposed that "all basic and critical things that individuals should have in order to cope with the environment, solve problems and adapt to existence should be included in the concept of intelligence." Thereby the concept of synthetic intelligence is proposed, which includes cognitive factors of traditional intelligence, as well as motivational factors, emotional factors, and personality factors. In this way, intelligence can be equal to psychology, consciousness, and personality.

2.4 Intelligence test

Since Binet and Simon proposed the first intelligence test in the early 20th century, the debate on intelligence tests has not stopped. The main manifestations are: (1) intelligence tests are lack of correct theoretical guidance, so that people think that "intelligence is what is measured by the test"; (2) the content of the intelligence tests is too narrow, mainly limited to cognitive ability; (3) the results of different tests for the same trait cannot be compared; (4) the academic performance cannot be well predicted; (5) the creativity and achievements cannot be well predicted, and high intelligence can't guarantee high creativity. Intelligence tests are not effective, and there is an abuse in society.

3. Research of Modern Cognitive Psychology on Intelligence - Intellectual View of Knowledge

With the development of cognitive science and cognitive psychology, studying intelligence with cognitive perspectives has become an important aspect of the spirit of the times. Cognitive psychologists interpret intelligence as the process of information processing in a psychological structure for a certain purpose, including mental skills such as pattern recognition, attention, memory, representation, speech and problem solving. Das proposed the PASS theory of intelligence, and Sternberg proposed the ternary theory of intelligence. The PASS theory has a solid foundation of neuropsychological and cognitive psychology. The ternary theory comprehensively considers the relationship between intelligence and environment, experience and psychological mechanism, and considers the unity of structure and process, which has greater rationality.

According to the knowledge classification theory of cognitive psychology, modern cognitive psychology uses the generalized knowledge view to explain intelligence and puts forward the "intellectual view of knowledge". We believe that this view not only has theoretical innovation significance, but also has strong guidance and great significance for the education and teaching practice. To understand the intellectual view of knowledge, we first need to update the traditional view of knowledge.

3.1 Classification of knowledge

3.1.1 General classification

The popular view of knowledge in China's educational theory defines knowledge as "the understanding of the attributes and connections of things, which is expressed in the psychological forms of perception, representation, concept, and law of things." The knowledge is divided into different categories according to the depth of reflection, including perceptual knowledge reflecting the external connection of external attributes of things, and rational knowledge reflecting the intrinsic connection of the essential attributes of things. According to the content of the reflection, there is natural, social, and thinking knowledge; according to its source, there is direct knowledge and indirect knowledge. The former is obtained directly from human social practice, and the latter is obtained through books or other means. The acquisition of knowledge is also called the mastery of knowledge, which includes three stages of understanding, maintaining and applying knowledge (Bai Xuejun, 1996).

The popular view of knowledge in China's educational theory has its rational points. It emphasizes that knowledge comes from the outside world, and there are different types of knowledge. The mastery of knowledge is a process, including some stages. However, this view can only provide principle guidance for teaching work, because it only stays in the philosophical theory of reflection, which is obviously not enough to practically and effectively guide school teaching.

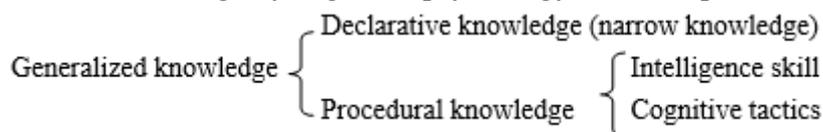
3.1.2 Classification of modern cognitive psychology knowledge

The knowledge view of cognitive psychology is different from the traditional view of knowledge. Cognitive psychology assumes the cognitive process of human beings as the process of information processing, the result of which is to obtain information stored in a certain way, that is, to acquire knowledge. Anderson divides knowledge into two broad categories: declarative knowledge and procedural knowledge. The former refers to "the individual has a conscious extraction of clues and thus can directly declare the knowledge." This type of knowledge is mainly used to answer questions "what it is." The latter refers to "the individual consciously extracts clues and can only infer the existing knowledge indirectly through some form of work". This type of knowledge is mainly used to answer the question "what to do."

Gagne divided declarative knowledge (verbal information) into three categories from simple to complicated: symbolic learning, factual learning, organized knowledge learning; Ausubel mentioned three types of learning in the theory of meaningful speech learning: symbolic learning, conceptual learning and propositional learning, which can also be seen as a classification of declarative knowledge; the target classification system in Bloom's cognitive domain makes a more detailed classification of declarative knowledge, with more than 12 types.

