



Application of Neuroscience in Education

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Abstract

Neuroscience is a part of biology that focuses on systems and nerve cells in the brain. The science of nerve cells and brain work systems has an interesting focal point, which is to find out how the human brain works in every activity and action performed. In the learning process, the application of neuroscience can be said to be appropriate to help the learning process become more optimal by maximizing brain work. That is one of the goals of neuroscience, which is to be able to maximize the work of the learner's brain in the learning process and to make learning more meaningful and more interesting for the students themselves. But, of course, the application of neuroscience cannot be done directly in the classroom. It must go through several connecting aspects first, such as neuroscience, cognitive neuroscience, psychological mechanisms, educational theory and then the classroom. In other words, the application of neuroscience in the teaching process still takes time, considering some of the aspects mentioned earlier.

Keywords: Neuroscience, Learning Process, Maximum Learning

Introduction

Neuroscience in education is a field that seeks to understand how the brain processes and stores information and how this knowledge can be applied to improve teaching and learning strategies.[1],[2]. By studying the neural mechanisms underlying cognition, researchers aim to bridge the gap between neuroscience and education, ultimately improving educational practices and outcomes [1], [3], [4].

This growing field has gained significant attention in recent years as educators and policymakers realize the potential benefits of incorporating neuroscience findings into education policy and teaching approaches.

Neuroeducation is a promising field that has the potential to revolutionize the way we approach education [5]. By uncovering the complex workings of the brain, researchers can develop targeted interventions and personalized learning techniques that meet individual needs and optimize learning outcomes.

In addition, the integration of neuroscience into education can help address learning disabilities and provide valuable insights on how to create an inclusive and effective learning environment for all students. As our understanding of the brain advances, neuroeducation offers promising avenues for improving educational practice and equipping students with the tools they need to thrive in the 21st century.

By analyzing the neural processes involved in learning, neuroeducation can also revolutionize assessment methods used in education. Traditional exams and standardized tests often fail to capture the true extent of a student's knowledge and abilities. However, by incorporating brain imaging techniques, educators can gain a more accurate understanding of each student's strengths and weaknesses, thus enabling more tailored and effective assessments.

This personalized assessment approach can result in more accurate evaluations of student progress and provide input for targeted interventions to address each area of difficulty. Ultimately, the integration of neuroscience into education has the potential to transform the way we teach and learn, creating a more inclusive, effective, and personalized educational experience for all students.

Education today has improved from generation to generation. Still, it will be even more effective if, in this education, we can know how the brain works in processing information and data. Not long ago, there was a new learning process, namely Neuroscience, which is one of the learning processes that examines how the brain works, although it takes a long time to learn it.

But it will feel balanced with the results or effects of neuroscience itself because, thus, every student will know how the brain works and will be able to maximize brain work.

It is also said that neuroscience is a process to be able to find out the work of nerve cells in the brain and how they work so that they can be used better and more optimally. Neuroscience also has the task of explaining every human action or activity that can be seen or revealed in the work of the human brain.

Method

This research is library research and is carried out with qualitative research

methods. The most important thing is the inductive process, and the results are presented in descriptive form, namely, in the form of a series of sentences that describe the real situation in the field. In addition, this study also emphasizes the social processes that occur in Indonesian society with technical data collection from electronic media information sources, print media and information from social media. Based on the information obtained, the author describes the application of neuroscience in education.

Results and Discussion

Understanding Neuroscience

Linguistically, neuroscience is defined as the science of the nervous system, which is, more specifically, the study of nerve cells [6]. If interpreted in terms of neuroscience, it can be interpreted as a field of science (scientific science) about the nervous cell system. Neuroscience is a science with which it studies the brain and all its nerve parts and functions.

If interpreted more simply, then we can conclude that neuroscience is part of human biology sourced from medical science (health). Basically, what regulates all parts of the life of living things is the brain itself, both in humans and animals. Even all activities carried out both consciously and unconsciously are the results of the work of the brain itself [7].

