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Revisiting Teacher Learning

Brain-Friendly Learning for Teachers

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How can we create professional development that engenders deep learning?

Think of those times you've left a professional development workshop saying to yourself, "Wow, that really made me think!" Now think of those grimmer occasions when you said, "What a waste of time! I'd have preferred a root canal." Why did you learn in one situation but not in the other?

During my four decades as an educator and educational consultant, I have seen professional development delivered in many formats, everything from "Choose three sessions from column A and two from column B" to programs individually designed for educators. Ostensibly, the goal of all these efforts was to offer teachers and administrators something new that would enhance their effectiveness. But enhancement happens only if participants actually learn something, which raises these questions: As teachers participate in learning activities, how do their brains determine what if anything to take away? And how can we use insights into the brain's workings to improve learning activities for teachers?

Motivation and Learning

Recent brain research using imaging technologies suggests how both children and adults learn. These findings merit attention because they have implications for how we teach (see "Insights From Neuroscience"). They can also help us to update our knowledge about adult learning so that we can design brain-compatible professional development.

The brain's biological mechanisms responsible for learning and remembering are roughly the same for learners of different ages. However, the efficiency of these mechanisms varies with the degree of development of the brain regions involved (Shaw et al., 2006). Emotional and social factors and past experiences also enter into play in terms of the brain's efficiency and an individual learner's motivation. Because these factors are more developed in adults than in children, they have greater influence over adults than they have over children.

Imaging studies show that regions in the brain's emotional and cognitive processing areas are activated when an individual is motivated to perform learning behaviors. All of us are motivated to learn because learning enables us to survive. For many teenagers, a major motivator is the desire to fit in with their peers (Schulteiss et al., 2008). Adults, however, are less concerned about peer approval and usually want to learn things that help them become more skilled in their chosen field.

This inherent desire to learn to do something simply for the satisfaction of doing the job well is an intrinsic motivation. Four key factors affect the intensity of a learner's intrinsic motivation in any given situation: emotions, feedback, past experiences, and meaning. These factors are all connected and influence one another to some degree.

The Role of Emotions

Our brain pays more attention to stimuli and events that are accompanied by emotions. We remember the best and worst things that happen to us while forgetting emotionally neutral events. Do you remember what you ate for lunch two weeks ago last Thursday? Probably not, unless it was a special occasion or the food made you sick. In either case, the accompanying emotions enabled you to remember it.

How we *feel* about a learning situation often affects attention and memory more quickly than what we *think* about it. In most adolescents, the brain region that processes emotions (the limbic area) is fully operational, whereas the regions responsible for thinking, reflecting, and controlling emotional reactions (located in the prefrontal cortex) are still developing. This is why middle school students

reactions (located in the prefrontal cortex) are still developing. This is why middle school students overtly display emotions inappropriately in the classroom (through pained sighs, rolling eyes, and blank looks).

Adults may also come to a learning activity with strong emotions. But a fully developed prefrontal cortex enables most adults to consciously dampen their emotions. If the activity captures an adult learner's interest, the mature cortex will override any negative feelings, and learning will occur. But teachers who are deeply annoyed by mandatory attendance or who feel emotionally detached may resist learning. They can conceal their negative feelings, but they may surreptitiously turn to activities like grading papers unless the activity is engaging enough to hook into some positive emotion.

When people feel positive about a learning situation, chemicals called endorphins and dopamine become active. Endorphins provide a feeling of euphoria. Dopamine stimulates the prefrontal cortex, keeping the individual attentive, interactive, and likely to remember what he or she experiences. Negative feelings, on the other hand, cause the hormone cortisol to enter the bloodstream. Cortisol puts the brain into survival mode; this shifts the brain's attention away from learning so it can deal with the source of stress. Instead of learning, the brain remembers the pressure and registers these kinds of situations as unpleasant.