There are also different types of procedural knowledge. Procedural knowledge is a set of operational steps that are made up of concepts and rules. According to the directionality of applying concepts and rules, procedural knowledge can be divided into two sub-categories: one is procedural knowledge that uses concepts and rules to work externally - intelligence skill, and the other is procedural knowledge that uses concepts and rules for internal control - cognitive tactics. Intelligence skill uses the learned concepts and rules to process external information, and cognitive tactics uses the learned concepts and rules to regulate and control their own processing activities. Some intelligence skills and cognitive tactics can be automated, and some require conscious control; there are both specialized areas and general areas of intelligence skills and cognitive tactics.

The classification of knowledge by cognitive psychology can be expressed as follows:



It can be seen that the concept of generalized knowledge includes not only narrow knowledge, but also the skills we usually talk about, and also includes the newly proposed cognitive tactics.

From the perspective of cognitive psychology, the concept of "knowledge" as opposed to skill that is popular in China is the declarative knowledge (narrow knowledge) of cognitive psychology, and the concept of "skill" is procedural knowledge. Skills always involve what people do, traditionally what they do for a person is always explained with the skills they possess, and cognitive psychology uses procedural knowledge to explain. The skills that cognitive psychology refers to are actually a set of procedural knowledge that an individual has acquired and the ability to do things according to this set of procedures. In cognitive psychology, skills are also seen as a type of knowledge. In this way, we should judge whether a person has knowledge from what he does rather from what he says. It can be seen that the knowledge view of cognitive psychology is fundamentally different from the popular view of knowledge in China. (Pi Liansheng, 1997)

Cognitive psychology also studies the process of knowledge learning. It believes that the learning of knowledge is composed of a series of stages or links, and different knowledge, learning processes and conditions are also different.

The study of declarative knowledge can be divided into three stages. The first stage is that new information enters short-term memory, which is connected to the activated related knowledge in long-term memory, so that the construction of new meanings occurs. The second stage is that the newly constructed meanings are stored in long-term memory, if there is no review or new learning, these meanings will be forgotten over time. The third stage is the extraction and application of meanings.

The learning of procedural knowledge (intelligence skill) is also divided into three stages. The first stage grasps the rules; the second stage applies the rules and practices, transforming the regular statements into the procedural form; the third stage is that the rules completely dominate the behavior of the people, and the skills are relatively automated.

The learning of cognitive tactics has three stages. The first stage is to acquire a cognitive tactics, knowing what the cognitive tactics is to learn; the second stage applies the relevant tactics to make the tactics related to learning, memory or thinking dominate their cognitive behavior; the third stage is to smoothly apply the relevant rules to govern and regulate one's own cognitive behavior under changing conditions, so as to improve the efficiency of learning.

The knowledge view of cognitive psychology divides knowledge into different types, in particular, the tactic knowledge is also included in the generalized knowledge category, and it proposes that different knowledge has different acquisition processes and conditions. These theories of cognitive psychology are more instructive for teaching and improving the cognitive performance of learners.

3.2 Intellectual view of knowledge

After updating the concept of knowledge, let us discuss the concept of intelligence. Intelligence

has innate ingredients and acquired elements, we need to distinguish between the two concepts of intelligence. One is the concept of intelligence in psychometrics. The psychometric intelligence is indicated by IQ scores, an individual's IQ score remains relatively stable throughout life, primarily reflecting one's innate factors. The other is the concept of intelligence in learning psychology. From the point of view of learning, personal learning can be fast or slow, but all the intelligence achievements acquired are the result of learning, and can be explained by generalized knowledge.

For example, Professor Perkins of Harvard University in the United States proposed the following intellectual formula (Bai Xuejun, 1996):

Intelligence = power + tactics + content knowledge

Power refers to the physiological function of the human nervous system, and it is difficult to be changed through environmental or educational factors; tactics is the aforementioned tactic knowledge; content knowledge includes declarative knowledge and procedural knowledge. This formula not only tells us the composition of intelligence, but also points us to the tasks and goals of intellectual education.

The "intelligence" in the slogan "Mastering knowledge, forming skills and developing intelligence" put forward by the educational theory field in China essentially refers to the intellectual intelligence that is acquired, that is, the learned cognitive ability or learned intelligence, where the intelligence may be explained by generalized knowledge.