The learning process that uses theory or neuroscience is a process that refers to being able to respond to all parts of the brain, including the nervous system, to work and be used optimally. It can be said that this theory rests on the process or workings of the brain to think so that it can process information or knowledge so that it can produce attitudes, actions and others. The conclusion of the neuroscience task itself is to explain how human activity is processed in the brain [8].

Basic Theory of Neuroscience

It is necessary to know the basic theory of neuroscience can be clarified as follows:

Emotion

Human emotions are based on a system called the thalamus (located in the middle of the brain that functions to regulate the balance of the human body). We take from the Canon that the thalamus is responsible for responding to stimuli or stimuli with which it will later form an emotion by sending messages (impulses) simultaneously to the brain as a whole (cerebral cortex) and transmitted to several other parts of the body.

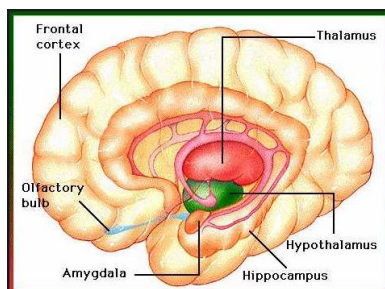


Figure 1. *Thalamus and Amygdala*

The Amygdala is an organ whose almond-like structure is found in the central part of the brain (the Temporal Lobe). In the limbic system or item that processes the emotional balance, there is an amygdala that serves as an emotional and sexual memory.

The Triune Brain Theory

In theory, the triune brain has three levels, namely:

1. The reptile brain is located in the part of the brainstem that plays a very important role in determining the state when a person is faced with a dangerous problem [9]. Other roles are protection, such as when hungry, the

ability to breathe and others, which are done unconsciously.

2. The limbic system, or by another name, the mammalian brain. That is, systems that act as body balance, such as emotional and sexual [10].
3. Neocortex can be called the thinking brain and is a major part of the brain [11]. It is located in the outermost part of the brain, called the learning brain.

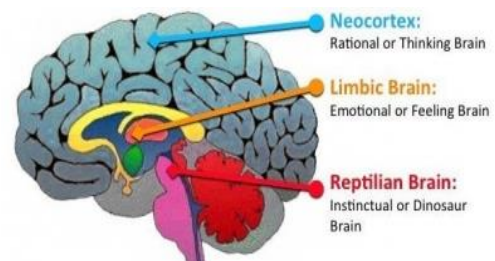


Figure 2. *The Triune Brain Theory*

Left and Right Hemispheres of the Brain

The right brain is the part that thinks effectively and regulates motor movements in the body. At the same time, the left brain is the part that thinks cognitively (knowledge) [10]. The application of knowledge with action means that knowledge in the left brain is applied with action by the right brain [12].

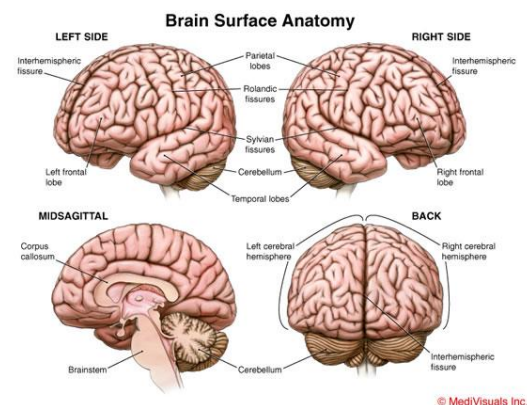


Figure 3. *Left Brain and Right Brain Purpose of Neuroscience*

Science that discusses the nervous system of the brain is either related to consciousness or sensitivity of the brain from a biological point of view [10]. The main goal is to examine every human action and activity from its biological side. So whatever happens either consciously or unconsciously, neuroscience must be able to explain it, that is, how the brain works in these activities or actions.

