

## **Chapter One**

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### **The Core Proposal, Technology and Deep Learning**

#### Index

Dedicated Social Media Infrastructure

Virtual World Assistance in Virtual Classrooms

Broad-based Justification for the Bridge

On the Question of Monitoring

The Acquired Learning Disability

Local, State or Federal Responsibilities to the Citizen

Transition Between High School and College

The Origins of a New Pedagogy

Deep Learning Methodology

Student Developed Focus Topic Repositories

The Loop Exercise

Comparison to Traditional Teaching and Testing

Loop Exercise, the Procedure

Community Based Collaboration

## **Dedicated Social Media Infrastructure**

An extension of current social media is proposed as the virtual part of a dedicated infrastructure supporting the transition between high school and college. This infrastructure might be developed using one hundred million dollars in federal grants or loans, or through some other process. The eventual yearly revenue from the infrastructure may top one hundred million dollars per year, within four years. The number of high school students served could be 15% of all high school graduates within that time, or over three million. The number could be far higher.

The virtual infrastructure is to be connected to communities via state chartered corporations owning a franchised specialty shop serving coffee, healthful teas, and baked goods. The specialty shops may be seen as means to ground the virtual infrastructure in a community centered business. These shops will have teleconferencing facilities. Economic support for a virtual transition program supporting high school to college transitions will come from these specialty shops. Our virtual infrastructure will also be connected to colleges and universities as part of college recruitment services.

The goal of establishing a transition service for all graduating high school seniors is a complex one. Planning has been less about how the *Bridge* will come about and more about the set of principles that provide opportunity. So there are some alternatives. The establishment of the *Bridge* could initially develop centered around a single college, or group of colleges. Or the process could start in several parts of the United States, using a mixture of public and private funding sources.

There are several possible pathways. Initial funding to create a next generation virtual world system might be developed as a grass roots movement, or as a grant or loan from the federal government. Initial costs are a small sum in both government and corporation worlds. However, we also envision the development of pilot state centered *Bridges* based on private funding and grants from local municipalities.

That such a large program might be considered is only possible because of where we are in history and due to the innovations in technology and pedagogy we discuss in the proposal. We make the argument that a one time federal grant creates economies of scale without jeopardizing local control.

Economic success is said to require a need that is addressed in an innovative and cost efficient fashion. The problem that the *Bridge* addresses is stated in one short sentence.

*High schools are failing to graduate students prepared for college level study.*

As part of our proposal we conjecture that a systemic root cause has evolved which functionally excluded most Americans from higher education. The nature of the exclusion is connected to natural tendencies of individual humans and groups. Because this exclusionary behavior is deep rooted in the current systems, the root cause can be overcome only by creating something that is independent of the current system. It is also necessary that control over processes involved in changing outcomes be primarily directed by individuals, rather than by state or federal government.

We try to justify our conjectures and the principles laid out in the proposal. However, we also accept that some aspects of our conjectures and principles will be modified. This proposal is a best attempt to actually address a core difficulty. The difficulty is one for which the education system is showing itself unable to effectively manage.

The common access point for any sixteen, seventeen, or eighteen year old; will be the Internet not the high school classroom. Enrollment will be before the individual has completed high school. A core objective is to help the individual select the college he or she wishes to attend. The high school will not be informed and will generally not be involved in any way. Existing tutoring and college preparatory businesses have a similar relationship. However, our purpose is to carefully evaluate the individual and to open opportunities for which exclusion has become hard wired. The individual must feel that the *Bridge* experience is unique and not biased against him or her in the same way as was experienced in school. There is a chance for advancement that is not depending on cultural, racial or personality characteristics.

The individual will enroll through an identification process, where all private information is protected in secure fashion. Once enrolled, fees will be minimal or waived so that in no case an individual is prohibited from enrollment due solely to financial consideration. Income for each state-chartered *Education Bridge* will come from a private sector function. The profits from Second School™ specialty shops provide enrollment slots. The growth of the system will depend on these funded slots. Enrollment will; however,

be conditioned by strict terms of agreement. Similar to the model of a boarding school, it is understood that participation in the *Education Bridge* is subject to continuing demonstration of advancement and in the individual's conformance to behavioral rules.

The transition infrastructure is to include a platform for three dimensional on-line game type environments, with avatars, buildings and landscapes. Some individuals will wish to develop building skills and learn how to simulate real world processes using natural science and higher mathematics. This work will be under the supervision of a growing number of accredited Second School professors. These accredited individuals together create curriculums and will provide instruction on deep learning methods. The curriculum is oriented towards a liberal arts core, at the college level. New curriculum is oriented towards deep learning methodology. This curriculum opens new employment potential in the areas of Internet service provision and in the biological sciences.

User accessible building and process scripting is currently available in Open Sim<sup>1</sup> and Second Life™ virtual world infrastructures. Individuals may learn to shape terrain, place vegetation and scripted animals, and build building structures. In this way the owners of these systems benefit from user effort. The *Education Bridge* virtual worlds will provide building and scripting tools, available now as free open source software from Open Sim. However these tools may be made more powerful and may be used to design original machines and processes by simulation.

### **Virtual World Assistance in Virtual Classrooms**

Any design of a business-based infrastructure, which serves public service interests, will have a certain amount of complexity. This is just necessary, expected, and natural. If the design of infrastructure does not reflect the difficulty of a social problem, then it will likely fail. Education is not a normal business. So all aspects must be designed in depth. Our proposals outline principles where the differences and similarities between public interest and private interests are accounted for. The first principle has to do with the design features of a, future, virtual classroom. This classroom will be modeled as closely as possible to the real classroom, and will support the real world educational

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<sup>1</sup> Open Simulator web site: [http://opensimulator.org/wiki/Main\\_Page](http://opensimulator.org/wiki/Main_Page)

system. Students who have learned that they cannot learn mathematics are shown the falseness of this lesson.

Our summer 2012 pilot is designed to create a magnet for high school students, based on:

- 1) Healthy music and social iteration (monitored as if in a boarding school - see section three of this chapter.)
- 2) A core liberal arts curriculum, offered entirely on line in monitored virtual worlds, including: a) Reading, writing and foundations to higher mathematics via deep learning methods and b) The sociology of growing up in 2012, with topics like "identity of self", "social obligations", etc

The goal is to complete final steps leading to a dedicated virtual campus, with virtual classrooms, where deep learning methods and social interaction enhances youth opportunities in the City of Atlanta. This system can be scaled to handle tens of thousands of individual student transitions from high school to college.

Deep design is particularly important when considering how the *Bridge* is to be supported economically. The real differences between business interest and public interest have created an opportunity. Business is by nature oriented toward profit, whereas public service is oriented towards serving the common welfare of everyone. This separation, between profit for a few and value for all, is seen in the physics of particles and waves. So the underlying mechanics played out in economic cycles is also present in elementary physics, as well as in the means by which the physical brain maintains cognitive coherence.

The classroom design is intended to fit into an economic structure while fulfilling society's need for quality transition from high school to college. The *Bridge* is designed to allow any 16, 17 or 18 year old American citizen to register and acquire an avatar. Once in the system, the student will find that the *Bridge* is for educational purposes only. And yet the power of this three-dimensional simulation world will be far more profound than video games.

The initial mission of our supporting business franchise is to fund individual transition of graduating high school students into freshman college classes. This means that the

system will be designed to manage the enrollments of millions of young adults. This management will be centered in the physical location of the Second School Tea and Coffee shops. This business franchise is to be centered on a coffee, tea and baked goods shop with teleconference rooms. Several considerations are advanced through the function of these shops. These businesses will serve as recruitment centers for *Bridge* services as well as in the provision of administrative and professorial personnel.

The shops act to center college recruitment work on the actual needs of each local community. Baked goods, coffee and healthful teas are shared in a social fashion, creating a revenue source. Different ethnic groups might be served through specialization in how bread is baked, or tea is served. People will buy at the shop as a means to support the *Bridge*. There will be some identification of how successful each location has become, while protecting the identity of individuals who enroll. Statistics are to be communicated, but no individuals will be elevated as “winners” in the public space. This often harms the individual who is not oriented to competitive schooling and the current over emphasis on winners and losers.

The second consideration is that a physical classroom serves a dual purpose by providing a teleconference resource rented by the hour. This provides a service that is growing of value. Additional revenues will be developed consistent with the mission of the Bridge. However, the physical classroom is also essential to our enrollment process. The physical classroom is generally necessary for enrollment into one of the class cohorts. These cohorts form due to availability of enrollment slots. Ideally, the deep learning methods should be taught in a physical classroom as a first step for each individual. Experience suggests that this learning process requires three weeks. As a second step, individuals who have graduated from this three-week class are then organized into cohorts of 20 to 40 individuals. The membership of these groups can come from anywhere around the nation.

