

# The Application of Consistent Cognitive Framework in Physics Teaching

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**Abstract:** The cognitive framework is based on human psychology and consists of a set of unique psychological elements consistent with feelings, concepts, opinions, attitudes, and behaviors. Cognitive framework is the instinctive way that human beings use to recognize new things. Cognitive framework greatly affects people's learning process and learning effect. If teachers can make full use of a consistent cognitive framework in teaching, students will get twice the result with half the effort. This article uses three cognitive models, namely electric current, photon, and the world line in the theory of relativity, to illustrate the importance of the consistency of the cognitive framework in physics teaching.

**Keywords:** Cognitive Framework; Physics Teaching; Circuit; Photon; Relativity

## 1. Introduction

When human beings use their own eyes to understand the world, they do it on the basis of their existing cognition. Existing cognition includes psychological elements such as feelings, concepts, opinions, attitudes, and behavior habits. The overall composition of these existing psychological elements has a great impact on the current process and results of cognition of things. The whole constituted by these existing psychological elements forms a cognitive framework. Here we give a definition of a cognitive framework: A cognitive framework is based on human psychology and is composed of a set of unique psychological elements consistent with feelings, concepts, opinions, attitudes, and behaviors. From the definition of cognitive framework, it can be seen that cognitive framework greatly affects people's learning process and learning effect.

People's cognitive framework needs to be consistent, there is no contradiction. Otherwise, people's cognition will be confused. If teachers can make full use of a consistent cognitive framework in teaching, students' learning will get twice the result with half the effort.

Patrick H. Cox et al., explained the application of cognitive framework in image recognition. Samuel G. Robson and others explained the application of cognitive framework in fingerprint recognition. Sascha Meyen et al., conducted an experimental study on the role of cognitive framework in human cognitive activities.

This article uses the practical application of circuit cognitive frameworks in teaching to illustrate how the cognitive framework plays a role in the cognitive process of students, and the importance of the consistency of the cognitive framework in physics teaching.

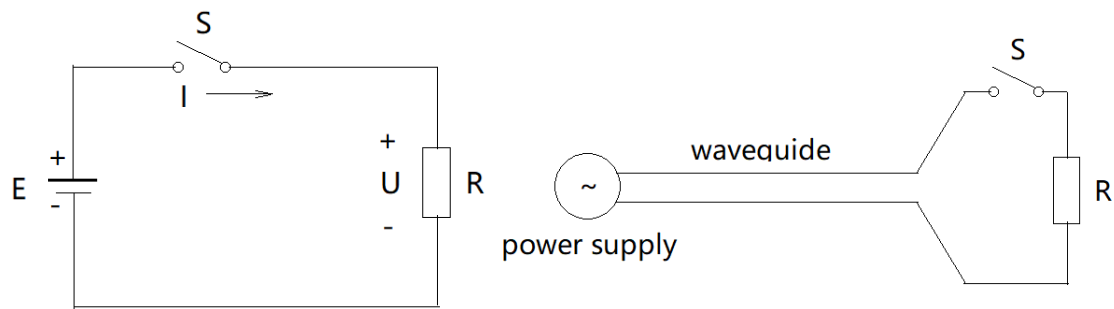
## 2. Circuit cognitive framework

In physics, circuits are generally described in terms of voltage and current. The power supply provides electromotive force to maintain a certain voltage at both ends of the power supply. Under the action of the voltage, a current is formed in the wire, and the current flows through the electrical appliance to perform work and then flows back to the power supply. In electromagnetics, electromagnetism believes that the power supply provides electromotive force to maintain a certain electric field at both ends of the power supply. When the circuit switch is closed, the electric field of the power supply re-establishes and distributes the electric field along the circuit. This process will form electromagnetic waves. Under the action, an electric current is formed, and then the electric current does work inside the consumer. The essence of the whole process is that the power supply provides electromagnetic energy, which is transmitted to the consumer after the electromagnetic wave propagates along the wire. The above two statements are different. This leads to a conflict between the two cognitive frameworks of circuit voltage, current and electromagnetic field.

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(a) Circuit Cognitive Framework Constructed with the Concept of Voltage and Current  
 (b) Cognize the West Outer Ring Frame with the Circuit Constructed by Electromagnetic Field

Fig. 1 Two cognitive frameworks about circuits

In actual teaching, the above two cognitive frameworks are integrated as follows, and good teaching effects have been achieved:

- (1) The circuit is composed of power supply, wires, switches and electrical appliances.
- (2) The power supply provides electromotive force to maintain a certain voltage at both ends of the power supply and form an electric field.
- (3) When the circuit switch is closed, the electric field of the power supply re-establishes the distributed electric field along the circuit. This process will form electromagnetic waves.
- (4) The consumer forms a current under the action of the newly established electric field, and the current does work inside the consumer.
- (5) Alternating current will continue to produce electromagnetic waves. The electromagnetic energy provided by the power supply will be continuously transmitted to the electrical appliances after the electromagnetic waves propagate along the wires. However, after the electrical appliances consume electromagnetic energy, the current will decrease, and the circuit will generate new electromagnetic waves and increase the current reduction. The electromagnetic energy of the power supply will also be continuously transmitted to the consumer through the wire.

In teaching, attention should be paid to helping students form correct cognitions and avoid forming wrong cognitions:

- (1) From power to electrical appliances, the carrier of energy is electromagnetic waves, and the transmission speed of energy is the speed of light.
- (2) Electromagnetic waves are easier to propagate along the wire in the wire direction than the free propagation in space.
- (3) From the relationship between electric potential and electric field, and the relationship between current and magnetic field in electromagnetics.

$$\vec{E} = -\nabla\phi, \quad \nabla \times \vec{H} = \vec{J}$$

It shows that the voltage corresponds to the electric field, and the current corresponds to the magnetic field. This shows that the two theoretical modes of voltage, current and electromagnetic field are consistent and can be integrated.

- (4) Direct current does not exist in essence, it should be a pulsating current at low frequency, but it can be approximated as a steady direct current.

### 3. Conclusion

Cognitive framework plays an important role in students' cognitive activities. Teachers should try their best to help students form a consistent cognitive framework in teaching, which will help promote teaching.

### References

1. Patrick H, Dwight J. Great expectations: minor differences in initial instructions have a major impact on visual search in the absence of feedback. *Cognitive Research* 2021; (6): 19.
2. Samuel G, Jason M. The effect of expertise, target usefulness and image structure on visual search. *Tangen and Rachel A. Searston* 2021; (6): 16.
3. Sascha M, Dorothee M. Group decisions based on confidence weighted majority voting. *Ulrike von Luxburg and Volker H. Franz* 2021; (6): 18.