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**NUEVAS METODOLOGÍAS DE ESTIMULACIÓN
PARA EL PROCESO DE ENSEÑANZA APRENDIZAJE**

NEW STIMULATION METHODOLOGIES FOR THE LEARNING TEACHING PROCESS

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Resumen

Este artículo a partir de los mediocres resultados del programa internacional para la evaluación de estudiantes (P.I.S.A.) para España y viendo que el alumnado español está por debajo del promedio general de acuerdo con la organización para la cooperación y el desarrollo económicos (O.C.D.E.), presenta líneas de actuación para que la competencia de nuestro alumnado mejore. El director de las pruebas P.I.S.A., recomendó a España, para obtener mejores resultados académicos, trabajar menos la capacidad de memoria y desarrollar más las habilidades de resolución de problemas de la vida diaria. Además, animó a los docentes a crear pensadores que participen en el trabajo en equipo y en actividades más creativas. Como buenos profesionales, tenemos la obligación de enseñar a nuestro alumnado la capacidad de autodescubrimiento, a desarrollar un pensamiento crítico. De hecho, nuestro alumnado debe aprender a aprender y, para ello, hemos considerado que la nueva metodología que ofrece la neurodidáctica, se adapta a las necesidades de nuestro alumnado. Las conclusiones de este artículo presentan propuestas de mejora en lo referente al ámbito educativo.

Palabras Claves

Aprendizaje activo – Disponibilidad para el aprendizaje – Metodología – Motivación

Abstract

This article based on the results of the programme for international student assessment (P.I.S.A.) for Spain and seeing that Spanish students are below the general average according to the organization for economic cooperation and development (O.E.C.D.), presents lines of performance so that the competence of our students will improve. The director of P.I.S.A. assessment recommended Spain in order to acquire better academic results, to work less memory capacity and to develop more problem-solving abilities of daily life. Furthermore, he encouraged teachers to create thinkers to participate in team work and in more creative activities. As good professionals, we have the obligation of teaching our students the capacity of self-discovery, of personal opinion. In fact, our students should be able to learn how to learn and in order to do so, we have considered that the new neurodidactic methodology adapts to our student's needs. The conclusions of this article present proposals for improvement regarding the educational field.

Key Words

Active learning – Availability for learning – Methodology – Motivation

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What is Neurodidactics?

The 90s was the decade of the brain when new sciences such as cognitive psychology¹ and neurosciences emerged. We can define neuroscience as the study of the biological basis of human behaviour. In this article we will use the term neurodidactic neuroscience to understand how the brain works when applying it for the learning process of our students.

“The term Neurodidactics was born in Germany in 1988 from the fusion between various disciplines such as education, psychology and neurosciences in an attempt to understand the aspects of neurodevelopment that influence learning and use this knowledge to create new methodologies in the classroom to optimize the teaching-learning process.”²

We must consider what³ says about teaching and learning which are two processes that are linked and they condition each other. Learning involves the treatment, storage and active recovery of the information we have received, and teaching should help those who wish to learn so that they can conveniently develop their skills to process information and regularly apply it to solving any type of problem.

According to Gamo⁴ neurodidactics aims to use the knowledge of neurosciences to apply methodologies within schools. He also hopes that in the future neurodidactics will include the objectives of education.

The questions he addressed in his origins were: Does the usual and traditional method of teaching, that of “each teacher has his way, have a scientific basis”?

Are traditional mechanical repetition duties effective?

Is it possible to make a competency assessment through a classic 10-question exam in one hour?

Benefits of Neurodidactics

The functional knowledge of the brain allows us to more easily identify the causes of a particular learning problem, and in that way, it helps us to design appropriate methodologies that can be used in the classroom. In this sense, the new technologies - ICT - are having a relevant role to speed up the learning process, make it more attractive, motivating, collaborative, communicative and visual, qualities, that from the viewpoint of neurodidactics, are seen as essential. The principles of neurodidactics show us that the brain learns much better if learning occurs in a fun, spontaneous, active and creative state.

¹ Cognitive psychology is the scientific investigation of human cognition, that is, all our mental abilities – perceiving, learning, remembering, thinking, reasoning, and understanding.

² Elena Morán, ¿Qué es la Neurodidáctica? <https://www.smartick.es/blog/educacion/que-es-la-neurodidactica/> 2019 (Consultado el 30-11-2019).