Professional development leaders should ask themselves the following questions to determine whether the format and content of their programs connect to positive emotions in most teachers and avoid triggering negative ones:

- Does the program offer learning experiences associated with moderate challenge, excitement, creativity, and joy so teachers will be more likely to remember what they learn and implement it in the classroom?
- Does the program speak to a problem that teachers identified rather than some outside entity? If not, can we connect this content to teachers' concerns?
- Are teachers excited about this initiative?
- Have we included opportunities for hands-on participation and activities that address a variety of learning styles?
- Will participants give leaders feedback on the program– and receive regular feedback?

When I worked with the West Orange School District in New Jersey to design professional development on applying brain research to classroom practice, we included teachers in the development and assessment of the program and planned ways to elicit positive emotions. To generate excitement, we asked teachers who were using brain-compatible strategies to share their positive experiences at faculty meetings. Workshop presentations included direct instruction, audiovisual segments, and opportunities for self-reflection and small-group discussion. The district administration also agreed to sustain building-centered support groups, peer coaching, and follow-up workshops for a minimum of three years.

Teachers who participated in this program reported that it made a difference in their selection of teaching strategies and that students seemed to learn better when they used these revised strategies.

Feedback Fuels Learning

Recent imaging studies have shown that brain regions associated with motivation are more active in subjects who are learning tasks and receiving feedback than in subjects doing the same tasks with no feedback (van Duijvenvoorde et al., 2008). This finding should come as no surprise to teachers who use constructive feedback to encourage struggling students. Feedback is a key contributor to motivation. The need to be valued is a potent emotional force, and positive feedback fills that need. In our professional development with West Orange teachers, each participant presented a minilesson and received constructive feedback. But feedback is often a neglected or halfhearted component of professional development programs.

Effective feedback is timely. The sooner an observer provides reinforcement for a teacher's desirable behavior (such as trying out a new instructional strategy), the more likely that teacher is to repeat that

behavior. Using peer coaches (teacher pairs who observe in each other's classrooms) is one way to provide frequent job-embedded professional development that uses nonthreatening feedback.

Good feedback is also specific. Telling someone, "You're doing a nice job" doesn't help that person's brain explore and apply modifications to behavior that might lead to continued success. Nor will vague statements fire up the positive emotions needed to motivate a teacher who's trying out a new strategy and hitting snags. A better example of positive feedback might be, "Your students seemed engaged when you had them create graphs using data from their online survey."

Specific, positive feedback stimulates the prefrontal cortex to reflect on ways to improve performance. Negative feedback may never reach the prefrontal cortex. Instead, it is often diverted to the limbic area, where it produces stress and results in the release of cortisol so that the individual goes into survival mode. Powerful negative feelings surface, intrinsic motivation declines, and the learning portion of the brain shuts down.

When professional development leaders need to give teachers feedback about areas in which they should improve, they can make this feedback less negative by building on teachers' strengths. For example, if a teacher presents a lesson that is well organized and on target for achieving the learning objective but that embeds essential information too far into the middle of the lesson, compliment the teacher on the overall great organization early in the conversation. Then ask if students might remember the important information better if the teacher placed it at the beginning of the lesson rather than in the middle.

Past Experiences and Meaning

Past experiences here refers to experiences that the brain encodes into long-term memory and readily recalls. Past experiences always affect new learning. As we learn something new, our brain transfers into working memory any long-stored items it perceives as related to the new information. These items interact with new learning to help us interpret information and extract meaning, which is part of the principle called *transfer* (Sousa, 2006).

This process affects whether a teacher will be disposed to commit to a new professional initiative. If that teacher's brain recalls that previous professional development activities were worthwhile, then he or she will approach a new activity positively. Conversely, if the teacher's brain rejected past professional development activities as meaningless, that teacher will likely come to the new activity with little motivation. In this situation, convincing the brain that attending to new information will prove useful for the future becomes the major and daunting task for professional development leaders.

