Proposing a National Center:
Exploring Self-directed Learning within Immersive Virtual World (IVW)

Outline of Efforts for 2010-2011 Academic Year and Beyond

Paul S Prueitt, PhD
Saturday, May 8, 2010

Abstract: We are proposing to provide evidence that the generational decline in math attainment may be reversed. We will use a combination of modified R L Moore methods for teaching math, combined with demand side pedagogy. The delivery will be in the classroom as well as in dedicated immersive Virtual Worlds. By delivering via virtual worlds it is believed that students who have been put off by math will find that they may succeed. This success will enable them not only to better serve themselves, but to serve the nation as well. Outcomes will include increased employment opportunities, reduced indebtedness and increased understanding of accounting and finance. The methodology we propose includes advanced methods in intelligence technology. Statistical models will be created regarding the treatment using demand pedagogy as compared with standard practices. Control data will be gathered from a representative cross section of community colleges, colleges and universities. It is proposed that a study be piloted in two or three educational institutions with the full knowledge and backing of the academic staff and board of trustees. Funding will be sought to support this program and the work will be published in educational journals.

Purposes

Presidential leadership is stimulating to new educational processes. Increased attention is being paid to the measurement of educational outcomes. Work on pedagogy is part of restructuring and redeveloping education in America. Some experts believe that 3D virtual worlds will soon replace web sites as new social networking capacity is developed. A national center, exploring self-directed learning within Immersive Virtual World (IVW), could be proposed and funded.

My request is that the faculty members in mathematics and computer science work with me a grant seeking process through insight, thoughtful modification, and collaboration. I wish to teach liberal arts or developmental mathematics over the next two years, and to

develop multiple funding instruments. The teaching methodology involves in-class strategies, development of curriculum and the stepwise adoption of new web based social networking tools.

There are a number of almost independent activities, several of which may be used as a basis for grantsmanship. One of these is the development of outcome statistics on categories of educational institutions. An abstraction process has been developed based on the reification of formal classes from data from instances. This work could produce a foundational ontology for the measurement of changes that would occur given the introduction of self-directed learning as a component to the freshman classes. Our working hypothesis is that a balance between self-directed learning and traditional methods will produce very positive results. If these results are measured, the pressure to transform all aspects of American education will have a means to focus our intentions.

The foundational task is a significant one, how to measure the outcome resulting from reform and restructuring treatments. Statistical methods may be complimented with ontological tools. Each community college, college or university is unique and yet there are shared common elements. Elements common across some subset of instances may be reified as ontological primitives. These elements may be represented in the definition of formal categories and the resulting computing platform. The result is a data repository structured by an ontological model about all college, community colleges and universities. Done in a proper way, the result is that any specific college may be properly represented by some aggregation of primitives[1] [2].

A methodology for creating abstract models of classes is envisioned. This methodology maps to advanced methods in intelligence. It will take some effort to describe the methods, which are based on the logics of Bacon, Peirce and Mill[3]. I would hope to

---

[1] Prueitt, Paul S. (1995a) A Theory of Process Compartments in Biological and Ecological Systems. In the Proceedings of IEEE Workshop on Architectures for Semiotic Modeling and Situation Analysis in Large Complex Systems; August 27-

[2] Prueitt, Paul S. (1995b) An Implementing Methodology for Computational Intelligence. In the Proceedings of First International Conference on Computational Intelligence and Neuroscience. IEEE

[3] Prueitt, P. (1997). Grounding Applied Semiotics in Neuropsychology and Open Logic, in IEEE Systems Man and Cybernetics Oct. 1997.
Prueitt, P. (1997). Quasi Axiomatic Theory, represented in the simplest form as a Voting Procedure. VINTI, All Russian Workshop in Applied Semiotics, Moscow, Russia. (Translated into Russian and published in VINITI Conference Proceedings.)
Prueitt, P. (1998). An Interpretation of the Logic of J. S. Mill, in IEEE Joint Conference on the Science and Technology of Intelligent Systems, Sept. 1998, NIST.

create some advanced seminar and seek tenure based on a new set of peer-reviewed publications based on the application of this work to computing theory, ontology and service oriented architecture. Some additional research will be discussed in a few pages, related to differential equation and difference equation models of neural and immune function. A third area of unpublished work is derived from that application of elementary number theory when numbers may have changes in base.