The intellectual view of knowledge advocates that all learned intelligence should be explained by generalized knowledge. Unlike the theory of the formal training, which explains intelligence by the so-called "form training" in addition to mastering knowledge. That is to say, mastering generalized knowledge is to develop intelligence. However, this does not mean that there is no difference between mastering knowledge and developing intelligence. In fact, the intellectual view of knowledge emphasizes that different types of knowledge have different effects on children's ability to complete intelligence tasks. For example, the general concepts and principles in knowledge are more conducive to assimilation of new knowledge than the specific factual knowledge; tactic knowledge helps learners learn to learn, remember and think, and is considered to be the core component of developing human intelligence. In short, after the establishment of a new concept of intelligence, the study of how to develop intelligence becomes a study of how to effectively master different types of knowledge, and has direct guiding significance for teaching practice.

In short, in the intellectual view of knowledge, intelligence is not something else, but the learned generalized knowledge. The best way to develop intelligence is to give students access to learn declarative knowledge, procedural knowledge and tactic knowledge. Therefore, the mission of intellectual education is to: (1) impart declarative knowledge to students. Of course, the knowledge acquired by students must conform to the characteristics of good cognitive structure proposed by Ausubel; (2) help students transform declarative knowledge into procedural knowledge, making it a skill to successfully complete various intelligence tasks; (3) teaching students to acquire and apply tactic knowledge, to learn the skills of effective learning, memorizing and thinking, and to become self-conscious learners and self-regulating learners.

4. Successful Interpretations of Intelligence with Knowledge

Modern cognitive psychologists and artificial intelligence researchers have achieved many compelling achievements in insisting on the use of knowledge to interpret intelligence, and these achievements can be seen as support for the intellectual view of knowledge (Pi Liansheng, 1998).

4.1 Intellectual view of knowledge and problem solving

Solving problems is considered to be a psychology research field that best reflects people's intellectual level, and psychologists have been concerned with problem-solving research since the 20th century. In 1910, Dewey proposed five stages of solving problems - confusing, identifying problems, reorganizing problems, testing hypotheses, and applying answers to new strange examples. In 1926, A. Wallese proposed four stages of preparing, breeding, clearing and testing. There are many stage models coming up later, however, before the birth of modern cognitive

psychology, psychologists often explore the general process of solving problems outside specific fields, resulting in slow research progress.

In 1978, Ausubel took the lead in pointing out the role of different components of cognitive structure in solving problems. He distinguishes three types of knowledge in the process of understanding the problem: background knowledge, inference rules and solving tactics. The background knowledge determines the understanding of the problem, and the latter two determine whether the problem can be solved smoothly.

The modern cognitive psychologist system analyzes the different roles of declarative knowledge, general procedural knowledge, and cognitive tactics as special procedural knowledge in solving problems. Modern cognitive psychologists point out that solving problems generally involves problem representation, designing problem solving plans, implementation of solving plans and monitoring of the problem solving process. The correct and clear representation of the problem mainly depends on whether the corresponding problem type knowledge is stored in the learner's cognitive structure. Once the new problem is included in the learner's original problem type knowledge (or problem schema), the problem is immediately understood. The planning and monitoring mainly involves tactic knowledge, a good problem-solving tactics can speed up the problem-solving process. The implementation of problem-solving plans involves knowledge of general problem-solving procedures and operational steps, which are carried by individuals in the form of skills and decide whether the plan is carried out smoothly.

Modern cognitive psychologists also regard the reading and writing process as part of the problem-solving process, and generalized knowledge is used to explain reading and writing skills. The writing process involves three psychological components - conceiving, expressing and modifying. Research shows that middle school students spend 1/2 to 2/3 of their time in conceiving writing plans. In the process of conceiving, they need to extract content knowledge related to writing topics, which belongs to declarative knowledge. The richer this kind of knowledge, the easier the author is able to choose from it. Expressing involves reviewing questions, selecting and organizing information, and these activities require the application of tactic knowledge. Expression is the process of implementing your own writing plan in a standard form of text, requiring knowledge of characters, words, sentences, and textual structures, which are stored by the author in the form of writing skills. Modifying needs to find problems in the first draft, including content, organization, characters, words, sentences, etc., this involves the use of knowledge in declarative knowledge, general writing skills and writing tactics. It can be seen that writing ability is well interpreted by generalized knowledge.

