NEUROSCIENCE-BASED BIOLOGY SCIENCE LEARNING STRATEGIES AT THE ELEMENTARY SCHOOL LEVEL

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ABSTRAK

Neurosains merupakan ilmu yang mempelajari saraf atau otak. Pembelajaran yang efektif tentunya merupakan pembelajaran yang menyesuaikan dengan karakteristik cara kerja otak. Oleh karena itu, penelitian ini bertujuan untuk: 1). mengungkap strategi pembelajaran yang sesuai dengan karakteristik otak; dan 2). mengidentifikasi strategi pembelajaran berbasis neurosains pada pembelajaran IPA Biologi di sekolah dasar. Penelitian ini merupakan penelitian studi pustaka. Analisis data dilakukan secara deskriptif kualitatif. Hasil penelitian ini adalah: 1). strategi pembelajaran berbasis neurosains meliputi tiga komponen, pertama, *orchestrated immersion* yaitu menciptakan lingkungan belajar yang sepenuhnya melibatkan siswa dalam pengalaman pembelajaran; kedua, *relaxed allertness* yaitu berusaha menghilangkan rasa takut pada peserta didik, namun tetap mempertahankan lingkungan yang menantang; ketiga, *active processing* yaitu dengan mengondisikan peserta didik untuk dapat menginternalisasi informasi dengan memprosesnya secara aktif. 2). Dalam pembelajaran IPA Biologi, komponen *orchestrated immersion* dapat diimplementasikan dengan memberikan apersepsi maupun brainstorming yang menyentuh emosi, membangkitkan rasa menantang untuk berpikir, misalnya dengan menyampaikan hal-hal yang menakutkan seperti penyakit-penyakit akibat tidak menjaga kesehatan organ tubuh, menyampaikan teknologi-teknologi terbaru, atau menyampaikan manfaat yang akan didapat ketika mempelajari materi biologi yang akan disampaikan; komponen *relaxed allertness* dapat diimplementasikan menggunakan metode bernyanyi ataupun bermain games pada materi IPA Biologi; dan komponen *active processing* dapat diimplementasikan dengan strategi pembelajaran aktif pada materi yang bersifat analitis dan problematik untuk didiskusikan oleh siswa secara aktif, contohnya seperti pada materi yang berkaitan dengan lingkungan.

***Kata kunci*:** Strategi Pembelajaran, Neurosains, IPA Biologi, Sekolah Dasar

ABSTRACT

Neuroscience is the study of nerves or the brain. Effective learning is certainly learning that adapts to the characteristics of how the brain works. Therefore, this study aims to: 1). uncover learning strategies

that match the characteristics of the brain; and 2). identify neuroscience-based learning strategies in Biology science learning in elementary schools. This research is a literature study research. Data analysis was carried out in a qualitative descriptive manner. The results of this study are: 1). neuroscience-based learning strategy includes three components, first, orchestrated immersion, namely creating a learning environment that fully engages students in the learning experience; second, relaxed alertness, namely trying to eliminate fear in students, while still maintaining a challenging environment; third, active processing, namely by conditioning students to be able to internalize information by actively processing it. 2). In Biology science learning, the orchestrated immersion component can be implemented by providing apperception or brainstorming that touches emotions, and generates a challenging sense of thinking, for example by conveying scary things such as diseases caused by not taking care of the health of the body's organs, conveying the latest technologies, or convey the benefits that will be obtained when studying the biological material to be delivered; the relaxed alertness component can be implemented using the singing method or playing games on Biology science material; and the active processing component can be implemented with active learning strategies on analytical and problematic materials to be actively discussed by students, for example, in materials related to the environment.

Keywords: *Learning Strategy, Neuroscience, Biology Science, Elementary School*

INTRODUCTION

Learning is a change in behavior that occurs through practice or experience where the changes that occur are relatively permanent and involve personality both physically and psychologically (Purwanto, 2006). The understanding of learning conveyed by educational and psychological experts also has the same point, namely always paying attention to changes in behavior caused by certain experiences (Hanafy, 2014). These behavioral changes include thinking (cognitive), feeling (affective), and behavior (psychomotor). However, behavioral changes in learning outcomes always involve a thinking process first (Novitasari, 2016). As we know that the center of the thinking process is the brain, so of course, there is a close relationship between brain function and success in learning.

