

## Children's Science Education Based on the Naive Theory

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**Abstract:** Most developmental psychologists believe that children have three naïve theories: naïve physics, naïve psychology and naïve biology. They can use these theories to look at the world around them logically. The theory has the characteristics of scientific theory, such as abstractness and cohesiveness. It has a set of causal interpretation mechanism and has the function of interpretation and prediction at the same time, and it is a dynamic developing process. Although it has the characteristics of the theory, it is simple, daily, and has a considerable distance from the scientific theory. Therefore, we cannot ignore the construction of the children's scientific concept in scientific education, and through inquiry teaching to arouse children's naïve theory. It also challenges children's naïve theory through explanation, prediction and counterexample, so as to achieve the task of scientific education that to promote the transformation of children's naïve theory to scientific theory.

### 1. Introduction

It has been a long time since the reform of science education in primary schools. It is gratifying to say that when it comes to the goal of scientific education, educators have realized the importance of scientific spirit and scientific attitude training, and the importance of scientific methods and scientific process learning. But they think that emphasizing the scientific concept, learning science runs counter to curriculum reform. In fact, this is a misunderstanding of science education. In order to promote the development of children's naïve theory, until the construction of naïve theory, it is necessary to grasp certain scientific concepts, and under the guidance of the theory, we should make full use of the original theory to create counterexample scene, produce cognitive conflict, make children aware of their own limitations of the naïve theory, therefore, the original theory is amended, developed, reorganized and rebuilt. Figure 1 is an introduction to the naïve theory of children.

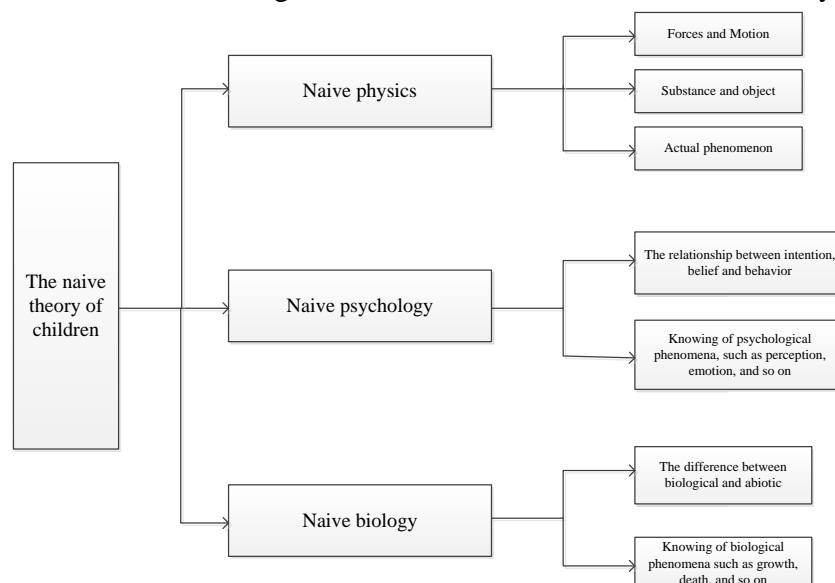


Figure 1 The naïve theory of children

## 2. Scientific Education Based on Scientific Concept

Scientific theory is a scientific explanation and systematic explanation of some experience phenomenon or fact. It is a knowledge system composed of a series of specific concepts, principles (propositions) and the strict proof of these concepts, principles (propositions). The structure of scientific theory is made up of three elements: the concept, the judgments associated with these concepts, it refers to the basic principles, the logical conclusions deduced from these concepts and principles, namely all kinds of specific laws and foresight. Although the theory is large and small, it is coarse and fine, but it can be called the theory that it must contain the core element of the concept. The naive theory of children is also no exception. It is also made up of a series of concepts with different levels and inherent logical connections. Figure 2 is an introduction to the characteristics of the children's naive theory.