The Mill - Peirce paradigm developed into a stratification framework in which the invariance over a number of instances is reified into an abstract model component. This model has the form of an ontological model. To begin to apply this model we should have definitive data about instances of college retention statistics. Three retention models are developed in this outline, and some sample of the dependencies explored. This is suggestive of future work. Each of the models attempts to describe a possible setting for the introduction of guided self-directed study in the freshman mathematics classes.

It is clear that a multi-year plan is required, and commitment by the faculty and administration ensured. For example in the first setting, the college has a strong natural science program which produces a significant number of graduating biology majors. In this example, the development of self directed learning of the right type of mathematics and computing theory could be combined with virtual world simulation of biological systems and environmental systems.

The ultimate purpose of our effort is to demonstrate the feasibility of a federally owned, but locally operated, virtual world infrastructure in which guided self directed study is learned by high school students. This learning might be mostly outside of the school classroom and yet could be a measure of the success, or failure, of schools in preparing students for their future. The evolution of classroom experience in the face of a "proven" new pedagogy will take time, and will involve teacher education and certifications.

This *Bridge* between high school and college will have simulation environments in which learning is supported for all of the core disciplines. Already Quest Atlantis ™ has fully developed virtual worlds supporting student exploration of writing and creativity[4]. Hundreds of colleges and universities have private virtual worlds under development and

[4] Quest Atlantis is a project of the University of Indiana in partnership with over twenty K-12 schools in Australia. http://atlantis.crlt.indiana.edu/ (accessed May 8 2010)

the hypergid development community is rapidly completing a set of implemented protocols These protocols makes moving from one of these virtual world to another as easy as using an URL.

Mathematics would appear to be the most difficult curriculum to lift into a virtual world, if we were to use the linear curriculum development institutionalized by textbooks and syllabus. All of this may change when we adopt the principle of stratification. Stratification creates a minimal set of topics and self-directed composition. In the modified method, a balance is found between traditional lecture and textbook, by creating a focus topic framework and substituting this framework for a detailed syllabus. Stratification in and of itself becomes an important element of curriculum. Stratification is seen in the way in which Google Earth is being developed, using a component warehouse. Stratification is seen in service-oriented architecture and in web services.

What is missing are the conjecture on acquired learning disability and the linkage between quantum cognitive neuroscience and how this disability may be overcome. Thus it is the demand pedagogy in the classroom that we will focus on this year. The demand pedagogy is based on focus topic frameworks; the stratification of the curriculum into the topics and compositions of self selected subsets of the topics. The evidence that stratification and self-directed composition frees the mind from the cognitive disability is what we are seeking to obtain.

Before moving to the next section, it is important to note that the introduction of self-directed learning and the use of immersive Virtual Worlds must be undertaken in a way where everything works. The system is not tolerant of any mistakes. The academic year 2009-2010 helped me design a modified method that is half way between lecture based on syllabus and the pure demand pedagogy. I used the modified pedagogy to teach computer science. However, my capacity is in teaching freshman mathematics and the modified method has not yet been used in teaching mathematics. So one semester is needed for me to become comfortable in a new university setting; and only after some agreements with colleagues might we design new pedagogy through which the program might be developed. My colleagues need the opportunity to see how the students respond, and the degree to which what I do in class fits, or does not fit, into the standard view of proper pedagogy.

I wish also to develop a study hall type resource for students who are having difficulty

and would agree to work within the demand framework in addition to regular attendance in their scheduled class. This effort would socialize the teaching methodology discussed in depth in *The Education Bridge*. I have specific views that we may discuss. What I have found is that it takes two to four weeks to bring a small class, ten to twenty students, to where they are completely aware of how the demand pedagogy works. Once learned in this way, the individual may apply the pedagogy to any course of study no matter how that course of study is taught.

Observations and Consequences[5]

We will now turn to the observation that habituation will always lead to a specific type of disability to learn. We have claimed to have well developed science on the side of an explanatory framework. When a biological response system has been under stimulated the system will develop the capacity to not respond to future stimulation of that specific type. This notion has been developed in the scientific literatures under the heading of re-enforcement learning.

Our conjecture is that re-enforcement learning leads to an acquired learning disability with respect to learning mathematics. One reason is because the class presentations did not go at the pace the individual needed at the time needed. There is also evidence that exceeding poor instruction is experienced often. We must be careful; however, as it is not a simple thing to understand how individual learning differences manifest in various settings. Of course, individualized learning has to be partially self-directed, and few individuals are taught how to be at least partially self-directed in the study of mathematics and science during middle school. So we have our work set out well.