Neuroscience is a science that has a special field of study on nerves, with the brain as its center. All human activities are controlled by the brain as the center of regulation and integration. Thinking, emotional, motor, and spiritual activities are all integrated by the brain. This science includes the form and function of parts of the brain, how the brain works, psychology (behavior and emotions), thought processes (cognitive science), to medical science about brain diseases (Taruna,

2015, p. 2). Therefore, it is important for teachers to learn this knowledge, so that the learning process carried out is by the characteristics of how the brain works so that the results are expected to be more effective. Learning that does not pay attention to how the brain works will certainly make the learning process less effective and reduce the quality of learning outcomes.

Based on the background that has been described, this research aims to: 1). uncover learning strategies that match the characteristics of the brain; and 2). identify neuroscience-based learning strategies in Biology science learning in elementary schools. This research is expected to be an additional insight for readers and teachers in particular in implementing neuroscience-based biology science learning strategies in elementary schools to improve learning effectiveness.

This study uses a qualitative research approach with the method used is the literature study method. According to Nazir (1988), a literature study is a technique of collecting data by conducting a review study of books, literature, notes, and reports that have to do with the problem being solved. After the data was obtained from various references, the analysis was carried out using Miles and Huberman analysis which consisted of three stages, namely data reduction, data display, and conclusion. At the data reduction stage, the main things are selected, focusing on the important things related to the research theme. At the stage of presenting the data, it is done by making narratives or data descriptions to make it easier to understand the data so that it is easier to conclude. The conclusion drawing stage is the result of research that answers the research problem formulation (Sugiyono, 2012, p. 345).

DISCUSSION

Brain structure and function

Paul MacLean (1978), revealed that the human brain consists of three parts, namely the reptile brain, the limbic system, and the neocortex (Nummela & Rosengren, 1986). The reptile brain is the first part of the brain located at the base of the brain. Called the reptile brain because its function is very similar to the reptile brain that reptiles have. The reptile brain is a center for sensory and instinctive behavior that has the task of regulating basic needs such as survival, reproduction, and self-care. In addition, the reptile brain also takes on the responsibility of controlling autonomic bodily functions, such as heart rate, lung respiration, and body temperature regulation. It is because of this function that the reptilian brain is said to be animalistic and primitive, acting on passion. The reptile brain is also associated with the function of spontaneous behavior (fight or flight) when there is a threat or pressure. It is active when a person feels fear, stress feels threatened, anger lacks sleep, or is tired. Some of the traits associated with the reptile brain include aggression, dominance, looking for a partner, sex, bigotry, obsession, compulsion, and greed (Raharjo, 2019).

The second part of the brain is the limbic system or mammalian brain. This section encloses the brainstem with the hypothalamus and amygdala as its main components.

The limbic system plays a major role in emotional and cognitive regulation. One example of the function of the limbic system as an emotion regulator is when someone does something that involves deep emotions, then he will remember it in the long term so that it is not easy to forget (Raharjo, 2019). The role of emotions in learning is very important, students who have good emotions towards teachers and their environment will support students with the ability to process new information. Conversely, students' negative emotions will cause students to experience obstacles in learning (Nummela & Rosengren, 1986, p. 100).

The third part of the brain is the neocortex (thinking brain). The neocortex is at the top and constitutes 80% of all material in the human brain. This section controls higher-order processes such as logic, reasoning, creative thinking, language, and the integration of sensory information. So this part of the brain is the main part of students to process information while studying (Raharjo, 2019).

