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DEEP PRACTICE

The First Step to Achieving Focus, Coherence, and Rigor

By Robert Sun

A visit to Baldi Middle School, located in an economically challenged neighborhood in Philadelphia, is a lesson in education that works.

That's because all of Baldi's 1,200 students are engaged, empowered, and energized.

The school's leadership, with support from the community and parents, has instilled a high-performing culture characterized by three traits: The children feel attached to their school and its mission; the environment supports productivity and performance; and students are energized to sustain accelerated effort over time.

Nowhere is Baldi's culture more fully realized than in its commitment to mathematics. In a nationwide online mathematics competition involving 6,000 schools in 45 states, Baldi ended this season ranked fifth, as students solved more than 17 million mathematics problems correctly in just 10 months. Baldi has consistently ranked among the top 10 schools in the nation in this competition for each of the past five years.

How was this productive culture established? Why do Baldi students embrace mathematics with such enthusiasm when the subject intimidates so many children?

It begins with a concept known as Deep Practice.

In sports, when we swing a bat and miss the ball, we receive instant feedback through our senses. Players learn easily and naturally through a practice loop where proficiency is attained through immediate awareness of success or failure.

When solving mathematics problems, there usually is no similar form of encouragement. Create a Deep Practice system that provides an immediate and non-judgmental feedback loop, and mathematics is suddenly no longer intimidating. By allowing students to tackle a complex subject in manageable parts—stopping when an error occurs and practicing that one skill until it is perfected—they march steadily toward mastery. This is the hallmark of Deep Practice.

Using Deep Practice techniques, skills that might take months of conventional practice can be mastered in a matter of days. These techniques have released a tremendous amount of energy not just in mathematics, but in other subjects as well.

The benefits of Deep Practice go beyond curriculum attainment. They are vital to meeting the most ambitious requirements in modern education—including the problem-solving and critical-thinking objectives of the Common Core State Standards for Mathematics (CCSS).

Critical thinking is one of the hardest mental skills to acquire, mostly because we humans do not like to think. We find thinking difficult and generally avoid it if possible. That's because our brains were not designed to think. Our brains evolved to quickly process vast quantities of visual information.

Computers can now beat the best human players in chess, but we have yet to design computers that can steer robots over uneven terrain or even drive a truck, because processing the vast amount of changing visual information is so complex.

The portion of our brain allocated to thinking is the neocortex, commonly referred to as the "working memory." It is by nature limited. That is why we have difficulty carrying on more than two conversations simultaneously; overtax our working memory and our ability to reason slows or may break down altogether.

There are two ways for information to enter into our working memory for processing. The first is from the environment—what we experience through our senses and problems that we encounter. The second is to draw from our "long-term memory," which is our storehouse of accumulated factual knowledge.

In his book Why Don't Students Like School, Daniel Willingham (2009) describes how we have developed two distinct ways around the limitations of our working memory capacity.

Through repeated practice, humans turn tasks into habit loops that become automatic. These are held in our long-term memory as stored procedures that can be called upon and executed without taxing our working memory. When a child is first learning to tie his shoes, almost all of his working memory capacity is devoted to the

DEEP PRACTICE

continued from previous page

task, but after building automaticity he is able to tie his shoes without thinking.

Humans possess the ability to "chunk" data by grouping information. Chunking reduces the number of variables that our working memory needs to retain. If I present 12 letters of the alphabet randomly and ask you to quickly memorize them, it will tax your working memory—but if I present them as CNN, FBI, IBM, ABC, the task is easier because the letters are "chunked" in your long-term memory—as long as the acronyms CNN or FBI already have meaning to you.

If we are to succeed in implementing the primary objective of the CCSS—to enable students to think critically and thereby approach math with focus, coherence and rigor—we need to encourage repeated practice to build automaticity (stored procedures) and ensure that their long-term memory contains comprehensive knowledge related to mathematics.

Put another way, CCSS is like asking our children to not merely be able to cook, but to become gourmet chefs. When a child's pantry is sparse, he cannot fulfill those expectations. Stocking our children's pantries with knowledge is essential if we want them to think critically.

From the moment they are born, children are exposed to thousands of impressions and varied sources of information. Researchers have studied the impact that early parent/child interaction has on a child's later academic achievement, using an unobtrusive device that records up to 16 hours of conversation. After five years of looking at many different families, the findings are sobering.

The number of words spoken by a parent to a child in a family receiving financial assistance is about 600 per hour. In a family where the parents were in a professional career, the number is 3,100 per hour. By the age of three, the deficit for a disadvantaged child is already 30 million words.

Another interesting finding of the research showed that TV talk, in many cases, was actually detrimental. The only way for information to become stored in long-term memory is when a child is engaged and thinking. Merely hearing words without active engagement will not stock the pantry.

This research points to the drawback of relying on a passive style of teaching that does not engage students. Imagine a teacher lecturing and relaying facts and figures—essentially laying important ingredients onto a table—and hoping they will be collected and put into the pantry. When a student is not actively engaged, those items never get into the pantry, but pile up and eventually fall off the table's edge.

We have known for more than 100 years, thanks to studies conducted by Hermann Ebbinghaus in the 1800s and confirmed by modern research, that 90 percent of what a child is taught in class is forgotten within 30 days. Yet we sometimes forget that without students taking ownership through active engagement, we are basically on a treadmill.

We must remember the importance of stocking the pantry if we want our children to develop strong critical-thinking skills. We need to learn from successes such as those at Baldi Middle School. Stocking the pantry may not be the most glamorous aspect of mathematics education but when our students' pantries are full, there's no limit to what they can accomplish—or to the future they will be inspired to invent.

Robert Sun is the CEO of Suntex International and inventor of First In Math®, an online program designed for self-paced learning in mathematics.