INNOVATIVE APPROACHES TO EDUCATIONAL PROCESS

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Abstract: Innovations appearing in educational practice also in Slovakia are represented by several terms such as neurodidactics, neuropedagogy, brain-compatible learning, and brain-based learning. It is a field that respects multidisciplinary approach. Neuroscience is a basis for this innovative point of view that is focusing not just on brain processes happening during learning, but also on lesson planning respecting and developing pupils' individuality.

Keywords: innovations, neuroscience, brain-based learning, brain, fundamental principles of the learning process

1 Neuroscience as a basis for innovations

N*euroscience* identifies the subject matter of the investigation rather than the scientist training. A neuroscientist may be a biologist, psychologist, anatomist, neurologist, chemist, psychologist, or psychiatrist – even a computer scientist or a philosopher (Garrett, B., 2009). Briefly, neuroscience is a multidisciplinary study of the nervous system and its role in behavior. B. Garrett (2009) further mentions that a psychologist who works in the area of neuroscience specializes in biological psychology, or biopsychology, i.e., the branch of psychology that studies the relationship between behavior and the body, particularly the brain (sometimes the term psychobiology or physiological psychology is used).

To find out where neuroscience and the classroom link up, it is necessary to explore these areas in separately. Every pupil in a classroom comes to school with a brain customized by life experiences. Pupil's life experiences have a huge effect on their learning. Their neural history is not just the grades and test scores. A seemingly trivial accident, such as a bump on the head at a summer camp, could create a brain insult in the anterior ventral temporal lobe, an area responsible for certain types of semantic memory. This means that although a pupil's memory may be good for common names and places, it is poor for proper names and places. This type of memory functioning is common, yet it puzzles teachers who think that a pupil is simply not trying hard enough. After all, if pupils can learn and recall some types of words, why cannot they do that with all of them? The brain's unique history is the answer.

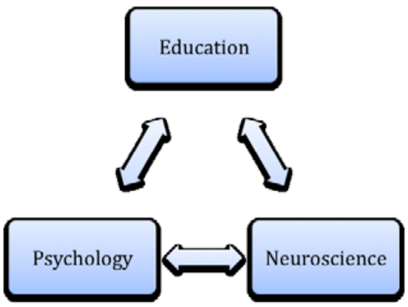

Figure 1 The Flow of Information in MBE Science. (In: Tokuhama-Espinosa, T., 2010)

The increasing interest in the learning brain is reflected by recent publications that focus on the connection between brain development and learning (Blackmore, S. J. - Frith, U., 2005; Hüther, G., 2002; Ratey, J. J., 2001; Spitzer, M., 2002, 2006; Stern, E., 2005; Stern, E., et al., 2005).

In 1988 G. Preiss, professor of didactics at the University of Fribourg, a specialist in early childhood mathematics education for youngest between two and a half and seven years, has pioneered programs that combined neurological research with math education and are based on a holistic approach to education. He propounded the introduction of an autonomous subject based on brain research and pedagogy that he called neurodidactics. According to this new discipline, school pedagogy and general didactics must attach more importance to the fact that learning lies in brain processes and that cognitive results keep up with the development of a child's brain. By taking this into account, one may say that neurodidactics studies the conditions under which human learning can be optimized to its highest level.

Neurodidactics is an interface between neuroscience, didactics, pedagogy and psychology. It tries to work out principles and proposals for effective learning based on the findings of brain research.

A new branch of education theory appeared that attempts to relate teaching strategies and learning modalities to the hard facts of brain research. This new learning theory called "neurodidactics" or "neuropedagogy" referring to brain-based learning came under debate in Europe recently (Caspary, R., 2006; Herrmann, U., 2006; Preiss, G., 1998; Spitzer, M., 2006).

Term related with neuroscience and neurodidactics is *brain-based education.* We can find various answers on frequently asked question "What exactly is brain-based learning"? N. Call (2010) says that „brain-based learning is a term used to describe how to apply theories about the brain to help children to maximize their potential for learning". She further writes that if you once understand the theory behind brain-based learning, then you can put its various aspects into practice and enhance the learning of the children - pupils in the classroom.

It is important to know method of working that derives from an understanding of the current research into how the brain develops.

Brain-based education is, according to E. Jensen (2008), best understood in three words: *engagement, strategies,* and *principles.* Brain-based education is the engagement of strategies based on principles derived from an understanding of the brain. It is not based on strategies given to us from neuroscientists. That is not appropriate. He further states that brain-based learning in accordance with the way the brain is naturally designed to learn. It is a multidisciplinary approach that is built on this fundamental question: What is good for the brain? It crosses and draws from multiple disciplines, such as chemistry, neurology, psychology, sociology, genetics, biology, and computational neurobiology. It is also a way of thinking about learning. It is a way of thinking about teacher's work. It is not a discipline on its own, nor is it a prescribed format or dogma. In fact, a "formula" for it would be in direct opposition to the principles of brain-based learning.

