

Root Causes of Students' Difficulties,

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Our purpose has been directed at establishing a system wide approach to instructional design based on deep learning methods. We imagine this system being used in the classroom, as well as in a virtual classroom. The proposed system, and methodologies, support individual assessment and create an individualized capacity to demonstrate knowledge of the foundations to higher mathematics and other academic subjects. The deep learning methodology, while was first used in 1994-1995 at St Paul's College in Virginia, has been refined while at Atlanta Metropolitan College in Georgia.

The work undertaken has helped understand a full spectrum of issues. Part of this spectrum is exposed using systems theory and a look into the neuroscience of human perception. The causes of poor performance can be listed. Systems analysis shows that there are specific causes arising from the individual, and causes arising from the social medium. In this chapter we will address the causes arising from the individual.

According to our analysis, the root causes to under performance in college mathematics classes include:

- 1) **Perception of Experience:** Students often exit high school with very fixed, and distinctly negative, notions about what classroom experience is supposed to be.
- 2) **Study Skills:** Students do not know how to study a college curriculum.
- 3) **Mal-learning:** Students, in under performing situations, have deep confusions about all aspects of arithmetic and algebra.
- 4) **Dependencies:** Many students have developed dependencies and cannot add or multiply positive integers without a hand held calculator.

In previous chapters we have focused on a systems analysis for the purpose of laying out the issues we, in the educational system, find ourselves. Most of us recognize that our social system has been self-limited. Human society is less that it could be. From the point of view of the educator, we often see the fault as being on the shoulders of the students. In this chapter, we take this point of view.

Deep learning addresses each of the four root causes. We have conjectured that the “individual” root causes are all explainable using a theory that we ground in principles of cognitive neuroscience¹. Our explanation is, of course, not the same as a perfectly correct model. It is not a tested model. In other chapters we try to address this failing, as well as a systems view of contributory causes arising from outside the individual. The fact is that any theory has its uses and limitations.

The limitation of a theory is in fact an important observation. Social viewpoints are limited and sometimes lead us to false conclusions and incorrect behavior. The same is true about individual perceptions. The individual poorly prepared student may have an incorrect perception about his or her ability to learn the foundations to higher mathematics. This false perception is the first root cause.

The natures of human misperceptions are understood to involve a false sense of exceptionalism when this exceptionalism becomes extreme. This is the fundamentalism that underlies the War on Terrorism, for example. Fundamentalisms are also involved in our politics, and in business processes as well as in our academic system. In the previous chapter, the philosophical case is made that a false sense of exceptionalism has created a system that limits individual understanding of higher mathematics and science. So this case is about the social dimension to our root cause analysis.

The individual is embedded in a social world. The case regarding a false sense of exceptionalism is merely an acknowledgement of something that is commonly believed. The nature of exceptionalism is then, perhaps, part of the means through which groups of individuals come to see differently. We share our sense of exceptionalism as we form social groups. The four root causes, listed above, are also acknowledged by students in under prepared college mathematics classes, as well as by their professors. Our question is about how we might see individual transformations within a community sense of exceptionalism.

Let us consider these four root-causes one by one. And as we make these considerations we reflect on the pathway of experiences that leads to each of these. The primary cause is the perception of self as a non-learner of mathematics. The following

¹ Prueitt, Paul Stephen (2011) *Stratification Theory as Applied to Neural Architecture enabling a Brain-like function for Social Networks*. Presented to Winter Chaos Conference of the Blueberry Brain Institute, Southern Connecticut State University, March 18-20 2011.

email provides some understanding of the image of self.