Long-term considerations are in place. American economic renewal is one of these. The next generation of virtual worlds will assist in the development of new innovations supporting technologies needed for future markets. A new level playing field will be established and patents will be expressed as three-dimensional simulations. These

simulations will have component information automatically encoded as part of the design and simulation, as if a real thing in a real world. Physics and biology engines support these simulations.

For example, a system has been designed to use algae in small ponds to produce oil and clean pollutants out of water. Investment to support this system has been hard to find. This example has been used during our design process as a prototype. If the algae to oil system could be built “in-world” then that system might also expose building information on all of the components. And because component information is designated in the model, the supply chain associated with the system’s components is also made available as part of simulations.

The algae to oil model we produced indicates that 20% of ALL oil consumption in the United States might be generated by a new nation wide ecosystem of sustainable algae to oil facilities. The cost associated with the initial development of this ecosystem in southwest Texas and southern New Mexico would be less than a billion dollars. However, a complete privately owned system would produce between five and ten billion dollars in revenue per year, within three years. This is easy to see with the simulations. It is also easy to see that system that would be sustainable in each of the fifty states will be eventually designed and built. More importantly, it is possible to plan on the ownership of the ecosystem being broadly distributed so as to serve common public interests rather than merely the interests of one or two multi-national corporations.

New social benefits are revealed. Any new innovation that is part of any innovator’s business model can be built as simulations within a complete model of a far larger system. The simulation can be the basis for patent claims and thus will protect the individual innovator. There is also support for business start-up processes that use innovations designed in virtual worlds. The costs of simulation can be very low, and yet the simulation itself serves as a cost reduction element if that innovation is to be included in real world economic development. There is a pathway in which the distribution of ownership is enhanced by educational processes, both in the virtual worlds and in real physics schools and colleges.

The development of markets and training required for maintaining markets can be

coordinated through the use of extensive simulation in these virtual world systems. For example, a large-scale simulation of algae to oil production might be made a part of a training program for youth in urban areas. New business ecosystems based on economies of scale might be an object of college level study. The reduction of costs also might assist individuals who wish to make life long commitments to a new ecosystem.

An individual might raise funding for ownership within the system. For example, an individual twenty acre ranch in southwest Texas might be converted to an algae to oil production unit if an investment of two hundred thousand dollars was available. Given that hundreds of these units will be needed as part of a billion dollar investment process, an individual ranch owner might apply for the funded needed to participate in something larger than the individual. Our simulations suggest that yearly income from this type of investment might be as high as one hundred thousand dollars per year. A large multi national corporation needs not govern this process.

The classroom creates a means to train our youth in next generation technologies, starting with higher mathematics. There are pathways to real world advancement economically for each student. Phase Two of the Bridge proposal is to create a federal-state funding mechanism that individuals can apply for, similar to the now federalized student loan program. Loans and grants will provide a financial means to give some members of the next generation of Americans a chance at a renewed American Dream. Building and scripting tools will be used to teach architectural principles, and foundational principles from the sciences. Elements of higher mathematics will be linked to things like the stress on building beams, or the natures of populations grown in an aquatic pond. Models from environmental sciences will be developed, as well as models of economic systems.

Given these loftily goals, it is important to make a specific point. The center of the *Bridge* virtual worlds is in fact the virtual classroom. This center requires that virtual reality be a simulation of the everyday reality that can occur, but often does not, in the physical classroom. The real classroom has centuries of history and is deeply rooted in our sense of what education might be like. We cannot leave the obvious behind. College level learning requires communication between the “class” and the professor. And communication is best made in the form of voice and visual gesturing exchanged

between individuals and professors.

So how is this simulation of reality achieved? Virtual classrooms have desks to sit at and virtual/real writing tablets. As a student writes on a real world tablet, this writing will be encrypted and transmitted into the virtual classroom. The classroom will then transmit appropriate sounds and results of handwriting on real world tablets to all participants. The avatars will write on a virtual tablet. Professors will write on a real world tablet as the professor avatar writes on a chalkboard. Voice will be easily transmitted, as is now the case in Second Life. The purpose of the classroom is to enable communication between the professors and the students, and between students and students. The use of digital handwritten message serves this purpose. The technology is currently available on smart phones, technology pads and computers.

The classroom is to be developed so as to simulate the existing dynamics of a college classroom. The simulation will be as loyal to the real world as possible. This deep design has been developed in spite of the more common view that virtual worlds will be used to teach by engaging the students in entertainment. Our deep design is based on learning pedagogy and not upon a need by entertainment industries to continue making high profits through an addiction to violence and sex. Simulation of an actual college classroom is thus been a central design feature of our work. This work has moved against the standard views of how virtual worlds are to be used in education.

Deep design principles arise from Constitutional issues related to government control of social processes. In turn these principles are rooted in the mechanisms connecting non-locality to locally realized interactions. Stratification as a principle is seen in physical and political systems. We expect that a *National Education Bridge* will be administered by public-private partnerships at the state level. Its presence will radically alter the quality of the freshman mathematics class by better preparing entering freshman in higher mathematics and science. Even though our initial focus is on technology, higher mathematics, and science; we will also develop learning support programs for writing and reading, as well as some topics from the humanities. The issue of governance will be included in the transition curriculum. This is necessary because of the profound political changes that the Bridge will advance. These political changes can be and should be

aligned with a modern understanding of physics and biology.

What is possible does seem to be unreachable. The technology within the *Bridge* will accelerate a common understanding of advanced technologies revealed within the *Bridge*. For example, a new technology based on stratification will be explained, introduced and implemented<sup>2 3</sup>. The platform will not be “for on-line games” but rather will be a means to establish virtual communication and support for learning and teaching. The same system will evolve a design medium focused on supporting sustainable economic processes. Building standards called Building Information Modeling standards will be used in producing the constructions we will see within the *Bridge* worlds.

These goals are not unreasonable. It is just that those responsible for the administration of education are off somewhere else doing something other than looking towards an rapidly emerging future. Several parties are developing various types of next generation collaborative cooperative social media. On-line game systems, and social media like Second Life™ are well developed. Open source versions of the software exist. As these new platforms are developed we find congruence between the design advanced in the marketplace and the concepts we have described as part of our initial work on the *Bridge*<sup>4</sup>.

The primary difficulty has been how to realize a three dimensional social media in which all of the issues related to exclusionary processes has been accounted for. The classroom simulation and digital handwritten message exchanges is where the tires meets the road. When looked at as a complete package, one begins to see that digital handwriting exchanges and a high level of private security are one aspect of a positive strategy. Deep learning methods are a second aspect. A third aspect is the follow-through opened up because of our definition of the leading edge of green technology. This third aspect needs some explanation.

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<sup>2</sup> Prueitt, Paul S. (1995) 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 27-29, Monterey, Ca, USA; Organizers: J. Albus, A. Meystel, D. Pospelov, T. Reader

<sup>3</sup> Prueitt, Paul S. (1995) An Implementing Methodology for Computational Intelligence. In the Proceedings of First International Conference on Computational Intelligence and Neuroscience. IEEE

<sup>4</sup> Prueitt, Paul Stephen (2011) Systems Science and Service Computing, <http://www.servicetechmag.com/I57/1211-3> Published Dec 14th 2011, Service Technology Magazine.

There will be innovations; primarily arising from methods developed for national intelligence<sup>5</sup>. The architecture for the *Bridge* platform is based on a stratification of virtual phenomenon, reflecting organizational stratification found in nature. It will have features and capacities not found in the current generation of virtual worlds like Second Life™. For example, in Second Life™ and Open Sim virtual platforms, one finds a well-developed physics simulation engine, but nothing that would serve as a biology simulation engine. The new system will move us in this direction.

Computer process stratification allows the use of process ontology, and other models of complex phenomenon, to guide the development of complex simulations by ordinary users. How this works is outlined in our proposals<sup>6</sup>. While this feature is now only a theoretical notion, the new architecture can be shown to have capacities not realizable without stratification. The ability to produce a model over all activities within a virtual world is one of these capabilities<sup>7</sup>. Modeling the evolution of a social structure, as expressed in a monitored virtual world is an essential element to our provision of a boarding school like experience.

Deep learning, as defined in our work, involves a shift in responsibility for learning from the professor to the student. The theory about deep learning is extensive, and yet confused. Stratification is an essential part of a coherent theory connecting physics and biology.

