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BRAIN-BASED LEARNING

Three Brain-Based Teaching Strategies to Build Executive Function in Students

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For young brains to retain information, they need to apply it. Information learned by rote memorization will not enter the sturdy long-term neural networks in the pre-frontal cortex (PFC) unless students have the opportunity to actively recognize relationships to their prior knowledge and/or apply new learning to new situations.

Here are some teaching strategies to help build executive function in your students.

1) Provide Opportunities to Apply Learning

When you provide students with opportunities to apply learning -- especially through authentic, personally meaningful activities -- and then provide formative assessments and feedback throughout a unit, facts move from rote memory to become part of the memory bank.

These opportunities activate the isolated small neural networks of facts or procedures, which then undergo the cellular changes of neuroplasticity that link them into larger neural circuits of related information. These extensive neural circuits integrate new information when they are a) simultaneously activated and b) when they recognize patterns in common.

The expanding of related categories of information (Piaget's schema) through executive function activities will consolidate learning into networks. These networks can be activated when students are prompted to use new learning to solve problems or create new products. This is the transfer process that further promotes network activation with the resulting neuroplasticity to construct long-term memory. Without these opportunities for strengthening, any memories learned by rote are simply pruned away from disuse after the test.

2) Introduce Activities to Support Developing Executive Function

Students need to be explicitly taught and given opportunities to practice using executive functions such as how to learn, study, organize, prioritize, review, and actively participate in class. Activities that can support executive function network development include comparing and contrasting, giving new examples of a concept, spiraled curriculum, group collaboration, open-ended discussions. Additionally, executive function is developed when students summarize and symbolize new learning into new formats, such as through the arts or writing across the curriculum. (See The Brain-Based Benefits of Writing for Math and Science Learning (<http://www.edutopia.org/blog/writing-executive-function-brain-research-judy-willis>) .)

Authentic, student-centered activities, projects, and discussions will give students the opportunity to do the following:

- Make predictions
- Solve a variety of types of problems
- Pursue inquiries
- Analyze what information they need
- Consider how to acquire any skills or knowledge they lack to reach desirable goals

This type of student-prompted information and skill seeking strengthens students' attitude about the value of learning. When motivated to solve problems that are personally meaningful, students apply effort, collaborate successfully, ask questions, revise hypotheses, redo work, and seek the foundational knowledge you need them to learn. And they do this because they *want* to know what you *have* to teach.

When students acquire desired facts, skills, or procedures to achieve authentic, valued goals, the information has a template (neural circuit) to which it can link. Foundational knowledge is not isolated. Learning is consolidated into related patterns, connected in neural networks of long-term conceptual memory, and available for retrieval and transfer to solve future problems and investigate new ideas.

3) Model Higher Thinking Skills

In planning instruction, consider how and when you will model these higher thinking skills and provide opportunities for students to activate their developing executive function networks throughout the learning process.

Judgment

This executive function, when developed, promotes a student's ability to monitor the accuracy of his or her work, and to analyze the validity of information heard or read. Techniques such as estimation with feedback and adjustment, editing and revising one's own written work using rubric guidance, or evaluating websites using criteria to separate fact from opinion are examples of promoting the development of networks for judgment.

Prioritizing

This executive function helps students to separate low relevance details from the main ideas of a text or topic of study. Prioritizing is the executive function that guides students when they plan an essay, select information to include in notes, and evaluate word problems in math for the relevant data. Prioritizing also promotes one's ability to combine separate facts into a broader concept with recognition of degrees of relevance and relatedness.

Prioritizing networks will be activated as you guide students to organize, plan ahead, keep records of their most successful strategies, and use this information to make the most efficient use of their time.

Setting Goals, Providing Self-feedback and Monitoring Progress

Until students fully develop these pre-frontal cortex (PFC) executive functions, they are limited in their capacity to set and stick to realistic and manageable goals. As they develop these executive functions, they need guidance to recognize their incremental progress they make as they apply effort towards their larger goals. This is part of the "video game model" described in my previous blog, [How to Plan Instruction Using the Video Game Model](http://www.edutopia.org/blog/how-to-plan-instruction-video-game-model-judy-willis-md) (<http://www.edutopia.org/blog/how-to-plan-instruction-video-game-model-judy-willis-md>) .