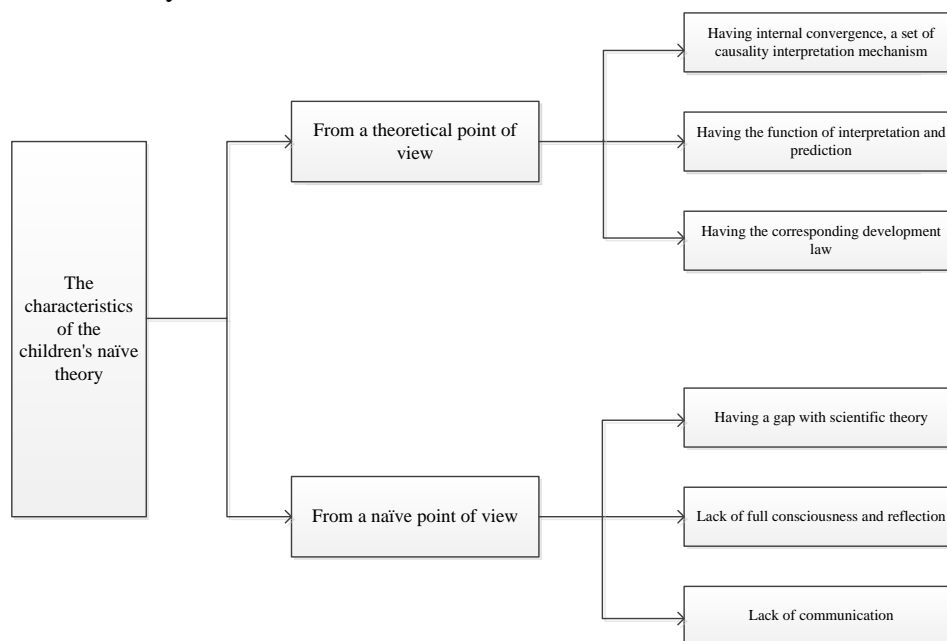


Figure 2 The characteristics of the children's naive theory

### 2.1 Attaching importance to the construction of scientific concept

The concept has an abstract feature; it is a logical form that reflects the essential connection of things through repeated abstract thinking based on the people gain a rich and sufficient perceptual knowledge of empirical facts, and it is the reconstruction of experiential facts in the minds of people, it is purely speculative, the logic form. Scientific concept is abstracted and summarized from a large number of scientific facts, and is the footstone of scientific theory system. It can provide intelligence saving methods for organizing and summarizing large amounts of data. The knowledge that constitutes a concept can be better migrated to a new situation than the isolated and scattered knowledge. Therefore, when students grasp scientific concepts, they can make the scope of the applicability of the learned knowledge more widely. So, students' understanding and mastery of scientific concepts are very important links in scientific learning. No one will think that a concept has all the characteristics of a formal scientific theory, but the concept also has most of the characteristics of theory, such as abstractness, cohesiveness and a causal interpretation mechanism. First, in form, it is expressed as a number of statements, which are different from the statements that describe the evidence. In addition, its entities are not alone, but are organized in a special structural system. Each part has its inherent logical connection, and it can make causal explanations based on this logic system. So, the concept does work in some ways like the micro theory, and the concept can be used to explain and predict the occurrence, development and existence of things. Theory is the expansion of concepts, and the establishment of concepts is the necessary and most important link in the construction of theory.

Learning science means expanding and revising concepts rather than remembering factual

information and definitions, and it does not blindly emphasize the spirit of inquiry. If we ignore the establishment of scientific concept, children's science learning will be a blind process without purpose or direction. Scientific information cannot be integrated into a whole, and it presents a scattered and fragmented state. The new scientific experience cannot be incorporated into the existing schemata, which is not conducive to the improvement of the scientific cognitive structure. In practical teaching, a series of scientific concepts will help them build up a system, a strict scientific concept system, and promote the further development of the theory.