One means to enhance deep learning is for the student to take notes in class, and review their notes while outside of class. Remembering that deep learning methodology is not mainstream and has not been fully developed; we can suggest some of the features we envision. These involve a student constructing representations of the curriculum, and expressing these internalized representations in hand written notes. All students in each “class” will see proof that the material can be mastered. This proof is equivalent to a proof that the individual has been inappropriately excluded from access to higher

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<sup>5</sup> Prueitt, P. (1997). Grounding Applied Semiotics in Neuropsychology and Open Logic, in IEEE Systems Man and Cybernetics Oct. 1997.

<sup>6</sup> The American Education Bridge, a proposal to President Obama; draft materials have been posted at [www.educationWorlds.com](http://www.educationWorlds.com).

<sup>7</sup> Prueitt, Paul S. (1996). Semiotic Design for Document Understanding, in the proceedings of the Workshop on Control Mechanisms for Complex Systems: Issues of Measurement and Semiotic Analysis: 8-12 Dec. 1996.

mathematics. The class, and the virtual classroom is an essential part of this proof.

Each semester, an upper list of names of topics is to be included in the course syllabus. The students, using two-level topic taxonomy, will extend the upper list. The original list is the outline of the approved curriculum. The student developed extension of this list is derived from note taking in class, and other means such as viewing videos of topics as seen on many of the free mathematics tutorial websites.

Each semester, the course would start with no topics in a focus topic repository of hand written notes dedicated to that class. Students will meet, both on line and on college, school campus or at the Second School™ shops; to review video and to work on video clip submission to the professor. Students will prize note taking, even though all posting to the community of practice, the class, will always be missing name and voice. Handwriting is expressive. Student work on making expressions complete and perfect is part of the instructional strategy. Topics would develop both in number and as additional notes on a specific topic is submitted.

In the virtual world a student will be able to write on a tablet, or sheet of paper with a digital pen. This method could not be achieved even a few years ago, but is now possible at low cost. Peer-to-peer interaction is being proto-typed from the website [www.liftingPedagogy.com](http://www.liftingPedagogy.com). This site will develop a topic map model of student perception about deep learning methods<sup>8</sup>. When our real time digital handwriting exchange is on line, we will further develop a focus topic orientation to deep learning by allowing students to post sections of individual class notes as part of class activity.

### **Broad-based Justification for the Bridge**

Our justification for the *Bridge* proposal involves complex arguments and requires an extensive intellectual background. We make some references into several scholarly literatures, but clearly not enough. Many of our arguments are made without the type of evidence that could be gathered. As we apologize for this failing, we acknowledge the sheer magnitude of our effort. For example merely testing brain patterns, for what Prueitt has predicted will always be seen, has been proposed but collaboration has not occurred.

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<sup>8</sup> The capabilities of [liftingPedagogy.com](http://liftingPedagogy.com) will be developed, as funds are made available.

In one instance, a professor at Emory University explicitly recognized both the feasibility of measuring acquired learning disability from EEG and the importance of this. Researchers having EEG labs have already a full agenda.

On the other hand, it is most important that our arguments make political sense. In this third subsection of chapter one, we continue an examination of questions that are hard to ask, and even harder to find complete answers to. Generally, we address the purpose of public education and specifically how one measures learning outcomes. We see testing of the type standardized using computers as harmful to the learning process. Deep learning is measurable using handwritten expositions, similar to when a student writes an essay on an assigned book.

Deep learning methods can be completely realized in the virtual classroom. We have developed physical classroom methods and practices, at Atlanta Metropolitan College, and these can be lifted into the virtual classroom. Deep testing will be via real time handwritten digital exchanges, using digital pens and smart boards. The individual practicing for these “Blank Paper Tests <sup>TM</sup>” requires the student internalize the actual curriculum, in much the same way as reading the book and reflecting on how to write an essay prepares the individual.

As illustrated in the last part of Chapter One, a Four Step Method <sup>TM</sup> is used to (1) find an example, or be given one, (2) name the focus topic that best fits that example, (3) create several illustrations or exercises that show various aspects of the focus topic, (4) use proper mathematical notation to evaluate the importance of the topic.

In the next section we address philosophical issues related to extensive monitoring that will be required if a national infrastructure is implemented using social media. We also address the feasibility of a clinical approach designed to recondition individual perception after individual perception has developed in a harmful circumstance. In neuropsychological terms, we seek evidence that a “good” perceptual field can replace a “bad” perceptual field, removing the acquired learning disability even after years of bad math classroom experiences.

The *Bridge* proposal is seen in an historical settling. It seems obvious that public education is benefiting a declining percentage of our children. An increasing percentage

of children graduate from high school, and an increasing percentage of those graduating are proficient in core curriculum. School learning in core academic subjects is not being retained. It is as if our children have become un-interested in those core academic disciplines that define liberal education.

Our questions have been regarding how to properly represent what has happened and what might be done. The challenge seems almost impossible. It is easy to be unfair, and we try to avoid pointing fingers. However, because of Prueitt's own experiences, he often points to the colleges of education, and programs for teacher education. In his opinion, these programs are described as philosophically poorly grounded in science. In the colleges of education, PhD production focuses on protecting the integrity of the system, rather than on defining how our democracy might realize universal education. Administrators often get side tracked and waste huge amounts of public funds, while innovation is discouraged. The Bridge is designed to be away from the same control constraints.

The decline in educational outcomes may mirror a trend in our perception of who we are as Americans. The perception is that we have lost something. We, collectively, have a perception that has been called the American Dream. The perception is itself both a definitional collective idealization as well as an embraced illusion. For example, this vision of an America with healthy middle class is not shared equally in all of our cultural sub-populations.

The development of the *Bridge* proposal is encouraged by our belief that the American Dream might soon be enhanced. The enhancement depends on understanding these questions regarding a loss of common purpose. Central to our goal is that a community of professors lead in charting an end to the crisis in American education. Our proposal conjectures that this leadership will not occur until there is real clinic evidence that the capacity to learn is actually harmed in most cases by school experience. Further that this damage is so severe that only a reconditioning of each individual's internal cognitive system returns the individual to natural capacity. The evidence supporting Prueitt's 1983 conjectures on acquired learning disabilities is nearing the point where such clinic evidence is possible. Again, the challenge is in getting ample time and resources spent

on innovation.

Phase One develops what we regard as a necessary infrastructure. The virtual world environment creates a location for collaboration between professors and teachers. As early collaboration brings a common approach, pilot programs are anticipated where small groups of students are taught using deep learning methods.

Phase Two creates economic incentives for our children, providing a promise of support for those who develop new models of sustainable living. The infrastructure is designed to be independent of the current school and college institutions. The reasoning is addressed in other sections, but is summarized in a simple way. Higher education does not feel responsible for the crisis, and school education is less and less well equipped to address new trends.

Deep learning creates the possibility that students develop long-term retention of curriculum. The individual is given the responsibility for demonstrating knowledge at the evaluative and synthesis levels. This responsibility for synthesis and evaluation is novel to most. We use this novelty to create a new perception about academic core subjects. Our foundational reasoning is that the present perception has been damaged and thus we turn to behavioral cognitive neuroscience to recondition inner cognitive capacity.

The *Bridge* proposal envisions both traditional classroom and virtual classroom activities. Classes are formed, sometimes after initial face-to-face meetings and sometimes through an Internet based selection process. These classes then evolve and during this time classroom behaviors are expected, including negative consequences from damaging experiences in school classes. In the real classroom the student behaviors range from active involvement to passive disinterest.

In under served colleges, learning support programs often see severe attendance problems. Some times the same class section will appear to the professor as completely different one day to the next. Most often there is very little administrative recognition of this circumstance. Monitoring of the type we propose provides an objective view of a class of behaviors, including those that indicate strong natural ability has been repressed.

The crisis in education persists to a large extent because the damage done in school is not

officially recognized by significant parts of the post K-12 system. A selection has occurred, and the best students are the best students. Those who under performed are simply not the best students. Things are black and white. Monitoring a class provides to the professors the possibility that damage done to individuals can be identified and specific encouragements made. For example Hispanic girls are often socially punished for expressing interest in math. So a complex of personality and behavioral problems often arises. These block the learning process. In the following chapter subsection, we will discuss Prueitt's 1983 conjecture that the school system has been producing an acquired learning disability.

### **On the Question of Monitoring**

Questions about monitoring can be answered by taking a specific viewpoint. We may see the nature of deep learning methods from a perception of an emerging science about the human self. The reader may see that by monitoring, we mean primarily self-monitoring using tools that are now only available for limited purposes of national security, or for the perceived commercial interests of large corporations.