Prior Knowledge Activation and Transfer Opportunities

Plan activities where students can relate what they know from past experiences to their current learning and tie it to the larger concept. When you provide learning experiences by which students can apply new learning to multiple applications, you promote the neural construction of larger conceptual networks that make the new information a valued tool and part of long-term memory. An example would be the use of the rules of magnetism and geographic facts to discover how to use a compass.

Metacognition

Taking the time to plan learning contexts that are personally desirable often means going beyond the curriculum provided in textbooks. This is a hefty burden when you are also under the mandate of teaching a body of information that exceeds the time needed for adequate activation of prior knowledge and mental manipulation. When you plan for and teach with mental manipulation for executive function in mind, your students will come to recognize their own changing attitudes and achievements. When students begin to experience and comment on these insights, consider sharing the processes you used to create the instruction that they respond to positively. Describe your mental manipulation, challenges, and the executive functions you used to create something new as you found the authentic active learning opportunities that activated the students' interest, perseverance, and higher levels of thinking.

These are teachable moments to promote student metacognition, where they can recognize their abilities to extend their horizons and focus beyond simply getting by with satisfactory grades. Help them make the connection that they can build their executive function of long-term goal-directed behavior when they choose to review and revise their work, even when it has been completed, rather than to be satisfied with "getting it done." Your input helps students see the link between taking responsibility for class participation, proactive collaboration, and setting high self-standards for all classwork and homework such that they can say, "I did all I could to do my best."

Making the Case for Investing in Executive Functions

As the caretaker of your students' brains during the years of rapid prefrontal cortex development, you should consider how you can activate and guide the development of your students' greatest resources -- strong executive functions. The opportunities you provide for mental manipulations using these critical neural networks are precious gifts. These tools will empower them to achieve their highest potentials and greatest satisfaction as they inherit the challenges and opportunities of the 21st century.

Time Well Spent

Planning instruction and teaching units that activate executive function processing takes teacher and student time -- and it's time that's already severely taxed. However, that time is regained because the learning in these units is successfully retained in long-term memory and re-teaching time is vastly reduced.

The first ones to notice the brain changes of learning that is mentally manipulated through executive functions may be your students. Beyond the increased engagement they experience through active learning, they will find it takes less time to review for tests beyond the unit test, such as a final exam. You'll find that students, who previously didn't have the growth mindset needed to stay with challenging lessons when understanding was not instantaneous, now persevere. But the "payoff" will be especially powerful when their teachers ask you the next year, "What did you do?? The students from your class actually remember what they learned last year."

Now think what this means in terms of time. If you didn't have to re-teach "last year's material" you'd be getting all those weeks of time at the beginning of each unit. Thus the a school that promotes instruction for the activation that is needed for development of strong tracts of executive function and long-term memory will build better brains for its students. These brains will retain learning in sustained, transferable, and retrievable long-term memory. Instead of the re-teaching previously required before new instruction can start, there will be weeks of "found time."

Take Care of Yourself

In the professional learning communities I observe when I travel throughout the country I see dedicated professionals who chose to become educators because of their dedication to making a difference for all students. Teachers are drawn to their career choices for admirable reasons. (We know it is not for the big bucks or having the work day "end at 3.") Creativity, imagination, perseverance, and motivation endure in the educators I meet, even in these times of teacher blame and over-packed curriculum.

It is critical that we prepare today's students with the executive function skill sets they will need for success in the globalized, information explosive, and ever-expanding technologically progressive 21st century. Just as certain is the continued accountability by educators to teach the over-packed curriculum in the existing standards.

Please take care of yourselves. Take the time to acknowledge any progress toward your goals. What I'm advocating regarding more activation of students' executive function networks may not provide you with immediate evidence of the changes you are promoting in their brains -- although it is highly likely you'll find behavior "management" problems decrease as engagement increases. You'll have to use your executive function of resisting immediate gratification (such as eight hours of sleep or a weekend without prep work) to persevere on the long-term goal of setting in motion the birth of dendrites and synapses to give your students the best chance of achieving their highest potentials of professional, social, and emotional joy, and success in the years to come.

Thank you for what you do!

Understanding How the Brain Thinks

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