A New Model of Cognition Applied to Teaching Invention

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Full STEM ahead – here come the young inventors! Listen up all teachers of STEM classes. We've been blessed with an amazing discovery from the laboratories of cognitive psychologists. This discovery will draw students into our classes like flies to rotten bananas! But first, you need to understand why and how this discovery affects us.[1]

Remember the young people we've seen avoid our classes because they had heard, from reliable sources (?!), that science, technology, engineering, and mathematics are far too difficult. And they lower your grade point! You can forget college!

Then you started prying and found multiple root causes of these baseless ideas. They included such pseudo wisdom as: "Science sucks! Math problems don't make sense, and besides, they have computers don't they? Physics is too weird! And, the thought of cutting up frogs causes the word *biology* to turn my stomach!" Yes, these and endless variations of hearsay and scare stories, without any basis of rationale, meet every generation of students.

It's very sad – so many young minds sidetracked from exciting lives of rewarding mental challenges. Imagine what we could do with a magic wand that opened doors to intellectual excitement, and brought in students running. Well, good news! We may now have one. With it in hand, we can start our lectures like this: "Listen up class. I'm going to teach you how to become a new generation of Thomas Edisons, the inventor with 1,093 US patents.[2] Yes, you are going to learn how to discover your own inventions that solve real-world problems, and – pay attention – do it without numbers, specifications, or equations. Now that's exciting! What young person wouldn't want to be able to invent?

Here's the deal. Cognitive psychology research since 2000 has made very interesting discoveries about how our brains work during problem solving.[3] They learned this from functional magnetic resonance imaging (fMRI). This neat technology can image a person's brain while it is solving problems. Questions cause nearly instant reaction by the unconscious as it begins to process the incoming information. Such information flows from all five sensors 'watching' the external world, and information from other sources within the brain.

Processing each bit of information refers to rapidly searching short-term and long-term memories. This process finds associations from past experience, which help to categorize these sudden interruptions. An immediate decision must be made. Is it a sign of danger, or a sign of food, or is it an association relevant to the question? This begins within the first one thousandth of a second of receiving a signal. Other sensor-signals are also arriving for processing. It's a busy place.

In a little while, actually about one third of a second, the conscious, which has been paying scant attention to these fast fleeting signals, finally focuses on a relevant one and it becomes a conscious perception. That's it, a solution concept to the invention we're working on! Now the conscious has become aware of it and starts to lay it out in words and logical phrases with which we can communicate the idea.

This is the new model of thinking that cognitive psychologists have discovered, a bi-level model of thinking. Here comes the shocker. In essence, all thinking is done by the unconscious. The conscious comes into play in constructing syntactic language with which to communicate this information. This includes internal and external communication. We use this communication to think with, and to reach other people's minds.

Now STEMers, here's our magic wand and how we can use it to make every young student an inventor. First, we need to learn how to construct a good problem statement, one that is easily understood. Then we show how to parse the problem into manageable pieces for mental consumption. A good problem statement is one having a single problem, a minimum number of objects, and a clearly understandable goal.[4] Consider the following example.

A coffee café serves hot coffee in thin paper or plastic cups that can be uncomfortable to handle. Along comes a young inventor and says, "I can fix that. Use two cups, one inside the other, and that solved the problem -- for the moment. Then the company's purchasing agent said, "Aren't we losing money? We're using twice as many cups!"

Along comes the next inventor who has a solution concept for the new problem. "Try this. Slip a narrow band of coffee-cup material over each cup where insulation is needed." Voilà, another successful invention! Next the company discovers that competition is making it more difficult to make a profit. We need to cut costs somewhere. Could we, for example, eliminate the extra sleeve on the cup and cut the additional time lost placing the sleeve onto the cup?

Again, along comes a young inventor who thinks and thinks for a few seconds and says, "Why not simply corrugate the cup material before it is rolled into the cup shape? Then there would be less hot surface area to contact the skin." Voilà again. Life is getting better.

Notice what happened in those three incidents. The inventor was presented a problem situation that required a solution concept, not an engineered design ready for manufacturing. Solution concepts are the starting points of invention. They do not require numbers, specifications, or equations to discover. The 'too difficult to learn' excuse just went out the window. When young STEM aspirants become hooked on the power of their own brains to invent, I suspect they'll be slipping into STEM classes at the first opportunity

So hang out your shingle on your classroom door and advertise – **"Register Now. Learn How To Invent Solutions To Real-World Problems. No mathematics required to enjoy the excitement of taking your brain into places others have yet to discover."**

Wait a second. Ponder this. Suppose the coffee-cup maker discovers that competition is rising and she needs a less expensive solution. What's the next young inventor going to propose? Ask one.

Endnotes

[1] I consider myself a STEM teacher, though, before retirement, my classes on problem solving, at Ford Motor Company, were filled with adult, professional technologists of all academic stripes and years of experience.

[2] Edison executed the first of his 1,093 successful U.S. patent applications on 13 October 1868, at the age of 21. (Wikipedia)

References

[3] Stanislas, D. (2014). Consciousness and the brain – Deciphering how the brain codes our thoughts. Viking.

[4] Sickafus, EN, (1977). Unified structured inventive thinking – How to invent. ISBN 0-9659435-0-X (www.u-sit.net).