We may see that individually managed knowledge representation tools are missing today, altogether. There is no college curriculum that informs the individual about these tools. The *Bridge* brings both access to and instruction. The tools will be oriented towards the private self, and will be used by individual human beings. We may see how this reduces the cost of health care and life long learning, while increasing private and spiritual value. We may see that deep learning by individuals has changed the potential each of us has.

We see profound illusion arising from the early use of these tools. Misuse was often shaped by an absence of principles. We may not fully recognize all of the causes of terrorism, or the damage done through the sale of additive products. We can and have been misled by a misplaced sense of our being right and justified. The sense of correctness that flows from the nature of the brain system has yet to be commonly understood. And we often find the responsible recognition of our cultural "American" principles difficult because they are high-minded ideals. Concepts of individual freedom and constitutional rights often are brought into conflict.

The *Bridge* envisions a more perfect society than the one we have today. By reading the

*Bridge* proposals, the reader may see new possibilities and new hope. The reader may see more correctly the nature of community intelligence. How might community intelligence commonly manifest? What are the biological and physical roots of intelligence and consciousness? How might individual or group intelligence be advanced with digitally based self-monitoring tools<sup>9</sup>?

One may see human history in a new light, a light of positive hope. We see also high levels of profound ignorance. We may see how this ignorance drives advertising and the current mass media, debasing each of us. We may understand why there has been a crisis produced by our educational system. We may become aware that public K -12 education is supported by a direct national expenditure of just under a trillion dollars per year. We may understand how individualized medical services might be provided at a collective cost that is a fraction of today's cost. We may understand how we as a nation can afford to live healthy and productive lives.

The key to all good things is universal education based on deep learning. To achieve universal education, new capacity is needed so as to overcome past failings. Remember, the *Bridge* will be dedicated to an instructional process. Traditionally instruction is from a teacher, or in the case of college a professor, to students. This is often not personalized. The class is the object of the professor's attention and he or she addresses the class, as a whole, most of the time. In some cases, the student will be more comfortable with a mentor. In other cases, the student will be a self-learner. And of course, students adapt to the expectations of the situation.

New social media adds to the traditional sense we have come to expect from instruction. For example peer-to-peer learning, as well as elements of computer-aided instruction are enhanced by software like myMathLab™. The argument has been for many years that on-line learning also removed some elements that are thought to be valuable in college level instruction. This argument suggests that face-to-face communication in the classroom is often a critical element to learning. In good situations, this is true. For

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<sup>9</sup> 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.

various reasons the experience the student has from school math class is not a positive one.

As we make the first *Bridge* implementations, it is necessary to create a full experience for students. The fullness of the experience is to be shaped by theory and practice related to deep learning. Deep learning requires that an internalization of experience reinforce a development of perceptual atoms. As we discuss in other sections of our proposal, this development will not occur in a vacuum. For each person there is already a well-established set of perceptual atoms, and these are most often used to reinforce the belief that the individual cannot learn higher mathematics. How this may occur in general is presented in our theory, but in specific cases the rout to this development will depend on the individual.

One measurable aspect to deep learning is that learning occurs in such a fashion that knowledge is retained. What we find in learning support courses in Georgia is that knowledge about curriculum is not retained. What is retained is the belief that higher mathematics is not learnable. This belief is the single most critical barrier to individual success. A second aspect is that individual students develop the ability to demonstrate knowledge through the ability to write about topics. The development of this ability is assisted by the specific methods including a Four Step Method™ and Blank Paper Tests™.

In many instances the teacher has not been prepared to teach using deep learning methods. Both the curriculum content and the pedagogy that is taught in teacher education are inconsistent with deep learning methods. Without teacher buy-in we will not achieve the goals established by the *Bridge* proposal. The most essential part of the *Bridge* Phase One is the recruitment of some teachers who will serve in various roles within the *Bridge*. We do not anticipate that schools or colleges that will allow official participation. However, virtual worlds are ideal for creating a second identity. Using the persona of an avatar, teachers and students will be allowed the Second School experience without revealing specific personal knowledge to schools or colleges.

Deep learning methods are grounded in a philosophical position that will be comfortable to many teachers. The methods are constructivist and participatory and a teacher will

follow a proscribed methodology. So even before the first phase funding, we have seen teacher and professor involvement in discussions and planning. The circumstances in which teachers find themselves should also be explored.

In spite of the many definitional elements to good learning environments, we find a bottom line. It is necessary that the interaction between the individual and the system be experienced as a teaching-learning experience. Communication within the classroom is one means. There are many ways through which a substitution for face-to-face communication may be accomplished. For example, individual professors may work with individual students using normal communication skills realized in digital handwritten message exchanges, text exchanges, voice and even video. Students can and will develop avatar gesturing “scripts” to express personality.

We also suggest that the digital worlds provide elements that cannot easily be found in typical classrooms. Parts of the classroom experience may be automated, and new kinds of teaching or testing methods might be added. In the virtual world environments, the individual is allowed to leave behind certain aspects of self-doubt, such as is sometimes caused by disability or a poor past experience. Individuals who have suffered from racism or nationalism may assume the avatar he or she wishes. Finally, knowledge representation tools may be used in a variety of ways. It is with these tools that the nature of monitoring policy is most critical.

So as to bring the nature of the proposed monitoring into focus, we may look more closely at what automated advanced algorithms may be allowed to do. We may solve, or resolve, a central difficulty. How can learning outcomes be measured? Learning outcomes are hard to measure, largely because the information needed is not in a digital form. Let us take one example of how real time digital data will make a difference.

One of our learning outcomes is related to classroom note taking skills. Note taking increases the degree to which students retain knowledge. Note taking using digital pens has an additional benefit. Digital data is generated and may be managed in a digital form. If certain algorithmic systems are used it is possible to retain sufficient information about the individual so as to “understand” how learning objectives might be achieved. These methods may be opened up to inquiry.

The nature of algorithms, based on the study of computing and the human cognitive system, has matured over the past thirty years. We stand at the horizon of a new era. New types of intelligence systems were designed, or worked on, by those who have influenced the development of the *Bridge* proposals. Profound advances generate a clear perception of human nature, replacing what has been little more than scientific mythology. Many examples are possible where scientific “psychology” has failed to understand the nature of human beings. But other examples show alternatives. Handwriting analysis can be linked to psychometric tools like the Myers-Briggs personality type indicator.<sup>10</sup> A refined variety of these personality type indicators could enhance the individual’s knowledge of self. Associating these algorithms with the student’s self-developed profile creates a more proper pathway to individual knowledge of self, society and the environment.

Our theory of stratified organization is found in a correct study of nature. Our theory connects advanced algorithms (designed to produce deep learning in algorithmic form) to the biology of the neuro and related systems. Stratification is produced when the algorithms develop a small set of semantic atoms, from which representations of the organization of meaning is found. The organization of semantic atoms into meaningful aggregations follows a similar path to the production of human voice using phonetics. The classified version of this technology is derived in part from Prueitt’s study of Soviet era semiotics and cybernetics<sup>11</sup>. By deep learning we refer to the development of perceptual atoms as part of the individual’s sense of self.

As reviewed in other parts of the Bridge proposal, a deep learning methods, modified by Prueitt from the R L Moore legacy<sup>12</sup>, and from his study of quantum cognitive neuroscience<sup>13</sup>; shifts responsibility for learning from the teacher (or the system) to the individual learner. How this occurs can now be seen. The learning is deep only if an

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<sup>10</sup> Myers, Isabel Briggs with Peter B. Myers (1980, 1995). *Gifts Differing: Understanding Personality Type*. Mountain View, CA: Davies-Black Publishing. ISBN 0-89106-074-X. Myers-Briggs Type Indicator wiki citation: [http://en.wikipedia.org/wiki/Myers-Briggs\\_Type\\_Indicator](http://en.wikipedia.org/wiki/Myers-Briggs_Type_Indicator)

<sup>11</sup> Prueitt, Paul S. (1996d). Structural Activity Relationship analysis with application to Artificial Life Systems, presented at the QAT Teleconference, New Mexico State University and the Army Research Office, December 13, 1996.

<sup>12</sup> John Parker: *R. L. Moore: Mathematician and Teacher* (Mathematical Association of America, 2005)

<sup>13</sup> Prueitt, P. (1997). Grounding Applied Semiotics in Neuropsychology and Open Logic, in IEEE Systems Man and Cybernetics Oct. 1997.

internalization of the material actually occurs in the brain system of each individual. We can also see why digital tools are useful in guiding the individual formation of correct perceptual atoms about higher mathematics and natural science.