Several credible studies have presented ample evidence of the close entanglement between the brain and interconnected human behaviour or actions. Several technological instruments play a role in neuroscience, one of which is known as PET (Positron Emission Tomography). With this system, it can be known that six systems in the brain regulate all actions that occur in humans in such a way. The six brain systems are:

1. Prefrontal Cortex Section

The Prefrontal Cortex is a structure in the brain located in the frontal lobe, which is at the forefront of the brain. This part actually represents less than 10% of the brain volume and has a very large role in complex habitual processes. It also influences the formation of habitual personality in a person, such as making decisions and predicting results based on estimates and others. This part develops at puberty and begins to develop almost completely around the age of about 25 years.

2. System Limbic

Limbic System Is a collection of structures that play a role in the formation of emotions, memory, memory, play a role in the learning process, play a role in the body's response to stress and help regulate the autonomic nervous system, which can control unconscious body functions such as hunger, thirst, heart rate and others [11].

3. Gyros Cingulatus

The Cingulatus gyros is the one that acts as a regulator of cognition, affection and promotor.

4. Ganglia Basalis

The basal ganglia are structures that surround a portion of the thalamus of the brain.

5. Lobus Temporalis

Serves to capture information obtained from the ear and also plays a role in the ability to speak.

6. Cerebellum

It has the greatest function in the body, which is to regulate cooperation between muscles, control balance and maintain body structure. All brain systems listed above have their respective functions and roles in regulating human life, ranging from soft skills and hard skills in terms of intellectual intelligence to spiritual intelligence [13].

Among all these aspects, both spiritual and physical, the intellect will have involvement with one another to be able to develop in three aspects, namely IQ, EQ and SQ, during the education or learning process. So, it can be said that human activities and behaviours and even their nature are created with good cooperation between all systems in the brain.

So when we can regulate how the brain system works well, it will automatically have a good impact on human activities and will be able to control it consciously or unconsciously by involving emotions and spirituality. Even in the process of formation and moral education of children, we can explain how the brain system works from a different point of view.

Intelligence and well-being are the result of using the brain well [14]. This reason is what leads the science of brain neuroscience or neuroscience to be a science that can explain the relationship between the brain and soul and even the body of the human being, which means that it can be said that neuroscience is able to

explain the important role of the human brain itself on all activities and activities carried out both consciously and unconsciously [15].

Scope of Neuroscience

The scope of Neuroscience has several parts, including:

1. Cell Parts and Molecules

The human brain has over a trillion nerve cells [16]. This first discussion is the science of being able to know the various kinds of nerve cells contained in the calcium brain, with the functions of each nerve cell clearly and in detail so that these cells can produce both conscious and unconscious activity.

2. Nervous System Section of the Brain

The nervous system is the part that studies the work and function of each nerve cell in the brain to process the information obtained. Just as when a human being sees, the information from what is seen will be conveyed and processed in the visual system, or when a man hears something, then the information from what is heard will be conveyed and processed in the auditory system, and so on for other cases.

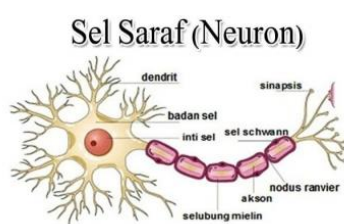


Figure 4. Nerve Cells

3. Behavioural Brain

This behavioural brain, or can be called attitude neuroscience, explains the complex cooperation between the nervous systems so that it can produce a certain activity or behaviour because optimal cooperation between the nervous systems can produce a person thinking intelligently and behaving properly and correctly [17].

For example, when humans receive information from vision and hearing, then

the information will be passed to each nervous system to be processed. Behavior will be produced from the information.

4. Social Brain

In the case of how systems and nerve cells are contained in the brain to explain the formation of social attitudes to relate to others. Humans can interact with others because of factors from the social brain that have a strong relationship to be able to interact with various parts of nerve cells in the brain, called the frontal lobe [15].

Application of Neuroscience in Education

Each child or student has their stages of development, and the development that occurs in students is inseparable from the development that occurs in their brains [17]. This brain development cannot be separated from several factors, such as parents, because cells in the child's brain are also passed down through the genes of his parents when the child is only three weeks old [18]. Therefore, it is very good for mothers who are pregnant to maintain their nutritional intake in order to maintain the development of the child's brain to be good and not disabled due to the error of consuming something.