³ Eric Jensen, *Cerebro y aprendizaje: competencias e implicaciones educativas* (Madrid: Narcea Ediciones, 2003)

⁴ Diario El País, España, José Ramón Gamo: *Aprendemos juntos*, 2015 <https://aprendemosjuntos.elpais.com/especial/los-ninos-aprenden-haciendo-jose-ramon-gamo>. (Consultado el 3-11-2019)

Gamo⁵ says that as brain scans show us, the acquisition of a new competence or ability causes the activation of the right hemisphere of the brain (visuospatial processing). However, reality shows us that in traditional education we do just the opposite of the natural learning process, because we expose students to a transmission of information by oral means and then we expect them to learn through reading. Therefore, in order to acquire new learning, we must turn to audio visual media and to practical and dynamic activities. When the information is already learnt and the competence is acquired, brain activity is fundamentally transferred to the left hemisphere and that is when the traditional methodology makes sense.⁶

Another classic error of conventional education according to Gamo is to remain static in the classroom, while neuroscience teaches us that less dopamine is released when we are sitting still. This means less activity in the prefrontal cortex which is fundamental in the learning process. That is, there is neuroscientific evidence that we must use in the classroom to better our teaching practices.

Based on the study of the brain, we now know with scientific evidence that:

There are more effective methodologies than the traditional ones that adapt to the brain's natural way of functioning in the face of learning challenges.

We know that we can train students with a truly adequate intensity that meets their expectations and can be measured and evaluated.

It allows us to generate a truly competitive teaching-learning practice, where children will transfer their abilities through learning, to a competence.

Individual abilities can be trained, because the brain is very plastic. It learns by doing and the training load is what makes it possible to enhance mental abilities.

Every teacher should ask these 3 questions: what are we teaching for, what do we have to teach and how do we have to teach. This is where neurodidactics offers us more knowledge and resources to answer how to most effectively teach students.

In summary, we can say that teachers should teach in order to enable students to solve real problems in their daily lives.

Basic principles of neurodidactics

“Learning requires an active role of the learner. In the case of students, it is essential that they are the protagonists and responsible for the process. Learning works best if the rhythms, interests and needs of each individual are respected. Advances in neuroscience show that learning requires exploration, search for meaning, reasoning and understanding. The mere exposure of content is not learning. Emotions have a great implication in learning.”⁷

⁵ José Ramón Gamo, Integratek, 2018 <https://vimeo.com/297285007>(Consultado el 10-11-2019).

⁶ Neurodidactics: the great opportunity for the paradigm shift in the classroom. Video.

⁷ Celia Rodríguez Ruiz, Educa y Aprende, 2019 <https://educayaprende.com/neurodidactica> (Consultado el 14-11-2019).

Physical activity, recess and movement in the classroom reduce stress and stimulate learning. The social conditions of the students influence their school life and their academic results. The brain is a plastic organ, so neurogenesis can be induced through the development of cognitive and emotional skills, reading, meditation, artistic training and enriched educational environments. Acute and chronic stress has a negative impact on behaviour and learning. Each brain is unique and different in its maturation, so a differentiated education must be offered based on the abilities, talents and interests of each student. Excessive content and long teaching times saturate the working memory, making memory and learning processes difficult. Artistic training has a positive impact on learning, both, in cognitive and emotional and social skills. Emotions influence learning and the school should teach appropriate emotional and social skills to improve the academic performance of students. Learning disorders and delays can be improved and even overcome by brain plasticity if appropriate educational programs are used. The memory is not fixed but malleable, so to remember learned concepts requires continuous practice and content review⁸.

General proposals of neurodidactics

Some formulas, which according to Rodríguez Ruiz⁹ serve a neurodidactic approach are:

The use of the inverted class or what is more recently known as flipped class. It is inverting the traditional model of the classes. The children are now the ones in charge of searching and developing the contents of the class at home, on their own and taking advantage of the class time to do work and ask the teacher about their doubts. The educator serves as a guide, as a scaffolding for the students' learning.

To work in small groups and cooperative learning. Students are responsible for their learning process; they elaborate and interpret the information. Cooperation learning among them favours their learning. To give active role to children in their learning. And to allow children to follow their own learning pace.

To use interactive ways of exposing information through videos, concept maps, etc. The information should be briefly exposed. It will be the children who investigate, experiment and explore to give meaning to the information and to create their own learning. To have Flexible classes paying attention to some students' needs, which they will normally be due to learning difficulties or due to certain deficits of basic or instrumental knowledge. To follow dynamics based on play and fellowship and to try to adapt a specific method for each boy and girl. Gamo¹⁰ considers that there are more important subjects than we think. He declares that physical education, music or arts are becoming increasingly relegated. However, we know that regular physical exercise facilitates learning by modifying the brain's chemical and neuronal environment. He also says that Physical education class early in the morning can improve academic performance and that Arts allow children to know their surroundings, which is essential for healthy brain development.