We must pause to address the current mythology. Deep learning theory could have always been the foundational theory for education, and yet has not been. The error has not been because the educational system decided, systemically, that average folk simply could not really learn. The system decided this because we collectively grounded our science of self in false perceptions arising from ignorance. We allowed science to become distorted. Science could have evolved in a different fashion, but we have what we have. Specific ignorance shapes the current system and science more often than not reinforces this ignorance. But ignorance will be overcome as human kind evolves into our next phase. We have this expectation because the nature of ignorance is based on false perceptions, rather than on correct perceptions.

The grounding of deep learning methods in the neuropsychology of Pribram, and the various theories of memory<sup>14</sup>, or anticipation has placed deep learning methods into the status of an emerging science. We review these methods later in Chapter One, and elsewhere in our proposal to the American President<sup>15</sup>. There is a simple bottom line. Deep learning can be measured and is best measured when the student has internalized essential elements of a curriculum.

As more fully described below, the Blank Paper Test™ has been the measurement instrument developed as part of deep learning methods. The Blank Paper Test is linked with instructional methods that use a Four Step Method™. The composition of a handwritten description about focus topics is under the control of the individual. This control allows a selection from what has been internalized. Internalization is always unique to each individual and so the composition will reflect the way that the individual has learned. Deep testing methods reward the individual development of a deep structure to his or her perception about higher mathematics.

A creative process is required to express internalized knowledge. So a shifting of

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<sup>14</sup> Schacter, Daniel & Tulving, Endel (Eds) (1995). *Memory Systems* 1994, The MIT Press, Cambridge Mass.

<sup>15</sup> Prueitt, Paul Stephen (first draft – 2009) *The American Education Bridge, a proposal*. 424 pages (unpublished)

responsibility from the teacher to the student for learning is reflected in a responsibility to demonstrate knowledge. This creates long-term retention. Deep learning eliminates the need for a permanent record of student success or failure.

The design of a class of digital tools, called isomorphic algorithms, creates an individual ability to measure and advance private knowledge of self. Isomorphic algorithms also may be tasked to produce models of natural systems, such as biological systems. A process has been automated so that any form of real time data from instrumented measurement of the system follows a series of steps. The first step is to create a set of compositional atoms from a measurement of the invariance in the data. This set is evolved algorithmically to have a completeness property. Any event occurring in the natural system can be described by an aggregation of a subset of these atoms<sup>16</sup>. Novel emergence is also accounted for using a model of immunological response<sup>17</sup>.

Allowing these algorithms to manifest in simulation worlds is a critical next step. Recognizing the importance of this step is essential if the reader is to understand why self-monitoring tools are a necessary part of the *Bridge* design. The individual is empowered by deep learning methods to use knowledge anytime. Something new has been created. The individual earns a real freedom from control over the individual by the education system.

The focus of the *Bridge* is on that necessary transition between school experiences, often not having prepared the individual, and college, where the level of instruction in college level higher mathematics has disintegrated. We hope to change how the individual perceives the nature of higher mathematics, and to provide a life long appreciation for learning. It is not our business to create a permanent insult that the individual must carry for the rest of his or her life.

The security of private information is a central concern. Like health information, public access to private information will lead to misuse, particularly by private sector commercial interests. So information that is developed is accessed only by the

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<sup>16</sup> Prueitt, Paul Stephen (completed as report to under contract - 12/24/2011). "Technical Foundations to Stratified Theory and Articulated Machines", an internal report. 25 pages

<sup>17</sup> Eisenfeld, J. & Prueitt, P.S. (1988.) Systemic Approach to Modeling Immune Response. Proc. Santa Fe Institute on Theoretical Immunology. (A. Perelson, ed.) Addison-Wesley, Reading, Massachusetts.

individual, or in cases where a professorial-student relationship has been established. We use a common sense measure by not retaining individualized data beyond the time in which the student is enrolled. There will be no permanent records maintained after the student graduates. This is indeed common sense.

Why would the system preserve such information? If learning has occurred, the student will be able to demonstrate this on standard tests or as a consequence of being able to perform well in college level courses. Life long learning is empowered because of the nature of deep learning. Schools, college and university can keep their academic records. Competition will still exist and will continue to drive excellence.

So what about this idea of complete monitoring of a social space?<sup>18</sup> What is this for? How is monitoring to be maintained by the Bridge? Our first issue is regarding technical capability. What is actually possible? The Bridge is designed to address the needs of several million graduating high school students. Monitoring such a large social space can be separated into the task of monitoring local regions. But how is this to be done in a complete and consistent fashion? The issue requires some extended background in advanced algorithms, and will be discussed in the proposal's final chapters in greater depth. The second issue is regarding constitutional rights.

We first recognize that large media corporations and governments already have in place social monitoring tools. These will conflict with the common perception that our Constitution protects a sense of individual privacy. New law will be required and must be Constitutionally verified. Many of the social monitoring tools are designed to benefit the corporation or the government, not directly the individual. The *Bridge* tools turn the tables and are explicitly designed to give the individual an awareness of the technical means to monitor social media. Bridge monitoring is for the sole purpose of education, and is very quickly discarded.

Peer-to-peer communication is to be monitored so as to keep in-world interactions focused on agreed upon learning objectives. Monitoring develops a real time model of

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<sup>18</sup> Prueitt, Paul Stephen (Oct 2004) "Developing Anticipatory Responses from Thematic Analysis of Social Discourse: Responding to the RFP [http://nrrc.mitre.org/arda\\_explorprog2005\\_cfp.pdf](http://nrrc.mitre.org/arda_explorprog2005_cfp.pdf) and published at: <http://www.ontologystream.com/beads/nationalDebate/challengeProblem.htm>

generalizations that are made about specific instances. For example, if a student is acting out in a specific way, there will be an abstraction created which indicates that this is occurring. The abstraction produces categorical information that can be used to see the specific instance, and all instances that are of that category. Social trends are then seen by professors who can take actions that increase the quality of the educational experience.

Instance data refines an ontological generalization; in the same way as does current national or corporate intelligence methods. Advanced algorithms work with specific instances. A representation of the specific instance produces a general or abstract model of events occurring within a social space. This abstraction process “sees” what is occurring and allows the professors or administrators to respond within the parameters of written policy. However, no instance data is preserved beyond the present moment. This is similar to how human perception in physical reality works.

The advanced algorithms work like human memory, in which perception is experienced in the moment, and then a representation of that experience is fractured and decomposed into a small set of perceptual atoms existing within that individual’s brain system. The fracturing destroys the specific instance data, and no records need to be kept of that data. The memory of instances depends on future real time experiences and the influence that memory substrate has on this experience.

In computed ontology, the development of small sets of semantic atoms is at one level of organization. These atoms persist over long periods of time. Yet the complete set is sensitive to the emergence of phenomenon having the property that this phenomenon is not describable as a simple composition of the small set. A compositional process, remembers as a consequence of past experience, real time stimulus and anticipatory mechanisms. One may see this as a “deep structure”. Our monitoring tools create deep structure as a persistence of consequences from the decomposition of data about the events in a social space.

Whereas this concept of “the system monitoring all individual activity in the system” is fraught with concerns; we may represent individual participation in the system as similar in nature to enrollment in a boarding school. At any one time, a professor may be aware of the general nature of interactions occurring within the bounds of the school. If there is

something of concern then a real time interaction may be the response. Discipline is enforced as if the behavior is occurring in a standard physical classroom. The methods are known by each individual, and so shapes expectations and behavior. The methods are also taught as part of the service that the *Bridge* offers.

One may anticipate that individual's experience within a fully functioning *Bridge* class section will have some of the elements of Harry Potter movies. Individuals will find the system adjusting to that individual, and bringing forward concerns and expectations deep within the individual's self. The class will evolve a highly individualized transition experience. As this happens, it should be understood that all record of this experience will disappear as soon as the class graduates. The experience is not public. It is private. To maintain the experience is the responsibility of individual minds.

Three types of participants are found; students, professors, and administrators. Students tacitly agree that the boarding school, the *Bridge*, will know about anything that happens within the student community; and the student community will sometimes work hard to violate this agreement. This is the nature of being a young individual. Acting out is part of the process of growing up. Clear communication of agreements might include provision for expelling/suspending an individual or for rewarding certain individuals for positive behavior. Clearly how the rules will evolve will be determined as we go along.

We should say something here about the application of *Education Bridge* tools to the health care system. In a way similar to the localization of many aspects of governance envisioned for *Second School* community centers, health care may use reification algorithms to develop individualized profiles of the health system of an individual or a community. A reduction in costs and the increase in performance are suggestive.

