Discussion and Analysis on the Postgraduate Classroom Teaching Method Based on Brain Science

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ABSTRACT
As one of the most cutting-edge, important and active disciplines in the current scientific research field, brain science has been rarely applied in education, despite its fruitful research results. This paper, based on brain science and according to the physiological characteristics of the brain and the latest related research results, discusses five teaching methods to address the common problems in postgraduate classroom teaching, including the attention capture, mechanical repetition, elaborative rehearsal, movement and emotional methods. These five methods demonstrate good effects in keeping students' attention to learning, improving their ability to memorize knowledge, maintaining their interest and developing their learning motivations. They provide new ideas and also theoretical basis for postgraduate classroom teaching and effectively improve the efficiency of teaching and learning between postgraduate students and teachers. Therefore, this study is a useful exploration of teaching based on brain knowledge and specific teaching scenarios.

Key Words: Brain Science, Classroom Teaching, Postgraduate Education, Teaching Method

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Introduction
So far, brain science has reached an unprecedented height. Many countries in the world have long considered brain research as one of their national key research areas (Hardiman et al., 2012; Lawson, 2010; Morris, 1991; Zou, 2016). Education, as an undertaking to cultivate talents, is closely related to brain activities. One of the main objectives of education is actually to expand the abilities of the brain so as to increase the efficiency of learning and work. In other countries, brain research is seeing gradual progress in education and starting to guide education policies. It has particularly profound influences on practice. Many teachers overseas are actively introducing brain science into their practical education work. In China, however, few of the actual research results in the brain science field has been applied in education so far (Niekerk and Webb, 2016; Esler, 2010; Goswami, 2008). At present, China is striving to carry out quality-oriented education in order to promote education structural reform. This requires educators to pay more attention to applying the results of brain science, so as to provide scientific basis for the promotion of the educational undertaking as well as the development strategies and theories of education work. Teaching with full understanding of the students' brain structures and their development characteristics has already been an important trend in the education field.

Related works on brain science
Whole brain model
In the late 1970s, Ned Hermann studied the previous analysis results of other researchers and proposed a new brain model theory. He used a 4-quadrant model to simulate the actual working
principle of the brain; in other words, four ways of thinking are used to describe the two hemispheres of the cerebral cortex and the two hemispheres of the limbic system (Salmiza, 2012; Stewart, 2015). Later, many brain researchers studied this theory and came up with a more consistent model: different functional regions of the brain are developed in different stages, so the development of some capabilities are closely related to the key development periods of these brain regions. This has given new inspirations to teaching. In certain important periods, giving students appropriate learning opportunities will not only speed up their learning efficiency, but also improve their mental health, which is very beneficial to the growth of students.

Theory of multiple intelligences
Howard Gardner, a professor of psychology at Harvard University, proposed the theory of multiple intelligences. This brought a great impact on the only teaching theory. His brain theory is based on the fact that the development of the main functions of the brain stems from their ability to change. Intelligence cannot be forecasted, nor does it exist in only one form. An individual's mental growth involves many aspects, which are related to the corresponding regions of the brain (Lesný and Vlach, 1982; Himmelseher and Schubert, 2008; Graves and Graves, 1965).

Emotional intelligence theory
In the 1990s, Joseph leDoux gave a hypothesis about emotional intelligence when studying the non-intellectual factor. The theory of emotional intelligence emphasizes the important role of the amygdala in emotions and the overall structure of the brain. It believes that emotion plays an integral part in human life (Bauer et al., 2016). Such research results have been successfully applied in school teaching and provided new directions for teaching development. Both emotions and social activities have become part of the teaching activities.

Postgraduate classroom teaching method
Attention capture method
(1) Brain mechanism for attention
Attention is a psychological effect, indicating the degree of concentration under certain conditions. The characteristics of the brain have something to do with the general features of attention.

1). Sensory register

The brain receives external information via the sensory receptors of the body all the time. The amount of information received is far greater than what one can pay attention to. The reticular activating system is also called the sensory memory system, whose main function is to filter out external data. When the external data are being input into the brain, the sensory register system will, in a short time, prioritize the information acquired according to each individual's existing experience, and then accept or reject the information of each event.

2). Immediate memory
After being filtered through the sensory register, the information to be received is transported from the thalamus to the tactile processing part of the cerebral cortex and then goes through the initial phase of short-term memory, i.e. immediate memory. Immediate memory is like a clipboard. The information obtained at this time can usually be retained for thirty seconds. Information not quite important will be directly discarded. Therefore, the brain receives information selectively.

Factors that causes the brain to remove attention and then select information continuously mainly include priority, depth of understanding, novelty and status of presentation, etc. Now let's take priority as an example to elaborate more on how the brain works.

![Figure 1. Characteristics of the brain in information processing](image-url)
is about life or has influences on emotional changes always has a higher priority than learning and other information when being received.