Children have a nervous system that plays an important role in the formation and development of character and ability. Although neuroscience learning is very influential and has important opportunities in the learning process and character-building of children, this neuroscience cannot be used just like that in the classroom because the learning process in the classroom is different from that in the neuroscience laboratory.

Because of the different variable factors between neuroscience laboratories and conditions in the classroom, we must refer to the five connecting aspects between neuroscience and the classroom proposed by Tommerdhal. The five

connecting aspects start with the neuroscience laboratory and then continue with cognitive neuroscience, psychological mechanisms, educational theory, and learning classrooms. Here are five aspects of connecting neuroscience with the classroom that will give students a good understanding of the learning process [18].

Because neuroscience is included in biology, it is necessary to know that a child's brain can develop automatically or naturally during its development, so attention must be paid to the nutritional intake given to children during the process of brain development, with the purpose of being able to make the child's brain work well and optimally. Thus, in this case, participation between teachers and parents is very important. People play an important role in maintaining children's food and must meet the necessary nutritional intake to maintain children's health.

The teacher's role in providing lessons or learning materials to children must be in accordance with the child's brain capacity so that children do not get excessive pressure in the thinking process that makes them stressed. In accordance with the explanation of the previous brain nervous system, it can be concluded that making an active and fun learning process that makes students participate in the learning process not only as spectators but it can also provides activity to the student's brain to process information so that it will cause development in children to be more optimal.

On the contrary, if the learning used is still passive or does not provide opportunities for students to be active, it will not make the child's brain work actively. As a result, the child will quickly get bored and forget the subject matter that has been delivered. This case is in line with Piaget's opinion, which means that the learning process carried out by the teacher must be able to make students active in carrying out

various activities that are in accordance with the child's ability level [19].

The results of research from educational neuroscience have motivated educators to be able to develop children's brain abilities in the learning process. This approach explains how the brain can be affected by the environment and experiences that make students not forced to learn but encourage students to learn naturally [20].

One example of the application of neuroscience in the educational process:

1. Challenging learning process (Orchestrated immersion). To develop the minds of learners, teachers can create challenging learning environments that can stimulate the child's brain, such as the provision of meaningful problems. Examples of puzzles and attractive and interesting games.
2. Fun learning process (Relaxed alertness). Teachers can make the learning process fun so that it can stimulate students to participate actively during the learning process. Examples of learning outside the classroom are learning with music media, learning in the form of group discussions, learning with interesting simulations and others.
3. Active learning process (Active processing). This process will be able to create certain conditions in the learning process that can awaken all five senses of children to be able to work, such as eyes to observe, hands to write, mouth to discuss and other limbs.

The brain is a very important part of humans because many theories say that it is the brain that distinguishes between humans and animals. After all, animals cannot think like humans [21]. Therefore,

educators need to know how the brain works to optimize the learning process.

Learning with neuroscience gives the message that in the learning process, there is no one-way communication, where only the teacher speaks, and students only listen to what the teacher conveys. In other words, neuroscience changes the passive learning process into active learning.

When teachers are able to maximize learning in accordance with the child's capacity, then children will be able to create new ideas and even be able to solve problems, especially in the present [17]. Someone with good thinking qualities and the ability to compete with maximum ability is a person who always develops his brain by learning in accordance with his brain capacity [9].

Therefore, knowing the nervous system of the brain is very important. The purpose of neuroscience itself is to determine how students are able to think actively because the working process of the brain can be optimized properly so that students can not only hear every explanation from the teacher but also give an idea, find an innovation, and even solve a given problem.

Conclusion

Neuroscience is a science that discusses how the human brain works. It is very important to be able to know how the brain works because it is one way to be able to maximize the workings of the brain in the hope of a better learning process and can achieve the goals of the study. Six parts play an important role in the working science of this brain, namely, the prefrontal cortex, limbic system, cingulate gyros, basal ganglia, temporal lobe and cerebrum. It has scopes such as molecular, cellular, nervous system, behavioural neuroscience and social neuroscience. The role of

neuroscience in education is very influential because it can help to maximize brain work.

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