Although a brain-based approach does not provide a recipe for us to follow, it does encourage us to consider the nature of the brain in our decision making. By using what we know about the brain, we can make better decisions and reach more learners, more often, and with fever misses. Quite simply, it is learning with the brain in mind.

2 Brain of pupils and the learning process as a basis for innovations

Brain-based education considers how the brain learns best. The brain does not learn on demand by a school's rigid, inflexible schedule. It has its own rhythms. If we want to maximize learning, we first need to discover how nature's engine runs. This singular realization alone has fueled a massive and urgent movement worldwide to redesign learning. What we thought was critical in the past may, in fact, not be very important at all.

As M. L. Slavkin (2004) says, brain is “not only the control center of the entire human body, organizing our behaviors and biological functions, but it also is the seat of our humanity. It defines who we are, how we act, and the very nature of our species.”

To understand behavior and pupil’s activity at school, we must understand how the brain works. And to understand how the brain works, we must first have at least a basic understanding of the cells that carry messages back and forth in the brain and throughout the rest of the body.

The basic and short anatomy of the brain is taken from publication of N. Call (2010). At the micro level, the human brain consists of about one hundred billion nerve cells, called *neurons*. These neurons can be thought of as very simple data processors, which work together to solve a particular problem as it is presented to the brain. The human brain is able to easily perform tasks that the largest, most expensive computers today find impossible to accomplish. Neurons develop *axons* for transmitting information to other neurons and *dendrites* for receiving information. As patterns of thought are first initiated and subsequently repeated, the participating neurons continually process and communicate. In doing so, they build stronger and more direct axon-to-dendrite pathways – called *synapses* – to other neurons. In other words, with repeated stimulation, these connections become even stronger and more established, and the brain has in effect “learned” how to solve that particular problem. At this point, the brain is ready to undertake further learning. Interestingly, those neurons that do not generate synapses quite literally die off.

At the macro level, the brain can be thought of in three parts: *brain stem*, the *limbic system* and the *cerebral cortex*. These parts of the brain are divided again into specific areas, each with an individual and complex role to play. Some areas process information gleaned from the senses, while others process different aspects of our emotional responses. Some are responsible for laying down certain types of memory, while others help us to “read” cues from other people and make appropriate emotional and physical responses.

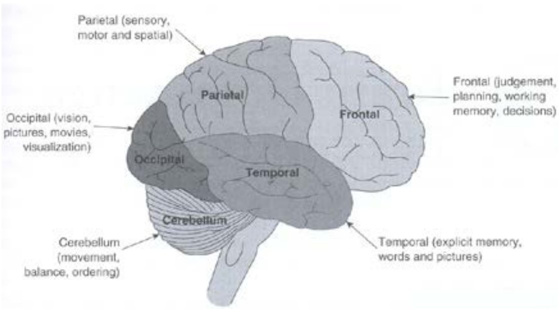

Figure 2 Lobes of the human brain. (In Jensen, E., 2008)

As we become more informed about the functioning and capability of the human brain, we can become increasingly effective in helping our pupils to learn. Scientists are helping to inform our school practice more now than ever before.

3 Fundamental principles of brain-based learning

The most important change for education is to understand how human beings learn and place that understanding at the very center of teaching. To make sense of the vast amount of research that has been generated in fields ranging from psychology to biology and neuroscience, the Caines (Caine, R. N., - Caine, G., 2009) developed a set of 12 Brain/Mind Learning Principles (Figure 2) that summarize what we presently know about learning. The principles were based on a view of human beings as living systems. Each principle had to meet four basic criteria:

1. The phenomena described by a principle should be universal. A brain/mind learning principle must therefore be true for all human beings, despite individual genetic variations, unique experiences, and developmental differences.

2. Research documenting any one specific principle should be evidenced in, and its influence must span more than, one field or discipline. Since a learning principle describes a system property, one would expect it to withstand validation and confirmation by triangulation of research that crosses multiple fields and disciplines.

3. The principle should anticipate future research. It should be expected and anticipated that research will continue to emerge that refines and confirms each brain/mind learning principle. For example, much of the brain research on the links between emotion and cognition was published after the first formulated principles in 1990. One example is the discovery of mirror neurons. Thus, a principle is a continuous work in progress, in the sense that new perspectives and ongoing research are constantly shaping and advancing our understanding of it.

4. The principle should provide implications for practice. By their nature, principles are general so they cannot be expected to tell educators precisely what to do. However, effective learning principles ought to provide, as a minimum, the basis for an effective general framework to guide decisions about teaching and help in the identification and selection of appropriate methods and strategies. Principles illuminate new sparks of *capacities for learning* which can be translated into further enhancements of instructional practices.