Our conjecture is carefully developed, since it would be exceedingly easy to get this wrong. The analysis about causes must be carefully grounded in data, and presented in a way that is not seen as a conflicting challenge to established teachers and professors.

The conjecture implies a remediation strategy. We now need experimental evidence that the remediation works. The theory underlying our proposed remediation will require some effort to describe. In fact our argument is that any complete presentation about educational outcomes will not be simple. Questions are often more important than

---

[5] These sections start at about page 24, and is the last part of the Preface for The Education Bridge, URL at www.secondschool.net/bridge.pdf

assumptions. Consider just one of these questions. What is re-enforced as a child grows to maturity in the United States? Immediately we see how complicated the answer might be. Clearly in-class experiences are not the only experiences that affect the child's awareness of what is called mathematics, or math. The processes involved are complex, with multiple types of causes building specific habituated responses over the life of individuals and over generations. However, a pattern is developed consistent with the outcomes that we can measure.

Observations about facts are important. Developmental mathematics courses, as now taught in colleges and universities, are essentially sixth grade level arithmetic and number sense. We are trying to get the children, now young adults, to do what they learned only partially in the early part of school experience. This partial learning has habituated into a resistance to reengaging that same material again, no matter what the proposed rewards are. The data tells the story. At most colleges and small universities, the percentage of students enrolled in developmental mathematics as a first course in mathematics will range between 20% and 70%. The failure rates in these classes are often more than 40% and sometimes even higher. In current practice, the programs may represent an end to college for more than half those trying to start college careers.

In the proposed program, we build a model for freshman liberal arts mathematics. The model is not pure demand theory but is a compromise. In the model we modify the pure demand pedagogy so that a focus topic framework is supplied, along with a standard textbook. Students are taught about the demand pedagogy principles, but only slightly as there has been some resistance to spending class time talking about the "knowledge management" type best practices[6].

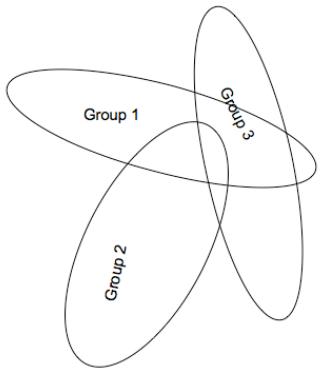
The modified pedagogy is as follows. A simple description is given to students about enumerating the topics in the entire book, or those parts we will focus on. Handing out a syllabus that lays out a timetable follows this description. "Chapters 1 – 3 will be covered by a specific date, etc". So the students are asked to create an individualized list of focus topics, and to do with without help form anyone else except the textbook. Then we from study groups and share the lists. Homework from the book is assigned

[6] The problem has been that students and faculty members are all set in their expectations as to how a mathematics class should be conducted. The concept that the student could or should be self-directed in how mathematics is studied is unfamiliar. Because there is so much pain around this issue, there is resistance to any change in expectations.

and taken up, graded, and returned in a timely fashion.

However, all tests are individual compositions by students of those topics that the student feels most comfortable with. Again, the process involved in preparing for the first expository test will take some class time to explain. Our experience at Talladega College, which had only an enrollment of 376 students at the time, was that all students on the campus learned how to “descriptive enumerate” the curriculum they were studying, no matter the course of study. This took a semester to set into place. This kind of phenomena has the capacity to transform an entire college or university and develop into a branding resource, to be used in recruitment and also in improving outcomes of all types.

Once the students, as a community, catch on, they begin to bring to class topics that they would like to see a lecture on. At one point, the classroom practice switches from normal lecture and going over homework to the instructor’s responding to a list of topics that students “demand” to see a specific lecture on. Clearly one can only conduct this type of class if one is a master of the curriculum.



Group interests with respect to topics in arithmetic

The figure suggests the results found when a class of 20 students comes to the classroom having understood the descriptive enumeration exercise and with a personal list of topics. The lists are not al the same! In fact students would red out a personal list, which I would write on the board. After several lists are on the board, we all become surprised at how the list indicate very different interests on that day. I would then be able to select a common subset and produce a lecture that ties those topics together, including developing original illustrative word problems.