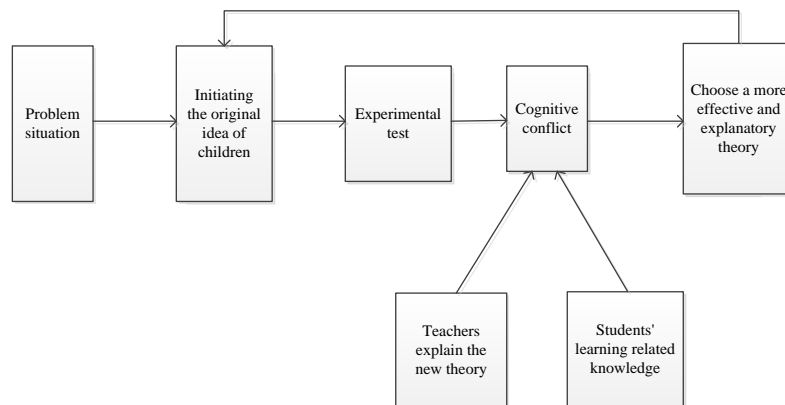


Figure 3 Scientific learning model

## 2.2 Taking the specific concept of science as the center to carry out teaching

According to Piaget's theory of cognitive development stage, we divide scientific concepts into three levels: specific concepts, first level abstract concepts and secondary abstract concepts. The specific concept refers to the concept that students can understand in the operation stage, which includes the factual concept of the macro world, the concept of the intuitionistic nature of matter and the concept of direct relationship. The first level abstract concept mainly includes the concept of ideal model, the factual concept of the microcosm, the concept of material non-intuitive attribute, and the concept and rule of a simple indirect relation. The secondary abstract concepts include complex relationship concepts, principles and laws. The arrangement and level of the concept constructed by students of different ages are different. We should choose different conceptual levels according to students' experience and cognitive ability, follow the principle of specific to abstract, and achieve the construction of scientific secondary level abstract concepts step by step.

But in primary school science teaching, according to the characteristics of children's cognitive level, namely, in the stage of specific operation and form operation, specific concept (as the different parts of the human digestive system have different functions, the purpose is to make the food absorbed by the human body) is easy for children to understand and explore. So teachers should understand and master specific concepts and design specific activities on this basis. Every question and operation should point to specific concepts; encourage students to acquire concrete concepts through self-exploration. By further abstraction and generalization of the essence of specific concepts, the first level concepts and secondary concepts are gradually obtained.

## 3. Inquiry Teaching -- the Way to Promote the Transformation from the Naive Theory to the Scientific Theory

The scientific curriculum standard of full-time compulsory education clearly stipulates that scientific study should take inquiry as the core. Inquiry is not only the goal of scientific learning, but also the way of scientific learning. The inquire-oriented learning activity is the main way for students to learn science by their own experience. This includes the following basic inquiry processes: asking questions, conjectures, assumptions, observing and experimentation, drawing conclusions and forming explanations, and discussing and communicating with peers. The author thinks that every effective inquiry activity is the process of gradual development and perfection of the children's naive theory. Based on the five links of inquiry learning process, this paper explains

in detail how to awaken and challenge children's naive theory through these links, so as to achieve the task of scientific education -- to promote the transformation of children's naive theory to scientific theory.

### **3.1 The first link, observation, discovery, and introduce a question**

Observing objective material world is the inevitable requirement of children's psychological development, and is the source of “inquiry learning”. The psychological essence of finding the problem is that the individual perceives a gap between the existing state and the state of desire. Naive theory thinks that children's understanding of things is not “white board”, but a set of ideas of their own. Therefore, before carrying out the observation, we need to find out the experience and ideas of children's observation and finding problems, and what theories have been formed on this basis. Then there are some targeted observations that challenged children's theory, guiding children to perceive that there is a gap between the phenomena of observation and desire. That is, when children cannot explain and predict what is happening now according to their own naive theory, they have a strong cognitive conflict with previous theories. Only the question raised under this conflict is the problem that children are willing to solve, so that the children's next exploration activities can be traced. Therefore, on the basis of observation, the simple theory of children needs to be awakened before finding and asking questions. On the basis of challenging the naive theory, the questions raised by children are often considered as the core of “Inquiry Learning”.

### **3.2 Second links, making conjectures, assumptions**

The two functions of the theory are prediction and interpretation, and the naive theory is no exception. In scientific research, we should pay attention to bold hypothesis and be careful to seek evidence. However, bold guess and assumptions are not entirely groundless. In a strict sense, it is a guesswork based on children's naive theory. Prediction makes children pay close attention to the phenomenon that is going to happen, it helps children understand what I think, what I see, what I will see, what I actually see. This link allows children to make specific predictions so that children can compare their similarities and differences between the predicted and observed results in the next step, so as to promote children to reflect on their own theory. On the basis of the first two links, we can guide children to do some specific observations and experiments. On the basis of children's theory, challenging children's theory in order to achieve introspection, transformation and reorganization of theory, that is, constantly revising, adjusting and perfecting their naive theory.