### **The Acquired Learning Disability**

The capacity to build in a virtual world gives, to the individual, several profound reasons for more complete participation in educational processes. The first of these arises because the individual may come to see that difficulties with advanced curriculum are not natural. The individual will realize that he or she has learned incorrectly. With this realization, the recognition can be made that his or her difficulty is not his or her fault. The *Bridge's* virtual world system is designed to support deep learning methods. Deep

learning methods can be used to rebuild the efficacy of the individual. The individual's sense of self can be restored.

In some cases, this rebuilding can be very difficult; even if there is a plan and guidance based on real science. For example, on many American Indian reservations the defined purpose of school is to teach the children that being Indian is sub-human. The purpose persists from an earlier period of our history when national intent was to eliminate Indian culture from the North American continent. Various accommodations took place so that the fact of cultural cleansing is replaced by the sense that "we" are helping "them". The reservation schools were created as part of this accommodation. The truth about school training for native Americans may be hard to accept, and is perhaps unfair based on certain exclusionary views. However, we see that exclusionary exceptionalism governs much of human behavior, and for good neurological reason. The sense of coherence and the sense of being right both provide sufficient illusion so that moral individuals can be caught up in teaching children that they should accept their non-human status.

Something similar developed for other minority populations, and in particular the African American communities. Educational processes designed for minority children must acknowledge that part of our mission to help the child accommodate the natural inferiority that is deemed de facto. Education in mathematics for girls used to have a similar stance.

It is not your purpose to provide universal education to everyone, the professors of education at University of North Texas told the PhD candidate, in 1983. There can be no such thing as universal education of the type you are talking about. The purposes of our institutions are to protect our integrity, in spite of the unreasonable expectations made by the principles of democracy. These words were used to explain why a committee of professors was unanimous in rejecting Prueitt's dissertation proposal. Prueitt had fully qualified to write a PhD in Pure Mathematics in topology or real analysis, but had moved to the College of Education to write a dissertation based on the thesis that students were acquiring disability as part of the schooling process.

In 1983 it was already very clear to Prueitt that the student behaviors in freshman mathematics classes was not natural. He had started to visit libraries, under taking a

review of all literatures on mathematical models of learning, and on models of biological response mechanisms in general. These investigations lead him to study the history of immunological theory starting with the early works on plant immunology by Burnet, and then later foundational work by Zerne and Richter<sup>19 20</sup>. What he understood less than the emerging and still unsettled questions about neural and immune response was the degree to which the American colleges of education had become devoted to exclusion. It was only his unique experiences working on national intelligence systems that crystallized the understanding of cognitive coherence.

Prueitt's stratification theory was necessary to bring deep structure and emergence into play. The theory suggests, following C S Peirce and the Soviet interpretations of Peirce and J. S Mill, a substructure MUST exist for any emergence to occur. Physical atoms exist. Chemical compounds arise from an emergent aggregation of elements. The profound nature of chemistry is revealed only when we ask the question, "why is one Helium atom the same as any other Helium atom for the purposes of inducing certain chemical compounds?" What makes atoms of the same type the "same". The fact that is a substructure of "types" underlying physical chemistry is profound enough. But what about human speech? Is there also not a substrate of types, the phonemes, on which a particular person's speech depends? Of course there is.

What was unknown to Prueitt in 1983 was how affective stratified theory would become in explaining human behavior. Human nature may be thought to be more complex, or complicated, than physical chemistry. The idea of individual humans having behavioral substrate can be easily dismissed as a bit silly. Anyway, science has no business looking into such questions anyhow, or so would say the professor of education. Everyone knows that human nature cannot be made the subject of investigations by science!

In current mathematics education we find the motivation level is all too often purely antagonistic. The reasons for the antagonism are discussed in the chapters of the *Bridge* proposal. In brief, we believe that the majority of individuals have felt cheated by

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<sup>19</sup> Prueitt, Paul Stephen (1988) Some techniques in mathematical modeling of complex biological systems exhibiting learning, PHD Thesis, in Pure and Applied Mathematics, University of Texas at Arlington Press

<sup>20</sup> Eisenfeld, J. & Prueitt, P.S. (1988.) Systemic Approach to Modeling Immune Response. Proc. Santa Fe Institute on Theoretical Immunology. (A. Perelson, ed.) Addison-Wesley, Reading, Massachusetts.

experience in “math” class. This feeling has, over the young life of the high school student, resulted in deep changes in the mechanisms involved in the perception of self.

The conjecture about an acquired learning disability was first developed in 1984, and proposed as a PhD thesis in the College of Education at the University of North Texas, by Prueitt. This conjecture was not regarded with favor by the tenured graduate faculty in the College of Education. In an discipline, education, in which almost no one understood the nature of higher mathematics; the College was unwilling to allow a reasonable thesis developed by an individual who was fully qualified to produce a PhD dissertation in pure and applied mathematics. In 1988, Prueitt earned a PhD in Pure and Applied Mathematics from the University of Texas at Arlington<sup>21</sup>. This work was a second step in developing a thesis that most individuals graduating from high school have repressed interest in higher mathematics.

Later we will say more about deep learning, simulations and building in simulation worlds. For now we simply mention that the simulation world provides an rich and potentially exciting place to learn; not by playing games but by actually designing and building machines and simulations of complex social, biological, environmental or economic processes. A rich social interaction is also possible. To support the proper use of the simulation world it is necessary to create the sense that one should separate personal experience and public experience consistent with normal social conventions. Monitoring is both necessary and positive, when the Constitutional rights of individuals are respected. Learning must be measured, both by the individual and by the system. Absolute assurance of informational privacy is required. These challenges are difficult ones, unless there are tools and technologies integrated into the infrastructure’s processing kernel. How this is to be done is addressed in our technical papers.

The repression is enfolded into a complex behavioral syndrome. An accommodation has been made that sees higher mathematics as both undesirable and unattainable. The thesis regarding repressed ability is connected with new social phenomenon. We expect radical change. The provision of a virtual world building capacity could excite the individual

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<sup>21</sup> Prueitt, Paul Stephen (1988) Some techniques in mathematical modeling of complex biological systems exhibiting learning, PHD Thesis, in Pure and Applied Mathematics, University of Texas at Arlington Press

and provide an avenue towards establishing new individual goals. Whereas this will not be ideal for everyone, we may see a significant change in how well higher mathematics is understood. In at least some cases, individual goals would arise from the opportunity to do something “real. Our learning pedagogy deepens the experience and in some cases overcomes completely the acquired antagonism. Deep learning enhances the opportunity to take learning experiences and apply them in ways that benefit the individual and society.

A new reason for learning higher mathematics is given to the young person. This reason recognizes the individual. In our planned three-dimensional social media, it is possible that the inner sense of self will find fertile ground in which to grow. Let us examine why this would be so. Deep learning in the college classroom creates a reliance on the self. The methods of deep learning, for example the loop exercise we will discuss shortly; create individually controlled learning cycles, without the need for a third party “teaching”. The responsibility for learning is shifted, at least partially, from the system to the individual. As this process develops, we may see a partial substitution of the individual professor for the three-dimensional simulation world.

Educational experience should reveal an inner sense of self, even while there is a context for personal growth, and economic rewards, provided by the “system”. In many good colleges, focus topics guide this process. Three-dimensional social media enriches what might be possible. For example, building in a virtual world leads also to experimentation and innovation directed at the central economic and environmental challenges we face. As part of the areas of application, the technical details of green energy innovations become accessible early on. The new capabilities, based on building and simulation experiences, create a new horizon. There are economic motivations, as well as an unfolding of the inner interests along a guided path.

Technical discussions require some background expertise, which we take up later on. What about the results we wish to achieve? Our desire is that the American education system recovers lost ground, given up over the past five decades. We also wish to see a cultural and spiritual renewal, one that is based on multi-culturalism. We anticipate a renewal of humanistic principles within an advanced democratic society. Our desire is

that the system in the United States of America fulfills the American Dream for everyone, not merely a privileged few.

The *Bridge* is designed to be consistent with the world that our children will live in. Education is the key to re-opening the American Dream to each citizen. The current system limits access to higher education, as well as opens access to a few. This outcome might be changed in several ways, one of which could be the *Education Bridge*. We all must become more fully and broadly educated. As a nation we must all become more fully educated.