⁸ Eric Jensen, *Cerebro y aprendizaje: competencias e implicaciones educativas* (Madrid: Narcea Ediciones, 2003).

⁹ Celia Rodríguez Ruiz, *Educa y Aprende*, 2019 <https://educayaprende.com/neurodidactic> (Consultado el 14-11-2019).

¹⁰ José Ramón Gamo, *Integratek...*

He also states that we learn through all the senses and the more channels through which the information reaches us, the better and that we also need to be surprised to learn: Neuroscience confirms that novelty originates in the right cerebral hemisphere, until it becomes a routine and passes to the left where it is stored. This suggests that it may be more convenient to start the class explaining new concepts, rather than reviewing the contents of the previous day. Gamo also declares the importance of rest in learning: Neuroscience has proved the effectiveness of inserting classes with breaks to consolidate learning. For each 45-minute session, we should have five minutes of relaxation. However, because of the large amount of annual content that has to be covered by teachers, it is difficult to respect these times. In addition, it has been shown that sleep is the only way to transfer that what has been learned to our long-term memory.

The idea that we only use 10% of our brain is a widespread myth. The brain images that current technology affords us, show that all parts of our brain have some level of activity at all times. The same happens in the learning process. For Gamo music exerts a powerful influence on the human mind and its study allows students to develop hearing, fine motor skills, intuition and temporal space reasoning.

He exposes that the more projects in groups the better as with projects carried out by groups we get several benefits. On the one hand, we get the student to become more involved in their own learning, since we encourage the child to discover new things for himself and also get excited about them. In addition, our brain is a social organ that learns from the knowledge of others.

We do not have to forget that the brain needs to learn effectively from emotion and motivation. These two factors make it easier for students to learn what is installed in areas such as the hippocampus which is responsible for long-term memory.

New technologies are important for him but also the use of paper and pencil. A good foundation of learning always incorporates in contact with hands and manipulation. It is not the same to write a word on paper as on a screen. It is not about eliminating all the technological means in a classroom, but it is essential that we know that in the development of writing and graf motricity, the frontal lobe region is activated, which allows students to pay attention for longer. The last topic but not the least important is that the more individualized the education, the more effective: Neuroscience has proved something that was already intuited: that the more individualized the education, the greater the student's performance.¹¹

Applied neurodidactics.

The great opportunity for change in learning

“Neuro-didactics is not an educational method. It is the application of the knowledge that neurosciences give us regarding how natural learning processes are adapted to teaching processes and it helps us select the methods that best accompany these natural learning processes and when they are most appropriate”¹²

¹¹ Antonio Pérez Leal, Blog Nueces y neuronas, 2018 <http://www.nuecesyneuronas.com/la-neurociencia-entra-en-las-aulas-la-neurodidactica/>(Consultado el 15-11-2019).

¹² José Ramón Gamo, Integratek...

This is the great opportunity; to adapt education to cerebral "reality".

After years of experience and reflection in the clinical field Mr. Gamo's team, after working with children with neurodevelopmental problems (dyslexic, hyperactive ...) that cause them learning difficulties, found out that neurological difficulties don't generate learning difficulties themselves. What really cause students difficulties is the use of traditional teaching methodology. If teachers adapt their methodology to students 'needs, the learning difficulties will disappear.

As a general belief we thought that emotions were contrary to learning, or at least disturbed reasoning and knowledge. Today we know that our emotions are continually conditioning our rational thought processes. Gamo¹³ explains that neurodidactics have discovered that there are 3 basic learning devices which help us in our learning. These basic learning devices are: motivation, attention and memories.

Motivation the student has to be motivated for learning to happen, to learn it is necessary to want to do it. Conscious attention, what is commonly known as concentration and finally, there are memories, in which we find three key frames.

Implicit memory is that of slow speed that takes a long time to be grasped, but once stored, it is never forgotten; we do not even have to remember it (for example, learning to read or ride a bicycle). This memory needs repetition and it is where the traditional methodology does succeed, because it uses repetitive operative mechanics. But repetition does not imply the ability to understand; that is, knowing how to read does not mean understanding a text, nor does knowing mathematical operations imply knowing how to solve problems. In fact, we find students with good mathematical operational capacity who, when they do not understand a problem and are asked what to do, answer, multiply and divide. That is, they turn to that in which they are skilled (operate). However, they are not yet sufficiently competent to solve the problem.