This type of lecturing may only occur if the teacher or professor has a flexible and deep understanding of the curriculum. The method is a compromise between traditional lectures and the R L Moore methods. The Moore method requires the, graduate, student to develop the material, in real analysis or topology, without any reliance on other students or on textbooks. The compromise method creates a sense of discovery and self directed control over the process of learning.

It would be useful to video some of this as the details have always been a bit hard to describe. The demand pedagogy is based on a theory and the theory has certain coherence to it. It is also necessary that all students who feel the need to have additional workshop time be accommodated. At Talladega College, where I was Chair of the Mathematics Department in 2007-2008, this meant my being in the classroom on the weekends until sufficient number of the students had come to see that success was really going to be possible.

Proposed Program

The program we propose to put into place would use specific pedagogical guidance, specific web based resources, and the current curriculum for a core mathematics course. For example, we take this specific catalog description.

> **CORE 130, MATHEMATICS, 4 credits.** Aims to further the development of students' critical and analytical skills through the study of various mathematical concepts. Topics to be covered include logic, concepts of algebra, equations and inequalities, concepts of functions with a study of their graphs and applications, systems of equations, matrices, and an introduction to probability and statistics.

From this catalogue description and from the assigned textbook, the faculty may develop a minimal list of focus topics, following the methodology developed by the National Council of Teacher of Mathematics. Once this is created we develop the focus topic framework for the Mathematics course "Core 130"[7]. This grid may be lifted to the web and associated with a database.

	notation	theory	illustration

[7] An example of what four semesters of business mathematics might look like is given at http://www.secondSchool.net/grid.html

MA 103			
set theory, basic			
set theory, intermediate			
real number system			
fractions			
fractions in bases other than ten			
elements of abstract algebra			

The beginning elements of a freshman Focus Topic Grid

The Challenges from Recruitment and Retention

The outcome from K-12 mathematics preparation establishes a difficult set of challenges for the university or college as a whole. The full scope of these challenges may be seen in the various models of enrollment, retention and graduation rates. For example, we may look at the dependencies between mathematics, the liberal arts and general studies, the natural sciences, the trades, and other disciplines. Each of a small number of model templates addresses the conditions in a specific setting in a different way. A separate model about the enrollment, retention and graduation rates in the average community college may be estimated along similar lines. This will be important work proposed by the national center, so that when the *Bridge* is technically in place the focus may be on community colleges and underserved colleges and universities.

Our effort is to create a general model that may be adopted at any college, community college and university. The model will assist in the proper adoption of both supply, traditional and demand pedagogy. For specificity we will consider three settings.

The first setting is a small university with total undergraduate enrollment of 1,170, and a 34% drop out rate after the first year. The university has a strong natural science program and experienced faculty members consider the drop out rate due to the difficulty that students have with the freshman mathematics. The drop out rate after the first year is 20%, and 22%. If we assume an entering freshman class of 450, then 66% of freshmen is the number of sophomores; e.g., 297. This leaves 238 juniors and 185 seniors. We might expect that a balance between the traditional methods and self-directed learning we may reduce the freshman drop out rate to 24%, and the sophomore and junior rates to 15% and 16%. This would bring enrollments to 1,327 in four years.

The second settling is a university having a total of 9,000 undergraduates. We assume

a retention rate that gives us the result that 35% of the undergraduates are enrolled as freshman. All of the 3,150 freshmen need at least one semester of mathematics. The number of mathematics majors has declined from around 160 undergraduates in 1995 to around 45 in 2010. During this time, the degrees in the natural sciences have declined slightly but only slightly. This may mean that natural science is being taught with less mathematical content.

The third setting is a small military university with 1100 students. An entering freshman class is highly selective, but 22% of this class is placed into a developmental mathematics class. From this group 40% fail the first attempt. Other aspects of this model include an across the board absence of student learning retention from one mathematics class to the next and the absence of adequate support from the mathematics discipline to engineering or business. In this case, military preparation may mask a decline in academics.

It is important to note that the individual identity of the college or university is not really important for the purposes of our study. What is important is that this data be developed so that a before and after comparison might be made regarding any improvements in measurable outcomes. One may remember that there is a conjecture that the acquired learning disability arises form a specific kind of pedagogy while in K-12, and that this disability may be removed by a specific treatment. We know that the current outcomes are poor and getting poorer. What we are looking for is a specific process that implements self directed learning in freshman mathematics courses. By acquiring data by type of institutions, perhaps avoiding the mention of specific names, we create the motivation to adopt self-directed learning strategies if we have the data that gives evidence to the conjecture.