An economic theory is used to fully discuss free market capitalism. Market economics will be one focus of the educational content to be delivered via the platform. Again stratification will be seen as a means to discuss localized economic transactions, and the harm or value created by a business enterprise to the common good. We as a nation will make capitalism work to benefit our democracy. The sense of market transparency is enhanced when all, or the vast majority of, individuals have an education designed to increase critical thinking skills. These skills are useful in a social world where new forms of social media create the instant ability for new ideas to gather and to form political force.

Transparency on the educational system itself is part of the mission of the new infrastructure. The current system supporting education is not exactly what the American society has paid for, and yet there is little real understanding of what happens in the classroom. Each year American citizens directly pay more than eight hundred billion dollars in educational services, *excluding* research funding. However, these large levels of funding are absorbed into the current system, without the possibility of the type of social renewal we might otherwise seek. The door to renewal is closed because we as a society all too often give up our decision making to the mass media.

An analysis of the system, using principles from systems theory, is difficult for reasons that we hope the reader will come to appreciate or already has appreciated. Part of our proposal is very carefully designed to create an objective view about the nature of systemic entrenchment. For example, testing often distorts the learning process in specific ways. Deep learning methods are designed to give the individual more

responsibility in providing an objective demonstration of knowledge actually owned by the individual. There is a loss of individual control over a large part of one's life. It is a reasonable step in human evolution to ask that the individual regain control. The educational system should be focused in this single objective, and yet it is not. In some sense, the opposite is occurring.

Obtaining positive outcome metrics will be a primary focus of a bridge between high school and college. Mathematical models of system behaviors related to entrenchment, and to the release from entrenchment, are seen in our preliminary work<sup>22</sup>. We expect that this preliminary work will be tested in a clinic setting so that physical measurement of acquired learning disabilities become commonplace.

### **Local, State or Federal Responsibilities to the Citizen**

To achieve a new result from education we have responded to detailed systems analysis in selecting specific objectives. This analysis identifies certain key concerns. If the *Bridge* is federally funded, an independent virtual world infrastructure is to be deployed, within eighteen months, and then attached to fifty state centered public corporations. If the *Bridge* comes about as a grass roots movement, more time will be taken. In either case, political considerations must be seen and respected.

The current political debates are often over whether or not the federal government has a right to subordinate the rights of any one of the fifty states. A state may have the right to mandate car insurance, whereas the federal government does not have this right; unless the state is found to be abusing this right in some specific way. These Constitutional questions are responded to in our proposal by developing three possible deployment strategies. We plan to allow the flow of history to select one of these, without predetermination. The goal is that an independent system is available to any graduating high school student, and that this system teaches the principles of deep learning.

The first strategy is the most straightforward. It may be argued that all American citizens, considered as a whole, are being limited in what the individual might do in life,

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<sup>22</sup> Prueitt, Paul S. (1996a) Optimality and Options in the Context of Behavioral Choice, in D. S. Levine & W. R. Elsberry, Eds. Optimality in Biological and Artificial Networks?, Erlbaum, 1996.

by an educational system that, for what ever reasons, has failed in most instances. Thus a request, to the White House, for one hundred million dollars has been made. This request is made also to private capital. These funds, as is described in the chapters to follow, are to be spent over eighteen months. The majority of these funds are to develop a specific open source software extension to the Open Sim virtual social media platform<sup>23</sup>.

Software development has been estimated, in 2006, to cost sixty million dollars and would use a well-specified software framework. It is also estimated that after the eighteen months, and this expenditure, the software platform will not require, and cannot accept, additional federal support. Additional evolution will come from a specific marketplace, as discussed in the chapters of the *Bridge* proposal. These chapters have been published for review on the Internet starting in 2009<sup>24</sup>.

However, federal funding is not the only possibility. In fact the question of funding is not settled. There are, at least, two other possible strategies. A software infrastructure and business ecosystem may arise from a single contract with the federal government or with private equity, or as the result of a grass roots movement<sup>25</sup>. Grass roots movements could adopt existing Open Sim software and educational content plus pedagogy. There are no financial barriers to this, as everything is ready for viral adoption. There are some small pedagogical issues remaining<sup>26</sup>.

A single source of funding has the advantage that a single review of details in our proposal might be made using a high level technical evaluation. This review might be accomplished within thirty days, given the work already completed. There may be several additional strategies that align, as state wide or national recognition develops. Political support for the Bridge might be found at any of the various levels of government; local, state or national.

Federal support to create a next generation simulation platform has two main arguments.

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<sup>23</sup> Open Simulator virtual social media platform: [http://opensimulator.org/wiki/Main\\_Page](http://opensimulator.org/wiki/Main_Page)

<sup>24</sup> Index to *The American Education Bridge, a proposal to the American President* is at : [www.educationWorlds.com](http://www.educationWorlds.com)

<sup>25</sup> 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.

<sup>26</sup> Prueitt, Paul Stephen (2012) *American Education Bridge, technology and pedagogy*. Accepted: The 3rd International Conference on Education, Training and Informatics: ICETI 2012 March 25<sup>th</sup> - 28<sup>th</sup>, 2012 – Orlando, Florida, USA

Disparity in education is too closely tied to local wealth, and thus to factors which may be seen as contributing to continuing disparity in wealth generation. Second, the optimality of implementing several hundred-man years of work, after a detained technical review, is argued. Internal Education Worlds™ documentation identifies individual contributions from between fifteen and twenty individuals; most whom non-disclosure agreements exist.

Regardless of how the initial infrastructure is established, the maintenance of the *Bridge* should be based on public capitalism and state, or regional, control over individual state, or regional, *Bridge* systems. Public capitalism is defined as an economic theory in which the public “owns” a service corporation, having a limited and very specific social purpose. The sole corporate mission for these state or regional entities will be to gather wealth in support of the *American Education Bridge* Infrastructure. In a very narrow sense, pure capitalistic principles will be used to support a social value.

### **Transition Between High School and College**

The *Bridge* will focus on the transition between high school and college. It will depend on a dedicated next generation three dimensional on-line social network media with avatars, buildings, landscapes, and knowledge management tools. There will be a new biology simulation engine, not now existing, as well as the existing Open Sim physics simulation engine. The platform will not be used as a gaming platform, and will have high level of information security<sup>27</sup>.

The evolution of individual *State Education Bridges* could occur simply as a viral adoption of a new social media platform, and methods leading to deep learning. A grass roots movement could arise simply because of the intrinsic value that deep learning methods have to the average individual. So what has stopped this movement from occurring, so far? The answer is related to the notion that an acquired learning disability has taken hold. Many teachers believe that most students will not learn. Most of our under served communities have adapted to a low expectation, and with this adaptation has come coping behaviors.

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<sup>27</sup> Prueitt, Paul and Peter Stephenson. "Towards a Theory of Cyber Attack Mechanics." First IFIP 11.9 Digital Forensics Conference. Orlando, FL, 2005.

Those graduating from high school in most cases have not seen higher mathematics or science clearly explained at the level needed. The common experience in math class is not one that enlightens. An accommodation is made by most individuals and by social as a whole. Our media reinforces this accommodation, in part because advertising and entertainment businesses use public ignorance to serve private interests.

A common, and informationally secure, *Bridge Platform* will allow high school students to access to deep learning methods and curriculum content sufficient to select a quality college or university, and be competitive during his or her college years. A possible path to the establishment of individual *State Education Bridges* is discussed in detail in the following chapters. Each state will evolve their *Bridge* using a common, next generation, software platform. As this process moves forward, new types of manufacturing will arise because the individual becomes more aware of what might be produced to benefit self and society. Building within a virtual world should allow innovators to flourish.

If the proposed principles are implemented, we will see free market principles serve an important social value. But how is this value defined? At first it is in overcoming a negative, later on it is in building a positive. What is the value, to understanding deep learning methods, to an individual who has not been properly prepared for college level higher mathematics and science? These are the questions we are worked on for several decades. Our theory is explained in neuroscience language<sup>28 29</sup>. Deep learning methods may release the individual from a type of economic and intellectual bondage imposed by a system designed to serve other purposes.

These “other” purposes may be observed, but the development of a strong theory about, say for example, the positive and negative influences from certain business ideologies is a difficult task. There are many businesses which prey on addictive substance, and which harm the individual and society. However, we would like to avoid discussing this theory. Our purpose is to get to the positive part, to show how higher mathematics and quality liberal education benefits the economy and the individual. The system in place may

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<sup>28</sup> Prueitt, Paul Stephen (1988) Some techniques in mathematical modeling of complex biological systems exhibiting learning, PHD Thesis, in Pure and Applied Mathematics, University of Texas at Arlington Press

<sup>29</sup> Prueitt, Paul S. (1993.) Network Models in Behavioral and Computational Neuroscience, invited chapter In Non-animal Models in Biomedical & Psychological Research, Testing and Education, New Gloucester: PsyETA.5

simply be imperfect, and corrupted by long established cultural imperfections, such as nationalism, racism or any one of the many kinds of fundamentalisms. Defining a more perfect society is perhaps the responsibility of each of us.