### **3.3 The third link, making observe and experiment**

A variety of materials are provided for observation and experiment. The main purpose of this link is to guide children to find evidence to support previous predictions and explanations, namely, finding evidence to support theory. Then, the material provided in this link and the instructing strategies of the teacher are particularly important. The counterexample is the most powerful weapon to refute the existing theory, and it also plays a very important role in the development of the children's naive theory. But when children face counterexample, it is not what we usually imagine that children will change their original theories immediately to adapt to new facts and evidences, but children often go through a struggling stage. They usually take means such as “ignoring counterexample, refusing counterexample, excluding counterexamples from theory, holding it, but not using counterexample temporarily and changing part of theory” to maintain the authority of the existing theory. So, there is no immediate relationship between counterexamples and the reform of children's theory, this requires our teachers not to be in a hurry, but to wait for the children to grow up. It takes time for children to develop, giving them time to notice and realize that when there are lots of counterexamples; children may think about whether they need to revise theories. In fact, it is the same as the mechanism of assimilation, adaptation and balance proposed by Piaget. So, in this stage, it is most important for improving children to realize the emergence of a large number of counterexamples in appropriate materials and proper guidance. Table 1 derives from a test survey of children's observation in different field entities

Table 1 Judgement score of children for different field entities

Project Age	Biology			Non-biology		Total average score
	Human being	Animal				
		Familiarity	Unfamiliarity	Familiarity	Unfamiliarity	
Three-year old (40)	4.650	1.950	1.650	2.750	2.775	13.775
Four-year old (40)	6.000	2.375	2.400	3.000	3.000	16.775
Five-year old (40)	6.000	2.950	3.000	3.000	3.000	17.950

### 3.4 The fourth link, draw conclusions and form an explanation

What is the goal of science education? Is it possible for children to get the correct scientific knowledge and scientific conclusions? But from the various strategies of children to deal with counterexample, we realized that it is unrealistic for children to change their original theories through several scientific observations and experiments. For this reason, we emphasize respect theory and the evidence. The author thinks the conclusion and explanation here refer to that children find the coordination between theory and evidence, that is, children need to “use the theory to explain the evidence”, “use the evidence to support the theory”, to this end, they can process the evidence in different forms to achieve the coordination with the existing theories. But if you can feel his efforts and struggles to maintain his existing theories, maybe one day he will be transformed in struggle. This transformation can be that children adjust the periphery of the theory instead of the core theory. Or it is from a naive theory to another naive theory, not the idea that we take it for granted, from the naive theory, it is bound to go to the scientific theory. Even though, we also think that the children's naive theory has been changing, and is in the process of gradual development and improvement. So in this link, our goal is to guide children to draw their conclusions based on the observed facts, accurately recognize the inconsistency between the existing theoretical and practical evidence, and be willing to make adjustments and attempts. If we can't get unified scientific conclusions and scientific concepts immediately, it does not need to be forced. But it doesn't mean that we don't recognize the acquisition of scientific concepts and scientific knowledge. But the establishment of every scientific theory is not accomplished overnight. As Popper explained, it experienced the tortuous process of pre-science, normal science, science crisis, scientific revolution and new normal science. Therefore, the acquisition of the scientific concept and the scientific theory is not immediate; it is an example, guiding the direction of our scientific education.

### 3.5 The fifth link, discuss and communicate with the partner

Talking about science is the process of constructing the science of children's society (especially scientific theories and evidence). This link refers to according to the record, children discuss and communicate with each other that the observable phenomena, the assumptions made, and hands-on conclusions observed in scientific activities. Respecting facts is the minimum scientific attitude. Children should first record their inquiry process and discovery through text and chart, which is the basis for them to draw conclusions, share and communicate. This link allows children to interact with children, children to interact with teachers through speech, group communication and class discussion in the whole class. This is not only a process for children to sort out their own inquiry process, but also a process for children to further clarify whether their theories and evidence are coordinated. It guides children from blind self-confidence to rational analysis, trains children's scientific attitude and spirit of respecting the facts, and promotes the self-construction of children's knowledge and experience. At the same time, the mutual doubts and contradictions among the partners will lead to new problems and stimulate further exploration.

#### **4. Conclusion**

In a word, science teaching based on the children's naïve theory should attach importance to the construction of scientific concepts and take scientific concepts as the guidance. Under the premise of fully arousing children's naïve theory, we can challenge children's naïve theory through explanation, prediction, providing counterexample, and so on, so as to achieve the reorganization and reconstruction of naïve theory, and promote the coordination of theory and evidence step by step, so as to achieve the establishment of scientific theory.

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