These principles were originally spelled out in the book *Making Connections: Teaching and the Human Brain* (Caine, R. N., - Caine, G., 1994). The principles look at all learners as living systems where physical and mental functioning are interconnected (learning is “psychophysiological”). As a result, *no principle is more important than another one. They are numbered for identification purposes only.*

Figure 2 12 Brain/Mind Learning Principles in Action. (In Caine, R. N. et al., 2009)

The principles help us understand why it has been so difficult to agree on what it means to learn. They show that several different processes are involved. The key to effective educational renewal is to integrate those different aspects of learning into the way we teach:

· For some, the primary aspect of learning is memorization, and the brain/mind is designed (in part) for memorization.

· For some, the primary aspect of learning is intellectual understanding, and the brain/mind is designed (in part) for intellectual understanding.

· For some, the primary aspect of learning is making intellectual and practical sense of experience, and the brain/mind is designed (in large measure) for making sense of experience.

· As more aspects of the principles are understood and implemented, the range of what is meant by pupil learning expands.

Three interactive elements emerging out of the principles are:

1. Relaxed alertness.

2. Orchestrated immersion in complex experience.

3. Active processing.

All of the principles and capacities suggest that there are three fundamental components or great teaching mentioned above. They are the foundation for professional development and must be mastered by teachers and understood by all educators. Authors address each principle separately, but it is critical to understand that each of these elements has a profound effect on the other two and is, in fact, never separate.

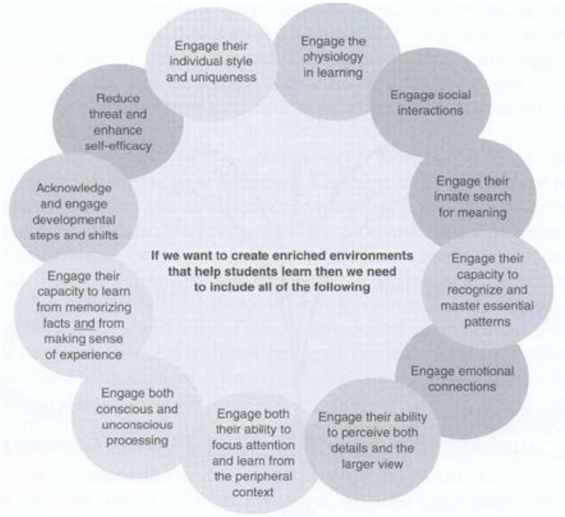

Figure 3 Learning capacities. (In Caine, R. N. et al., 2009)

How do educators implement fundamental principles of brain-based learning? To begin with, the principles tell us that every learner has immense and specific capacities for learning that teachers can and must address. In essence, learning based on biology is natural. Brain/mind learning capacities create enriched environment for learning. According to these principles, all learning engages the following (Figure 3). Our task is to orchestrate learning so that as many aspects of learning are engaged as possible.

4 Conclusion

It is important to know that humans learn in many ways, including sensitization, habituation, conditioned responses, semantic learning, imitation, and by doing. Many of these processes are not well understood. And although they may share parts of a pathway, we are each unique, and the different input is processed differently.

The center of the creative and humanistic style of teaching is a pupil, and it requires a creative teacher in particular. It means that a teacher that is not afraid of verify new teaching procedures, knows how to work flexible with curricula and textbooks, but also supports new projects and avoid the routine work in the classroom.

Brain-based learning is trying to implement the principles on the neuroscientific base and support creativity, use variable teaching methods, long-term memory strengthening, create enriched environment as well as relaxation and coping strategies.

Learning involves changes in strength synapses, the connections between neurons in the gray matter. Based on the findings of brain research, the brain-based teaching provides principles and proposals for effective teaching and learning. The main goal of these principles is to intervene in pedagogical practice. Not all of them are brand new, but they confirm the theories and principles of progressive pedagogy and prove that they are effective. Therefore, an integration of brain-based learning in the teacher training would be desirable.

Each pupil brings a unique personal neural history to school every day that gives teachers quite a challenge as they try to customize learning for each pupil. This uniqueness makes a strong case for legitimacy of different learning styles, a variety of learning strategies, multiple intelligences, and the role of appropriate choice. So while the history of a pupil (and his or her brain) does influence learning, it does not determine the learning. Even in the moment, it is how a pupil feels about the learning that plays as big part as anything. When pupils feel safe, exploratory, challenged, supported, and confident, miracles often happen. These miracles are the result of the triumph of environment over genetic makeup in the pupil`s brains. Scientists now know that our genes are susceptible to environmental input.

We live in a time in which a "revolution" in education is occurring. Through brain research and technology, we have unlocked many of the reasons why some children experience so much difficulty in learning. We know more about effective teaching practices than at any other time in history. Through technological advances, we have a whole world as our resource base. In addition, teachers are finally being empowered to make to choices that affect their classrooms.

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