Comment: Hello Dr.Prueitt. I am a student in your 0099 class on Tuesdays and Thursdays 10:00-11:50 class. I would like to say that I know that you mean well and you really do try hard to help us understand mathematics. Mathematics is hard for me and I am sure for the rest of the class and I really appreciate that you took our word about going over things a bit slower; also I am glad to see that you are on our side. This is really helping us. Hopefully I get out of learning support classes and pass the compass because this class is really set bad, not only for me but I think for the rest of my colleagues. To tell the truth I am terrified of math and this is the only subject I really struggle in. It scares me because I need to pass all of my math courses to get out of college and start my career. Also you are right, the school system is broken. I never done deep learning, I never learned this in high school, they didn't teach students a lot of laws. We are taught to just steps to get the correct answer and that's it; just to get on with your life you know? You mean well and are a great professor. I have faith that we all will pass the class and the compass. :)²

The email was written after seven weeks of class. This student is clearly in the process of examining her perception of higher mathematics and the experience she and her fellow students have had. This process is not yet complete, there is still a great deal of uncertainty and self doubt. The common perception of the experience in past mathematics classes is decidedly negative. We do argue that this negative perception is in fact coupled with an excitement of the frontal cortex³. This excitement of the frontal lobes results in an inhibition of electromagnetic phase coherence arising from the limbic system. The feeling experienced by the student is similar to that experienced from abusive situations. The fear they feel is real, as is the knowledge that this class serves as a gateway to a better life.

Our deep learning methods are designed to replace this bad perceptual field with a perceptual field that does see into the elementary topics of higher mathematics.

Quote on Deep learning>>>>>

² Received as part of an on line polling web page at www/iftingPedagogy.com; February 15, 2012.

³ Prueitt, Paul Stephen (2012) American Education Bridge, technology and pedagogy. Accepted: The 3rd International Conference on Education, Training and Informatics: ICETI 2012 March 25th - 28th, 2012 – Orlando, Florida, USA

Students report that they do not know how to study. It may be that they sit with the textbook and are unable to understand what to do. About at the same time as the email one of the students came to Prueitt's office and flat out said, "I just do not know how to study". The admission was with a sense of relief that someone could actually be told this. If the conjecture on acquired learning disability is reasonable science, it is explaining a condition where the mind simply goes blank. The role of the frontal lobes is to inhibit the competition between many forming phase coherences⁴. An executive function is exercised by selectively inhibiting⁵.

This student was deeply sincere in explaining her puzzlement over how to study college algebra. The first understanding was that what she had done in the past was not a study of anything, but merely various attempts at learning how to get some right answers, often by guessing. Over time, the natural interest in learning science and mathematics had been replaced by a numbing and by fear and avoidance. This is in fact a type of trauma. Quite literally, a student will have tried hard to follow the instructions in class, and have failed so many times that any new perception about some topic is quickly suppressed.

Students comments >>>>>

An inability to study is coupled with false understanding. Even when provided time and resources the student is only equipped with false understanding. Students have a fear of continuing to fail, and a mental block. Elementary rules of arithmetic, for example the distribution rule are incorrectly understood. For example the student will often write out something like:

$$2(x - 3) = 2x - 3$$

⁴ Levine, D. & Prueitt, P.S. (1989.) Modeling Some Effects of Frontal Lobe Damage - Novelty and Preservation, Neural Networks, 2, 103-116.

⁵ Pribram, Karl (1991) Brain and Perception. ERL

These are called mal-rules. The deep learning methods addresses these root causes in several ways. One of these methods that is most effective is the loop exercise, where the answer is found using two distinct methods. If one substitutes $x - 1$ into the left side of the above equation; we get -4 . However a substitution of $x - 1$ into the right side gives -1 . So clearly there must be an error in how the laws of arithmetic have been used. Additional loop exercises build an experience where the student develops independence from the textbook, and from the professor. This experience starts the process whereby the individual is able to assert positive knowledge of learning. This assertion is necessary to writing a Blank Paper Test.

Student description of a Blank Paper Test >>>>

An individualization of learning within the virtual world system, or as part of a classroom experience seems reasonable. However, the achievement of this goal has seen many challenges. During the academic year 2011-2012, we focused on the resistance that under prepared students have towards fractional arithmetic. A "Loop Exercise" was developed that specifically provided a means to self-study arithmetic. This exercise is described in the sections below.