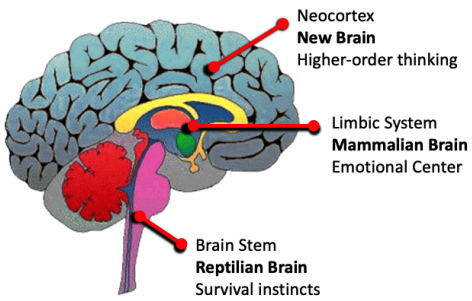

Figure 1. Triune Brain Theory
source: www.pamelarutledge.com

Cognitive development of elementary school-age students

According to Piaget's cognitive theory, the cognitive development of elementary-age children is divided into two phases, namely the first concrete operational phase (ages 7-11 years) and the formal operational phase (11-12 years and over). The concrete operational phase is a phase where children can think logically, rationally, scientifically, and objectively about something concrete or real. At this phase, in conveying the material, the teacher needs to convey it in a real, not abstract way. The learning process carried out also needs to be contextualized into students' real lives, for example by using direct examples (modeling) and doing practice (experiments) (Bujuri, 2018, p. 49).

The formal operational phase (11-12 years and over) is a phase where students can think about something that will or might happen (hypothesis) and something abstract. In this phase, students can think critically and think at a higher level. Students can use hypothetical-deductive thinking and think systematically in compiling steps to solve problems. Learning has been able to use constructivism and inquiry models that require high reasoning and require students to think actively, argue, and draw meaning from real and abstract things (Bujuri, 2018, p. 49).

Neuroscience-based learning

Caine & Caine, (2016) explain twelve principles regarding brain function in teaching and learning activities, namely: 1). the brain is a parallel processor, meaning it can perform several activities at once; 2). learning activities involve all physiological functions of the body, meaning that the brain and body parts are connected when learning; 3) the search for meaning is innate, meaning the need to understand everything is a characteristic of every

human being from infancy to adulthood. 4). The search for meaning occurs through pattern formation, meaning that the brain encourages someone to find and create patterns and relationships in understanding the meaning of something. 5). emotions are very important to make patterns, meaning that involving the role of emotions is very important to make patterns in understanding the meaning of something; 6). the brain processes part or all of the information simultaneously, meaning that the brain understands information from a holistic/wholesome perspective; 7) learning requires focused attention with a broad perspective; 8). learning involves both conscious and unconscious processes, meaning that the learning process does require an analysis process that is carried out consciously, but an unconscious thought process can also bring up intuition that influences learning; 9). brain memory consists of two types, namely explicit memory that can appear intentionally, and implicit memory that appears unintentionally; 10). learning is a development, meaning that learning is built from previous learning and experience; 11). the learning process is enhanced by challenges and hampered by threats, meaning that the most optimal mind for learning is in a state of alert but relaxed, not fearful; and 12). Each brain is unique, meaning that learning styles and ways of storing information vary from person to person.

Based on the principle of the brain in learning, Caine & Caine (1994) then describe three interactive components related to brain-appropriate learning: 1). orchestrated immersion, namely creating a learning environment that fully engages students in the learning experience; 2). relaxed alertness, namely trying to eliminate fear in students, but still maintaining a very challenging environment; and 3). active processing, namely conditioning students to be able to consolidate and internalize information by actively processing it.

Biology Science Learning in Elementary School

Learning in Elementary Schools in the 2013 curriculum is integrated thematic learning. Thematic-based learning activities are based on a theme which the theme consists of several subjects that are combined into a theme (Sari et al., 2018, p. 1572). Therefore, Biology science learning at the elementary school level is also included in the learning themes.

According to Carin (1997), biological science essentially contains 4 elements, namely: processes (scientific processes), products (scientific knowledge), attitudes (scientific attitudes), and technology (Sudarisman, 2015, p. 31). So in teaching Biology science material, it must include these four elements in the learning. Specifically, the basic materials or competencies of Biology in elementary schools began to appear in grades 4th, 5th, and 6th which were included in the learning themes. The list of basic school-level Biology science materials is presented in Table 1.