The three settings will be part of a model-based analysis that could be reported in proposals to Department of Education and NSF during the fall 2010. In pilot programs, we will attempt to describe the current expectations, and to treat the incoming freshman class in a new way, based on stratification of the curriculum into focus topics and the use of composition onto blank paper as assessment. So there is a treatment model and a means to reporting on the outcomes. By the spring of 2011, we will have at least two colleges or universities participating in some degree of pedagogy change.

Ontological modeling is a field from which few are skilled. However, our team has deep

experience in RDF, OWL, topic maps, mind maps, cognitive graphics and n-ary ontology; as well as semantic extraction techniques. The eventuality of major parts of educational services being lifted to 3D simulations is coupled with the eventuality of the use of ontological models of buildings, power grids, ecosystems, health systems and learning processes. The proposed National Center would accelerate the proper integration of ontological modeling and simulations environments supporting public and private education.

The following types of data becomes of interest. What is the enrollment of students in higher mathematics (Calculus I or above, not including Calculus for business majors or statistics for economics) when these courses are a service to biology, engineering, computer science and chemistry? In particular, how often is the desired mathematics class not being successfully taken in line with what is desirable for the biology, engineering, physics, and chemistry majors? Similar questions may be asked about the service support courses for all majors in the university.

Let us look at the second setting's as-is description. The entering non-mathematics and non-science majors are placed in eleven sections of first-semester precollege mathematics and eleven sections of second semester precollege mathematics. With average enrollments of 28 students in each section, this works out to 616 students. There are also 38 sections of college algebra, 6 sections of trigonometry, 6 sections of pre-calculus. With similar assumptions about class size, this works out to 1400 students. The calculus series is in place, accounting for perhaps 120 students but only a few courses in the pure or upper level mathematics major courses such as topology, real analysis, complex variable, abstract algebra. The total number in these higher mathematics courses may be approximately 30 total. The number of graduating mathematics majors is fewer that 10 each year.

What is startling here is that over 2000 freshman are enrolled in a non-major mathematics classes each semester, with only 10 graduating majors. There is no other discipline that has a similar ratio. So the question, "Is mathematics important to society?" Consider the ratio formed from the number of individuals enrolled as freshman and the number of students who go on to study and comprehend mathematics. The root cause analysis is instructive but will be attempted here only in brief. It is suggested that the ratio should be, if America is to remain competitive, not 1/200 but rather more like 1/20. Under what circumstances could this be achieved, and what would be the

consequences from 1 in 20 individuals actually knowing what mathematics actually feels like. Clearly in society today, the ratio is like 1/750, if we were to guess; or perhaps 1/1000.

Out immediate objective is to acquire funding for a national center to study the use of immersive Virtual Worlds (iVWs) as a public service infrastructure. The study will attempt to get out ahead of the rapidly developing use of behind the firewall dedicated virtual worlds by schools, colleges and universities. The integration of new pedagogy is an active area of development even in 2009. Increasing numbers of peer-reviewed journals are appearing.

Our Theoretical Grounding

The difficulty that students have with mathematics is certainly more complex than what might be termed an acquired learning disability. This is a given. However, the mathematical modeling of immune and cognitive; e.g., neural, function that was completed as part of a PhD thesis (in 1988)[8] in pure and applied mathematics and then extended over the next two decades, suggests a specific remediation. This remediation has behavioral and social elements.

It is important to see that the remediation is developed based on underlying theory. The theory is grounded in natural science, and implies architecture for implementation as part of the immersive Virtual World infrastructure proposed for *The Education Bridge*. So the national research center should advance the understanding of this theoretical grounding by developing experimental work based on observations of brain function while students are learning the pedagogy.

The remediation involves topic mapping by the student of the material that the individual is comfortable with, the use of knowledge management type thinking, and exposure to novel curricular elements. This remediation is also specific to the individual and each individual is evaluated and tasked in a way that fits his or her perceived needs. A curriculum that is not known by the students, and was not part of the standard curriculum, is outlined using a list of focus topics. Students are then minimally guided to see the curriculum as having two kinds of topics; those that the student knows and is

[8] Prueitt, Paul S (1988) Mathematical Models of Biological Systems Exhibiting Learning. PhD theses The University of Texas at Arlington.

comfortable with, and those that the student is not comfortable with.