(2) Classroom teaching strategies
Being concentrated is the first and also a very important step of learning. Therefore, the teacher needs to set a certain scenario to find the students’ unconscious attention, and then strengthen their conscious attention. Practical methods include setting stable external conditions, employing innovative methods, intriguing students’ interests, guiding positive emotions, adding humour, establishing links between information, giving a sense of pressure and using a variety of tactile ways to improve the effectiveness and efficiency of classroom teaching.

Mechanical repetition method
Mechanical repetition actually means providing repeated information and doing repeated work to make students keep the knowledge completely in mind. The teacher must find a novel way to intrigue students so as to keep them learning until the end of the repetition task.

(1) Mnemonics
1) Brain mechanism for memory
If information is fixed in the time memory area of the brain, the individual maintains a permanent memory of the information stored. Then, the individual can identify relations and develop understanding by extracting and using memory as necessary. In this process, there will be interferences from many other factors, such as the effects of the hippocampus and the connection of neurons.

Memory is related to a part of the brain known as the hippocampus. It is located at the base of the cerebral cortex, looking like a sea horse. Hippocampus creates a memory in the face of things and actual data. It has the ability to process information, and at the same time it can consciously transfer such memory information to long-term memory.

The hippocampus continuously screens the data of the working memory input, and at the same time constantly compares them with the existing events in the long-term memory. This process is also an inevitable stage of attention. After that, it sorts the input object data and then transports them to the cerebral cortex, and at the same time stores them according to the long-term memory strategy. The hippocampus is like a switch pivot between working memory and long-term memory, transforming data back and forth. The constant switches between the hippocampus and the cerebral cortex allow individuals to understand the external environment more clearly.

2) Classroom teaching strategies
Including rhyme memory, composition mnemonics, event mnemonics, simplified mnemonics, regional associative mnemonics, similar tone mnemonics, destination mnemonics, and shape mnemonics.

(2) Proper practice
1) Brain mechanism for practice
Initially, it is very difficult to achieve the required state of operational skills. This process requires attention and mechanical repetition. The mechanical repetition of actions is called practice. When information irrelevant to motor skills is being input, the visual cortex is considered to be a very critical part of the brain. Through practice, an individual begins to gradually understand various conditions and languages better. The result of practice is changes in the neurons in the visual cortex, and the corresponding changes in feelings with time. Through continuous practical training, the final skilled procedural memory will become deeper.

2) Classroom teaching strategies
Practice not only includes repeated motions. This requires teachers to establish suitable teaching strategies through appropriate research. For example, the teacher can select appropriate materials, carry out targeted exercises, give immediate feedbacks and rationally use centralized and decentralized training methods, so as to ensure effective adherence and stabilize memory.

(3) Utilization of chunks
Chunking is a process by which individual pieces of information are bound together into a meaningful whole. This process is related to the second stage of short-term memory, i.e. working memory. Working memory shows that the brain can carry out conscious short-term memory and also process and integrate information accurately and at the same time convert the information to long-term memory. The specific workflow is shown in Figure 2:
Figure 2. Working memory processing

The more data are stored in the chunks, the more information the working memory needs to process. So it can be seen that the brain processes multiple pieces of information by processing information into different chunks. The current feasible methods mainly include pattern- and classification-based chunking.

Elaborative rehearsal method

(1) Brain mechanism for elaborative rehearsal
Elaborative rehearsal is to repeat the processing of information and associate it with the previously stored information at any time, so as to add new connotations to the new information. Elaborative rehearsal allows the brain to be more comprehensive in the processing of data. This requires connection of many neurons, and thus helps achieve deeper memories.

Working memory is temporary. It can only work for a short time in processing data. Then the brain needs to take some time to process and transform the working memory into long-term memory, so that the newly input information can be stored in the corresponding region. The initial rehearsal is conducted when the information is entered into the working memory for the first time. If the information is not processed immediately, new meaning cannot be established and the information will quickly dissipate. If there is enough time for the brain to go from the initial rehearsal to stage 2 rehearsal, the brain will be able to conduct fine processing of the information, give full understanding and establish associations. This step can greatly increase the successful rate of storage into the long-term memory.

(2) Classroom teaching strategies

1) Using theoretical relation diagrams.
   Below are a few general relation diagrams: diffusion diagram, level map, association diagram, story map, comparison diagram, K-W-L diagram, Venn diagram, structure diagram, brace map and process diagram. A Venn diagram is shown in Fig. 3. It is plain to see the similarities and differences between several theories.

2) Making summaries. It is closely related to writing, which is what we call elaborative rehearsal. Through this process, the working memory gets to learn and summarize information. Summary tables can facilitate students' research and integration of knowledge, as shown in Table 1.