Explicit memory is another long-term memory. It is a kind of "attic" in which we store boxes throughout life or a place in which we know there are certain boxes, but we do not where, nor do we remember their size or many details. In addition, this memory functions depending on the context and emotions. That is to say, as you evoke it, you "complete" it with other memories or added emotions.¹⁴

Short-term memory (lasts 72 hours) and within it, there is the operational or working memory. The latter is the only one in which you become aware of what you feel, what you think, what you are going to do and the consequence that this has. Therefore, it allows you to have an internal dialogue. This means you can talk to yourself, regulate yourself and correct the behavior.

We consider important to explain the difference between concentration and attention: Attention is a primary act of the brain. In many cases attention is involuntary and comes from the area of the posterior cortex of the limbic area or the involuntary and unconscious brain. Such is the case of the kilometers that we sometimes drive "without

¹³ José Ramón Gamo, It world education, 2019) <https://itworldedu.com/conferencia-plenaria-con-jose-ramon-gamo/> (Consultado el 23-11-2019)

¹⁴ Tiziana Cotrufo y Jesús Mariano Ureña, El cerebro y las emociones: sentir, pensar, decidir (Barcelona: EMSE EDAPP, SL., 2018).

consciousness", because our thinking is focused on another activity that asks for more attention. It is also simultaneous and parallel because you can be aware of several things at once, obviously all of them receive a low level of activity. Concentration is totally different. It is an executive act of the frontal lobe and it implies awareness of where I put the focus of attention, it requires perseverance and effort and therefore it is tiresome, because it also implies inhibiting the external stimuli that distract us. The maximum concentration time in brains below 12 years is five to seven minutes while in adults, the concentration blocks reach a maximum of 45 minutes. Interestingly, unlike in children, the first block is the least effective and the next ones are in ascending efficiency. The maximum level is 90 minutes and suddenly attention drops sharply due to attention fatigue.

This is very relevant because it is important to know what the attention blocks are and their effectiveness.

And how are concentration and attention activated? To activate these basic learning devices, it is necessary that the amygdala¹⁵ indicate that neurotransmitters must be released to implement these functions. And we know that happens in 4 situations: when our life is at risk, when the brain suffers a curiosity factor, when there are motivational factors and when we are in aerobic activity.

Specific proposals

Bauermeister¹⁶ considers that higher mental functions (language, memory, attention and executive function¹⁷ collaborate to develop our capabilities. Learning makes us develop skills, abilities or knowledge allow us to solve real problems. The competence levels that we must acquire are:

- Intuition
- Creativity
- Critical thinking
- Emotional management
- Compassion
- Cooperative work
- Learn to learn
- Why do I teach a student something?
- What do I want to teach?
- How do I teach it?

Learning is an intrinsic fact of each person; nobody can learn for you; it is a personal task. The teacher teaches, motivates, stimulates, guides, etc.

¹⁵ The amygdala is a structure located in the temporal lobe of mammals formed by different nuclei and traditionally related to the emotional system of the brain.

¹⁶ José J. Bauermeister, «Neuroup.» En Hiperactivo, impulsivo, ¿distráido: me conoces?: tu? Acerca del déficit atencional para padres, maestros y profesionales (Logroño: Guilford Press, 2008).

¹⁷ Executive function is a concept of the field of neuropsychology that encompasses a wide range of cognitive skills aimed at achieving a goal.

We as teachers, have to generate challenges to promote inquiry. A good example will be to give students exercises already done. In this way students will have the challenge of finding out what is wrong instead of giving them exercises to do. This simple methodological change provokes a different action in the cognitive field.

If we use repetitive or mechanical stages, we activate the amygdala. But how can we send dopamine to the central lobe to reactivate the working memory? Simply with an aerobic activity, with a laugh, yawn and stretch. That is, we must increase aerobic activity in class, and we have to generate situations of curiosity and motivation. Technology can help us because it is more satisfying to repeat an exercise on a multimedia device than on paper.

Methodologies which are recommended by neurodidactics: are cooperative learning, work with projects and also gamification.