The search for meaning is innate. As a learning episode ends, the brain decides whether to encode the new learning into long-term memory or let it fade away. It's an important decision because people cannot recall let alone implement learning that their brains have not stored. How does the brain make that decision?

Working memory draws on the individual's past experiences to help it answer two questions: Does this new information make sense? and Does this information have meaning for me personally? When both sense and meaning are present, the likelihood of long-term storage is high.

Adults attach meaning to new learning by drawing on a multitude of past experiences, but they may not find a match that makes it relevant. When a participant in a professional development activity asks, "Why do I need to know this?" that individual is neither readily connecting the day's menu of learning to past teaching experiences nor accepting it as meaningful.

To create experiences that participants perceive as meaningful, professional development leaders should

- Directly connect the new initiative to job-related goals. For example, activities that show science teachers precisely how they can use new strategies to help students learn science content are more valuable than general suggestions.
- Present the topic over enough time and in enough depth so teachers gain a thorough understanding of how it relates to their work. It is foolish, for instance, to expect participants to make in-depth connections in a one-hour workshop,

especially if there are no follow-up activities.

- Use instruction modalities other than "telling." Participants need to see the strategy modeled and then apply it themselves soon thereafter. When teachers actively participate in a demonstration of the primacy-recency effect, for example, they more clearly recognize that the brain remembers best the first and last items presented in a learning episode– and they are more likely to sequence instruction with this phenomenon in mind.
- Initiate action research. Conducting action research in the classroom enables teachers to personally assess the effectiveness of a new strategy, obtain validation for incorporating new strategies into their repertoire, and investigate specific problems that affect their teaching.
- Promote in-school study groups around the topic. As group members exchange new research and share in-class experiences, they can analyze why– and under what conditions– a strategy is effective. Participating in study groups helps teachers who are reluctant to try out new ideas gain confidence.

Francis Bacon said knowledge is power. But real power lies in *applying* knowledge. Ultimately, we hope teachers will not only retain what they learn in professional development encounters but also transfer that new knowledge into action.

The field of education is strewn with the corpses of well-intentioned programs that failed to lead to action because developers failed to give teachers motivating feedback; connect new learning to relevant past teaching; establish long-term supports (such as peer coaching or action research); or consider how the program's approach might interact with teachers' emotions. In other words, they did not use brain-compatible approaches. When school leaders design professional development programs that reflect insights from educational neuroscience, educators are more likely to embrace professional development as a positive part of the teaching life.

Insights From Neuroscience

- ***Gene expression***. Certain genes express themselves only when provoked by circumstances in the environment, such as social interactions (Rossi, 2002).
- ***Mirror neurons***. These networks of neurons fire either when a person acts or when that person observes the same action performed by someone else, mimicking the actions of the one being observed (Iacoboni et al., 2005). The discovery of gene expression and mirror neurons highlights the importance of schools' social environments in motivating students to learn.
- ***Neuron regeneration***. Contrary to a long-standing belief, neurons can rewire themselves and establish new networks through in-depth learning in a low-stress, creative environment (Kempermann, Wiskott, & Gage, 2004).
- ***Memory capacity***. New discoveries show that (1) working memory has age-related capacity limits that should not be exceeded by "cramming" in content, and (2) people can hold items in working memory longer than previously thought– up to several weeks (Crone, Wendelken, Donoue, van Leijenhorst, & Bunge, 2006).
- ***ADHD, autism, and dyslexia***. New understandings are leading to successful interventions (Shaywitz, 2003).
- ***The role of exercise***. Exercise is central to brain growth, mood regulation, and cognitive processing (Hillman, Erickson, & Kramer,

2008).

- ***The arts***. Participation in the arts contributes to brain development, including visual-spatial ability, attention, concentration, and creativity (Ashbury & Rich, 2008).
- ***Body rhythms***. Daily body rhythms affect learning, particularly for adolescents (National Sleep Foundation, 2000).

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