Figure 3. Venn diagram
Table 1. Summary table

<table>
<thead>
<tr>
<th>Need category</th>
<th>Need Type</th>
<th>Modal Demand Model</th>
<th>Corresponding business system</th>
</tr>
</thead>
<tbody>
<tr>
<td>The first</td>
<td>Basic resources</td>
<td>Computational resource, Web resource, Communication resource, Storage resources.....</td>
<td>HPC, LAN, Internet, Ground broadband network, Satellite communication network, Memory management.</td>
</tr>
<tr>
<td>The second</td>
<td>Basic application</td>
<td>Convenient service, Standardized management of data resources. Significantly improve work efficiency.....</td>
<td>Web portal, Data Base System, Office Automation System, Disaster reporting system.</td>
</tr>
<tr>
<td>The third</td>
<td>Professional application</td>
<td>Professional products production.....</td>
<td>Numerical weather prediction system, MICAPS system, MESIS, Professional business systems.</td>
</tr>
</tbody>
</table>

**Movement method**

(1) Brain mechanism for movement

The cerebellum has something to do with the motor functions of the body. It plays an important role in keeping the body balanced and regulating muscles. But studies have found that the cerebellum is also crucial to information processing and decision making. The associations between motion and learning are shown in Figure 4:

![Figure 4. Diagram of the associations between motion and learning](image)

The frontal lobe is located in the frontal position of the brain. It is the main executive control system, used to control advanced thinking while dealing with problems and adjusting emotional changes. Behind the frontal lobe there is a series of neurons that lead to the brain, called the motor cortex. This area is in the same lobe with the parts that are responsible for emotions and thinking, proving that motion is related to advanced thinking activities.

(2) Classroom teaching strategies

Practical experience, dynamic learning and spatial learning are the three structures of learning. However, a solid neural network is mainly refined through experience. Studies have found that actual experience is mainly achieved through a stable and long-lasting neural structure, which involves multiple tactile organs. The brain retains information through a variety of channels and also recalls information through many other ways. Even if not all information can be obtained by experience, there are still many ways to add the process into teaching.

1) Collaborative learning

A. Peer learning: multiple objectives can be achieved at the same time. One is to give students the opportunity to repeat the learning content and increase the neural circuits of the brain; the second is to promote the students’ enthusiasm for the curriculum; the third is to solve psychological problems; the fourth is to give teachers accurate confirmations. Peer teaching mainly involves normal conversations.

B. Group discussion: this is a more extensive teaching method. It can strengthen self-communication and promote students’ overall learning interest, self-judgment and observations.

2) Operational practice

A. Obtaining knowledge by achieving actions: if a student grasps learning content through exercise and practice, he/she will gain a more profound understanding of the knowledge.

B. Strengthening understanding through practice: practice must first be related to the knowledge taught by teachers, and then involve imagination and hands-on ability.

C. Applying knowledge in reality

Applying knowledge to solve actual problems and situations, such as learning problems and living conditions.

**Emotional method**

(1) Brain mechanism for emotions

Emotion is closely related to thinking activities and actions. It is important to the brain when it pays attention to information. Emotions establish meanings and influence the way information is processed. Emotions have a special memory path. Personal and emotional responses are retained between the thalamus and the amygdala, putting the information into storage.
If stimulation is received from the outside world, the amygdala receives the message from the hypothalamus, allowing this message to fully enter all body parts and then let the body react quickly to the situation. This reaction is also called stress response. When the stress is too high, the brain network will be reduced, as shown in Figure 5.

However, if the stress is appropriate, epinephrine and norepinephrine will activate the automated response of the body. These hormones enhance the brain's memory of the events that activate stress response, as shown in Figure 6. Excessively low or high stress will lead to poor academic performance, but moderate stress will bring out the best performance of the students. If there is no stress, there will be no learning. But with too much stress, the learning process will be hindered by anxiety and affected by negative emotions.

(2) Classroom teaching strategies
When facing with great stress, students are not able to complete the learning task well. Teachers need to understand that it is not because they are lazy, but because their brains are prone to stress stimulation. Their improper response to stress creates unfavourable conditions for learning. Therefore, helping students face and fight stress can allow them to complete their studies.

1) Establish a harmonious and coordinated classroom environment: a coordinated and warm external condition can stimulate positive influences, while excessively high stress, complicated communication relationships, and disorderly lights all have negative impacts on learning.

2) Improve the teaching environment: a fixed teaching environment, a standardized learning environment, fair treatment of students, guidance of emotional control and timely feedbacks will all enhance students’ learning abilities.

3) Building students’ self-confidence: studies have shown that students’ self-confidence has a lot to do with learning performance, motivation, and their relationship with teachers. It also determines whether they are positive or negative.

4) Giving attention
It means paying attention to students’ learning. Excessively high or low stress will affect their learning. Therefore, giving the appropriate attention will enable students to learn more actively.
Conclusions
(1) This paper reviews and summarizes the internationally advanced teaching conditions and strategies and attempts to explore how to build a more scientific teaching environment based on brain science.
(2) It discusses five teaching methods to address the common problems in postgraduate classroom teaching, including the attention capture, mechanical repetition, elaborative rehearsal, movement and emotional methods.
(3) The five methods are very effective in keeping students concentrated, strengthening their memories and increase their learning initiatives. They provide new ideas and directions for the research on how to improve postgraduate classroom teaching.

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