The master classes are effective if the teacher has a great knowledge of his subject, when the teacher has great communication skills, when he connects emotionally with the students, but especially when he is a great motivator and is able to spread passion with what he is telling them. There is no learning without emotion. Other traditional methodology is based on tasks of mechanical repetition, on the reading of textbooks and the didactic learning units planned in 15 days.

These methodologies do not accompany the natural learning processes. In a 45-minute class, the average teaching staff dedicates between 50 and 60% of the time to the transmission of information through the oral channel. In the baccalaureate it reaches almost 90%, (80% of the information perceived by a brain). This type of communication is through the facial gesture, the body and the context. That is why technology is useful for teachers as it allows them to recreate virtual scenarios in which they put the information in context. That is why audiovisual support is the most recommended means for the transmission of novel information.

Confucius said: They told me and I forgot it, I saw it and I understood it, I did it and I learned it. Neuroscience states that this is the natural learning process. Learning by doing is the best way to acquire meaningful learning. The real challenges require us to investigate specific information. Students need to work with others and with the knowledge of others¹⁸.

There is no learning without motivation. To bring knowledge to a person, I have to generate curiosity, through challenges, videos, games, in short, create situations of interest for students.

If an adult explains something to a child, the level of activation of the tonsillitis system is medium in the case of a good teacher. If a child explains to another child the level is maximum (it is not yet known for sure why, it is believed to be due to mirror neurons but the important thing is that it occurs), the teacher is the one who creates the opportunities for a student to explain to their classmates. The brain is social and has to learn from others and with others.

¹⁸ José Ramón Gamó, It world education, 2019. <https://itworldedu.com/conferencia-plenaria-con-jose-ramon-gamo/> (Consultado el 23-11-2019).

We always evaluate students by doing. To evaluate competencies, you have to evaluate by doing. When we give the challenges to students, we show them their evaluation beforehand, so that they can focus on the acquisition of essential knowledge.

We have to thrill to learn: generate curiosity, generate challenges, try to make learning meaningful and experiential.

Students have to learn to learn, develop critical sense, work cooperatively, manage their emotions. Information is not important as it can be found on the Internet. Therefore, they should learn by doing and being part of the learning process.

We know, for the first time in history, that we will have to reset our level of knowledge and competence several times in our adult life. This implies that one must have good skills to learn to learn and that is where critical thinking is fundamental. This can be taught and we have to know how to implement it in the educational context.

We also know that we have to be able to develop skills related to emotional management. Emotions are closely related to learning because there is no learning without emotion. Furthermore, certain emotions can significantly hinder the development of our intellectual competences.

Cooperative work is another scenario that we also know will be essential. We are going to a global scenario where we have to be able to generate alliances, to convince others of our projects and this has to be instilled in our students.

The objective and slogan of our work group is always: Let's stop teaching students things they never do and start doing things with the children so they can learn.

When you prepare a class, motivation should be the first thing to bear in mind. We have to generate motivating actions with the students to provoke curiosity or interest in what they will learn. Within that same phase of motivation there would be a second step, which is testing. Testing means identifying what levels of prior knowledge about the new information or competence that we are going to work on. That is, to evaluate the knowledge students already have.¹⁹

And why is it important to know the previous knowledge that students have?

If you do not have any previous level of knowledge before encountering new information, when you take in that information, it might reach your conscious memory, but no data would arrive with which you could associate the information. You will not understand anything. However, if you take in the information through different channels besides the linguistic one, you will be able to not only learn it but truly understand it. Don't learn it, but understand it. Then the level of prior knowledge is decisive, since, if it is very low, the transmission of information in the next phase has to be through other tools such as audio-visual, visual thinking or concrete experiences²⁰.

¹⁹ Activation of previous knowledge: The brain builds on what already exists. It is demonstrated that the more previous knowledge we have about a subject, the easier it is that we can learn new information related to that subject and it is more easily consolidated in the long-term reports.

²⁰ José Ramón Gamo, <https://aprendemosjuntos.elpais.com/especial/los-ninos-aprenden-haciendo-jose-ramon-gamo/> 2015 (Consultado el 3-11-2019)

Conclusions

On the basis of the results of the programme for international student assessment and taking into account the proposals of experts such as Schleicher, director of P.I.S.A. assessment, we consider that it is relevant for teachers to implement new methodological strategies to use in our classes. We have considered that the new neurodidactic methodology presented in this article adapts to our student's needs and will also help our students in their capacity of self-discovery.

Now everything is neuro there is neuromarketing, neurotechnology... and we really know very little about "neuro" and therefore we must be very cautious especially when transferring it to the world of education.

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