4.2 Support for the intellectual view of knowledge by artificial intelligence research

In the past two decades, the development of artificial intelligence research has also been an important support for the intellectual view of knowledge. Artificial intelligence is the intelligence that is implemented manually on a machine (computer), and the concept of intelligence involved here is consistent with the concept of intelligence we learned above. Artificial intelligence was born as a discipline in 1956, since then, the study of artificial intelligence has made remarkable progress in machine learning, theorem proving, pattern recognition, problem solving and expert systems. After the 1970s, people gradually realized the importance of knowledge and generally carried out knowledge-centered artificial intelligence research. Since the research of artificial intelligence has shifted from the exploration of general thinking laws to the knowledge-centered research, the research of expert systems has made major breakthroughs in various fields, all kinds of different functions and different types of expert systems have been mushrooming, which have produced impressively huge economic and social benefits. Therefore, many artificial intelligence experts believe that "Intelligent behavior lies on the amount of knowledge and its generalization. A system is intelligent mainly because it has knowledge to operate."

4.3 A comparative study of the differences between experts and novices

The results of the comparative study of experts and novices in modern cognitive psychology also strongly support the intellectual view of knowledge. It is generally believed that experts in various

fields can skillfully solve difficult problems in their familiar areas, and they are considered to be highly developed intellectuals. Studies have shown that the difference in the ability of experts and novices to solve problems is reflected in the following six aspects:

The second is the difference between short-term memory and long-term memory. The short-term memory breadth of experts can greatly exceed novices. Similarly, experts in a certain field have superior long-term memory in this field.

The third is the difference in skill execution speed. Many skills of experts in a certain field have been automated, so they solve problems quickly and rarely go wrong.

The fourth is the difference in time used for problem representation. When solving problems, experts generally spend more time representing the problem, while novices usually spend more time trying to answer the question.

The fifth is the difference in the depth of the problem representation. Experts generally represent problems based on the inherent structure, and novices typically based on surface features.

The sixth is the difference in self-control ability. Experts tend to frequently check whether their answers are reasonable, and they do better than novices.

How to explain the difference in these abilities? According to our commonsense understanding of intelligence, it is often explained by the five components of intelligence (observation, memory, imagination, attention and thinking) and their quality. However, if this interpretation is dependent from knowledge, it will become a variety of formal training. The intellectual view of knowledge actually finds the reason behind the differences: experts gain their name for they have different quantity and quality of knowledge in a certain field than novices. If they leave the field of their expertise, their abilities are no different from those of novices.

5. Teaching Significance of the Intellectual View of Knowledge

With the rise of cognitive psychology and the deepening of artificial intelligence research, more and more psychologists apply generalized knowledge in explaining human intellectual behavior, affirming the intellectual view of knowledge while restoring all learned intelligence to knowledge. This view will gradually be accepted by the majority of people and will have an important impact on our classroom education and conceptual change (Pi Liansheng, 1998).

First, it is conducive to the implementation of individual teaching. It proposes to distinguish between the two concepts of intelligence and use knowledge to explain all learned intelligence, and it recognizes the concept of intelligence in psychometrics. Therefore, in educational practice, students' individual differences in learning speed must be considered and respected, and individual teaching should be implemented.

Second, it is conducive to the setting of teaching objectives. Intellectual view of knowledge believes that learned intelligence is determined by the quantity and quality of knowledge (different types) acquired by students, so teachers must carefully study the different roles of different types of knowledge in students' intellectual behavior, differences in different types of knowledge learning processes and conditions, and the differences in their measurement and evaluation criteria.

Third, it is conducive to giving play to the guiding role of teachers. In the intellectual view of knowledge, students' learned intelligence can be explained by knowledge. Therefore, when a student is found to lack certain abilities, the teacher will try every means to find the reason from the lack of knowledge in the student's brain, rather than simply classifying the student into "mental deficiency" or "mental retardation". Instead, the teacher should firmly believe in the teachability of intelligence, and give full play to the inherent functions of education.

Fourth, it is conducive to enhancing the initiative and self-confidence of students' learning. Intellectual view of knowledge believes that learned intelligence can be explained by knowledge. When students find questions that they cannot answer, they should not only check whether they have relative declarative knowledge or procedural knowledge, but also reflect on their tactic knowledge in these aspects. In particular, when students find that they have declarative knowledge and procedural knowledge in certain aspects and can't solve the problem, they will reflect on their corresponding tactic knowledge, instead of blaming themselves for being "stupid" and losing

confidence in solving problems and learning. Thus it can mobilize and enhance the enthusiasm and initiative of students to learn and improve their learning pattern.

6. Conclusion

In the study of intelligence, we need to distinguish two concepts of intelligence: innate genetic component and learned component. The intellectual knowledge view advocates that all acquired intelligence should be interpreted in a broad sense. Problems solving research in psychology, artificial intelligence research and expert-novice comparative study all support such views, and the intellectual knowledge view is more instructive to school education.

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