Once this separate mapping of one's own knowledge and comfort with topics has been achieved, the student develops strategies for (1) rehearsing and presenting from the topics he or she is comfortable with, and (2) experiencing the first occurrences of awareness about the nature of a topic that was formerly not understood. This remediation is specific to the transition between high school and college. We try to account for the broad range of experiences, the absence of certain types of motivation, presence of fear of mathematics, and the needs from the core curriculums in all of the other departments in the community college, the college or the university.

Bridge from High School experiences to College experiences

The experiences that are habituated from K-12 experiences might be unwrapped and an opportunity provided for each individual to reshape his or her capacity to learn higher mathematics and even real science. To make reference to Allen Bloom's famous 1987 book, *Closing of the American Mind*, the American mind might then open[9]. We see opening access to the foundations of abstract thought as a necessary element to opening the American mind to the future. What abstraction allows is a more complete and proper understanding about the nature of thought.

The mind of the next generation of students may be shaped by a sense of multi-culturalism and diversity. We as Americans have always celebrated these concepts. However the observed focused resistance to this evolution may have some roots in the entrenchment we see in our application of education and learning theory to teaching. In some simple sense, we propose an evolving educational theory that moves the individual capacity from mono-coherence to multi-coherence. A theory about the nature of multi-culturalism is addressed in the body of *The Education Bridge*. This theory does depend on a distinction between coherence and multi-coherence. The thesis regarding cognitive function and coherence is a demanding one that will take some time to develop. So we will put off this exposition for now.

The possibility of a universally applicable remediation is why an underlying excitement has arisen over the years. If the conjecture on acquired learning disability is correct, then new learning strategies might be developed based on principles derived from

---

[9] Bloom, Allan. 1987. *Closing of the American Mind*. New York: Simon & Schuster. ISBN 5-551-86868-0

natural science. We do not claim to have settled all of the issues. What we may do is to lay out an argument that the remediation strategy may be perfected and then scaled within the simulations in immersive Virtual Worlds so as to affect the entire education sector in the United States.

The lifting pedagogy is based on a shift in pedagogy, from what we call supply pedagogy to demand pedagogy. The shift may be seen as radical, but a radical shift appears necessary if we are to change what has become a deeply seated historical trend. When the new pedagogy is successful, the student sees a purpose in what is learned.

> "So overall, I love this class and everything we do in it. I find everything we do in here very useful not just for now but for future use as well. We found ourselves coming across problems that we thought could not be fixed, but yet we worked through them and fixed them. I feel that was the overall lesson of this class, to keep working though the problems and get to the goal."
>
> Norwich University Student spring 2010

From this purpose the student comes to compose original expositions about what is learned. The underlying methodology is based in part of the use of a list of focus topics that outlines the curriculum.

> "Pedagogy is the study of being a teacher. This portion of my paper explores the Demand Pedagogy. It will be the standard one day, but as of right now is still in development. The idea of using a focus topic grid instead of a syllabus is clever. A syllabus is a good tool, in that it lays out the plan of the course for the entire semester. The problem is, however, most syllabi are hard copies. What happens when the teacher gets sick and misses two days of classes?"
>
> Norwich University Student spring 2010

The composition process replaces multiple choice and short answer tests with focus topic framework based exposition. The student takes responsibility for saying, "I know this", and giving evident that this is a true statement. The intention of the individual is engaged in a fashion that is under the control of the individual. The key is to make learning self-directed while also imposing a regular order on the processes provided by schools, colleges and universities.

Literature Review from Educational Theory

"Demand pedagogy" may be defined as a modified Moore method[10], which is Socratic, participatory, and constructivist[11] [12]. In turn each of these approaches is defined in various literatures, for example Thomas (2000)[13] reviews of research on project-based learning. These literatures are to be integrated to produce a set of illustrations of demand pedagogy and to contrast demand pedagogy with an alternative paradigm.

Some state laws are now requiring college curriculum to be certified and posted onto the Internet. This requirement may be meet by posting a detailed syllabus dictating what is to be covered each day for the entire semester. This requirement meet in this fashion would be precisely the most incorrect program if the conjectured acquired learning disability is found to be well grounded in immunological theory. The reason is that the students have developed a specific ability to not respond to the topics in the standard curriculums.