Table 1. Elementary School Biology Science Subject Matter

No.	Grade	Biological Material
1.	4th	Functions of body parts in animals and plants

		The life cycle of living things and their preservation
		Conservation of natural resources in the environment
2.	5th	The organs of locomotion and their functions in animals and humans
		Respiratory organs and their functions in animals and humans
		Digestive organs and their functions in animals and humans
		Circulatory organs and their functions in animals and humans
		Components of ecosystems and food webs
		The water cycle and its impact on events on earth
3.	6th	Reproduction of plants and animals
		Reproduction system
		Types of adaptation in living things

Neuroscience-based Biology Learning Strategies in Elementary Schools

As previously explained, the learning strategy that is by the characteristics of the brain according to Caine & Caine (1994) includes three components, namely: 1). orchestrated immersion; 2). relaxed alertness; and 3). active processing.

The orchestrated immersion strategy aims to create a learning environment that challenges students to think so that students feel involved in the learning experience. This strategy can be implemented by providing apperception or brainstorming that evokes a sense of challenge for students' thinking. Apperception and brainstorming given to students should be the delivery of information related to biological material that impresses or stirs students' thoughts or emotions. Examples of this apperception, are by conveying scary or negative things, such as diseases in the human body due to not taking care of health-related to the biological subject matter of organs and their functions, conveying the latest technologies related to the biological material to be delivered, or conveying the benefits that will be obtained when studying the biological material to be delivered. Giving apperception aims to arouse positive emotions and positive thoughts of students. This is because students' positive emotions are beneficial for information processing and call for student involvement in learning (Nummela & Rosengren, 1986). In addition, this strategy can be pursued by providing questions that are packaged in a variety of ways and attractively. These questions are to facilitate students' thinking skills so that they are accustomed to developing their thinking skills and in the context of involving students in learning experiences (Chamidiyah, 2015).

The relaxed alertness strategy aims to create a fun learning situation but still has a challenge. This strategy can be implemented with entertainment or fun learning models, but still accompanied by competitions in the form of assessments or competitions that

have rewards. For example, this strategy can be conveyed using the method of singing or playing games. In applying the singing method, it can be done by inserting poems or lyrics derived from Biology science concepts into a familiar song. Biological concepts that are suitable to be used as song lyrics should be concepts that require a lot of memorization. The concept is an example of the material names of organs in human body systems, animals, and plants. Strategy for playing games can be done by playing smartly, crosswords, snakes and ladders, etc. which contains answers about concepts in Biology Science. Games function as learning evaluation tools that are fun as well as challenging and increase students' learning motivation (Anjani et al., 2016, p. 1790).

The active processing strategy aims for students to learn independently to actively seek and build their knowledge. So, this strategy is suitable to be implemented with an active learning strategy, because active learning provides a role for students to seek information or solve problems independently. This strategy can be applied to group discussions and information seeking (Zaini, 2009, p. 5). The application of this strategy to Biology Science material will be more appropriate to be applied to materials that are analytical and can raise problems for students to discuss. Examples of such materials are material on the life cycle of living things and their conservation, preservation of natural resources in the environment, components of ecosystems and food webs, and the water cycle and its impact on events on earth. The main points of these materials are directly related to the environment so that contextual problems related to the environment can be searched for by students to be discussed. The discussion is to find information and solutions to overcoming these problems while at the same time fostering environmental awareness among students.

CONCLUSION

Neuroscience-based learning strategies include three components: 1). orchestrated immersion, namely creating a learning environment that fully engages students in the learning experience; 2). relaxed alertness, namely trying to eliminate fear in students, while still maintaining a challenging environment; and 3). active processing, namely conditioning students to be able to internalize information by processing it actively.

The application of neuroscience-based learning in Biology science subjects includes: 1). the orchestrated immersion component can be implemented by providing apperception or brainstorming that touches emotions, generating a sense of challenge for students' thinking, for example by conveying scary or negative things, such as diseases in the human body due to not taking care of the health of the body's organs, conveying the latest technologies, or convey the benefits that will be obtained when studying the biological material to be delivered; 2). the relaxed alertness component can be implemented using the singing method or playing games on Biology science material; 3). active processing components can be implemented with active learning

strategies on Biology science material which is analytical and can bring up problems to be discussed and solved by students actively. Suitable materials are materials related to the environment.

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