The focus topic framework creates a means to comply with state laws, while at the same time providing the flexibility required for self-directed study using the lifting pedagogy. The student is allowed to select topics, categorize these as comfortable with or not comfortable with, and then study deeply that part of the entire curriculum which will benefit him or her the most. The state law is complied with because the curriculum is fully identified and each day's class procedures are also clearly identified. Each day, students will "demand" clear expositions at depth of topics that students have selected from the list of topics that is posted on the web as the curriculum for that course.

Clearly there is some criticism of a supply side theory of educational processes. There are also justifications based on the needs of an industrial society. The roots of this justification are to be explored. The review of the literature will shine light on a growing consensus for viewing all educational theory as being roughly within two schools of thought, a supply oriented school of thought and a demand oriented school of thought. For example the concept of being situated brings the intention of a unique individual into focus. To the degree that this focus is important to an educational process, we may say

---

[10] Charles A. Coppin, W. Ted Mahavier, E. Lee May, and G. Edgar Parker, *The Moore Method: A Pathway to Learner-Centered Instruction,* (Mathematical Association of America*, 2009).*
[11] Wilson, Brent Gayle (1996) Constructivist learning environments: case studies in instructional design
[12] Campbell , Jamie I. D. (2000) Handbook of mathematical cognition
[13] March, John Thomas (2000) A Review of Research on Project-Based Learning

that this is a demand side focus.

The demand pedagogy may also be compared with a pedagogy that is supply side in nature, and in this way an analogy made to demand and supply theory in economics.

The theory underlying demand pedagogy has various areas of application; in understanding natural science, in the design and use of a new computing technology, and in methodology associated with human management of knowledge and knowledge representation. The application to natural science takes the view that organizational stratification develops through replication mechanisms that express as compositions. Various examples include gene and cell signal pathway expression.

Computing technology may also use a stratification of the designed processes; e.g., programs or services, as compositions of a small set of service or process components. Certain benefits to service oriented stratification are suggested by best practices[14] [15]. There is an alignment between service oriented stratification and natural science underlying demand pedagogy.

Finally, the management of human knowledge representation may make a distinction between instances and reified universals. The universals are regarded as components of ontological models of particular instances.

Conjecture on a Specific Acquired Learned Helplessness

We then arrive at the core conjecture. This conjecture is the supply side educational processes are largely responsible for specific and measurable acquired learning disabilities.

Evidence is gathered statistically by taking data from groups who have experienced a predominately supply side learning experience when compared with groups who have experienced a predominately demand side learning experience. In particular the R L Moore method has some research associated with its use. The difficulties with the use of statistical models in this case are discussed.

Models based on neural networks are then developed. These models will extend and

---

[14] Prueitt, Paul S (2009) Articulating SOA in the cloud, http://www.soamag.com/I34/1109-4.php

[15] Prueitt, Paul (2009) - "The Service Engine: Structured Communication using Modern Service Technologies" SOA Magazine, http://www.soamag.com/I30/0709-1.asp

summarize the work by Levine[16] on modeling selective attention and the linkage between emotion and intellect. A model of immune response is also re-developed from work reported in Prueitt's (1988) PhD thesis on reactions networks as models of under stimulation of biological response mechanism.

The models suggest that long term under stimulation in mathematics and science classes accommodates an anti-intellectual social philosophy. The stability of this philosophy is supplied from the physics of the individual neural and immunological behavior as well as from replication mechanisms existing within American cultural histories.

Our model of selective attention then is used to suggest a biological basis for shifting viewpoints in a pure selective paradigm, as suggested by selectionism[17]. The acquired cognitive disability is seen as an inability to shift viewpoint. A remediation strategy is then suggested based on the use of focus topics, as components, and self directed composition of focus topics.

Lastly, we suggest experimental means to falsify, if possible, the conjecture that an acquired learning disability of the type we model is a controlling factor in the decreasing ability seen in the entering freshman class.

These experimental results will then be extended to suggest that in most cases the acquired learning disability may be removed using specific techniques that are constructivist, participatory and Socratic in nature, and which use a stratification of curriculum into focus topics.

The self-directed composition of a selected subset of the topics is then suggested as the assessment methodology for mathematics and science education.

---

[16] Levine , Daniel (1987) Introduction to Neural and Cognitive Modeling (2ed Edition)
[17] Edelman, G. M. (1987). Neural Darwinism. New York: Basic Books.