In the pages of the *Bridge* proposal, we offer some surprises arising from our desire to stay above the current controversies. We suggest that the perfection of the current educational system may properly depend on a free market oriented, economically managed, transition infrastructure. We believe that individual liberty is viable only if most individuals obtain a clear perception about the self, society and the environment. We add value to what is already positive. For example, adding value to current positive aspects of K-12 education creates a higher quality incoming class of freshman college students. So both the K-12 system and the college system may benefit from a market-driven success focused on the transition between high school and college.

The pedagogical focus of the *Bridge* is on deep learning methods, and the individualization of a specific well enumerated transition curriculum. Focus topics from economics, literature, history, art, mathematics and natural science are detailed through scholarly interaction between a council of college professors. However, the *Bridge* has also been designed with unique technology<sup>30</sup>. The pedagogy and the technology are from the same mold. This similarity is grounded in a detailed study of natural science. So as the technology and the pedagogy are both realized in the same medium we expect to see the radical evolution of educational processes/

Of great importance, we feel that the social value of the proposed system is too great to be privatized. The infrastructure should be developed using public money, and from money earned by a dedicated public corporation. It is our intention that all of the required technology be made open source and based on a non-encumbered intellectual property portfolio. There are, of course, some philosophical challenges to chartering public institutions that live with a very specific and dedicated charter. Again, as in the issue with state's rights, the issue of ownership over the technology is one that we feel might reasonably be compromised. However, all aspects of the underlying technology

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<sup>30</sup> Prueitt, Paul Stephen (2011) Systems Science and Service Computing, <http://www.servicetechmag.com/I57/1211-3>  
Published Dec 14th 2011, Service Technology Magazine.

are tied closely to foundational elements of pure computing theory. The elements of the portfolio are well defined in our founding documents. This portfolio would establish a type of level playing field for a next generation wave of social media. This level playing field should, we argue, be non-privatized.

Why might we compromise? The answer is seen in new political trends. New competitive business sectors could address current environmental, social and economic challenges. However, there has to be some explicit understanding of how the marketplace produces structural challenges within our social system. We must see into the inner workings of these specific economic sectors so that advantages are not given to processes that are selfish in nature and destructive of social value. The *Bridge* technology is itself to be taught using the principles of deep learning theory. These principles are based on an understanding of natural science, and thus in theory the teaching of these principles should ignite a new cultural revolution based on fair and transparent “public” capitalism.

In summary, the theory of organizational stratification relies on natural science, in particular on immunological and cognitive neuroscience principles. Finally, the *Bridge* technology is based on service oriented computing, a profound discipline that increases the clarity of business processes supported by Internet connectivity.

### **The Origins of a New Pedagogy**

A pedagogy has been developed from a decades long struggle with a dysfunctional educational system. During this struggle, I suffered and saw the suffering of many others. I have dedicated a part of my life to reducing the amount of suffering due specifically and only from a corruption of sorts. This dedication has two parts; the first is in understanding why the system is as it is. I have developed a theory, which may not be perfect but which does support a principled discussion. The second part is in the development of a strategy that might end the crisis. This strategy is more important than our analytic activities.

A deep learning method has been modified from my experiences as a graduate student under the R L Moore method for four years (1980-1985) at University of North Texas. The Moore method shifts to the student the primary responsibility for developing a

curriculum.

“R.L. Moore developed his approach to discovery learning from 1920 to 1969 at the University of Texas. Known as "the Moore Method," his approach was based on lists of axioms, questions to resolve, and results to prove. These sequences challenged students and led them to discover the essentials of the subject. The idea is simple and astonishingly effective. Yet success is critically dependent on the way the class is run, not simply on the theorem sequences.”<sup>31</sup>

In enrolling at North Texas, in 1980, I took a step beyond the master’s work in abstract algebra at SMU. For four years, I worked on deepening my understanding about the foundations of real and numerical analysis. Due in part to the courses I took, which almost always involved the use of the Moore method, my deep interest in the foundations of mathematics was made firm. This work was accompanied by teaching two freshman mathematics class sections each year.

In 1984, I qualified to write a PhD in pure topology or real analysis in 1984. However, my interest was regarding why students did not want to learn in the freshman classes. This interest resulted in my working for one year on a PhD in a program supposedly focused on the college learning of mathematics. During this year I came to understand that the College of Education at North Texas was clueless, regarding the causes of the crisis, and was part of the systemic corruption we seen around us. This corruption is itself something that can be written about. But such as description is not what we wish to be engaged in. A positive view of what is now possible is where we wish to engage.

The Moore method involved something that was quite natural to me. Even as a boy, I would often internalize something intellectual at a deep level and then re-express what was experienced. In both my modification of the Moore method, or in the original uses of the Moore method, learning relies greatly on individual internalization of a curriculum. The generalization seems natural. Internalization of clear perceptions will enhance an internal view of self, connecting deep interests in religion, history or literature. The inner self is given proper stimulation. Because internalization gives the depth of understanding that I sought, I felt that deep learning should be common in school and college

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<sup>31</sup> Quote is from the R L Moore Legacy web site: <http://legacyrlmoore.org/reference/FOCUS.html>

experience.

Why would the Moore method be helpful for freshman students? My first teaching experiences created a puzzle to me. Why were most students agnostic or even strongly opposed to learning the college liberal arts curriculum? This question was not one that graduate faculty in mathematics seemed to consider, or even to be interested in. It took me almost three decades to resolve the puzzle. A specific expression of the resolution is given in the Bridge proposals. The expression involves a deep look into the neurology of perception and systems theory. We suggest that a false perception about “math” is created by a variety of causes, including popular social trends and the usual experience by students in math class.

Since 1980s the situation has gotten far more acute. Math Learning Support, in colleges, enrollment has grown from none existent to perhaps 20% of the total undergraduate enrollment. The cost to the taxpayer is perhaps close to one hundred billion dollars per year. Costs to the individual, most of who will fail, cannot be estimated. This cost is what we envision to motivate the business case for public-private partnerships.

In some community colleges, learning support enrollment accounts for over 50% of total enrollment. In many programs the probability of starting at the lowest level course and completing the series of courses is less than 5%. As a general rule, graduate faculty is not interested in failure rates in non-major courses; much less interest is shown regarding developmental programs. The problem has become entrenched.

### **Deep Learning Methodology**

In 1985, I saw an opportunity to advance a theory of learning based on the biology of the neural and immune system, and transferred to The University of Texas at Arlington. The PhD thesis titled, “Mathematical Models of Learning in Biological Systems” was completed in 1988. This work suggested that an acquired characteristic of a human cognitive system might manifest as field potential having several organizational levels, one being measurable using EEG or PET. The thesis was, in my mind, a step on the path to the deep learning methodology that we are now attempting to demonstrate.

Work on validating the behavioral and cognitive neuroscience, underlying deep learning

methodology, is outlined in several papers published or submitted for publication this year<sup>32 33</sup>. What is needed, during the Spring 2012 semester, is a clean measurement of deep learning methodology. We felt that this might be achieved while also measuring skills using standardized departmental chapter tests, generated from myMathLab.

Ok, let us review what is proposed. We propose that high school experience in math class does not properly prepare the average student for college level learning. A transition curriculum has to make a new start and build a complete understanding of very basic concepts. This transition can occur as part of the private transition between high school and college, and use both virtual worlds and regular classrooms. Deep learning methodology puts much of classroom practice on its head. However, some reasonable concerns are raised. The most difficult is related to the issue of testing and measurement. Currently students all too often see only the single objective to pass the course. This perception is documented using a regular and repeated request for comment about the new experiences in our classroom<sup>34</sup>.

In our method the student is made responsible for the measurement of learning. To make this type of measurement effective, the individual student prepares an understanding about the curriculum and presents this much like an English class would write an essay about a novel. In mathematics learning support we start with the rules and laws of arithmetic. An illustration is needed. In the next section we describe a “loop exercise” as introduced to five sections of college level mathematics classes.

The use of focus topics from set theory and fractional arithmetic is discussed in the first chapters of our *Bridge* proposal<sup>35</sup>. A specific type of exercise is provided, as discussed below. The loop exercise is generalized as we develop evidence that deep learning does in fact change the dynamic. The first form of the loop exercise addresses a well-documented weakness seen in most freshman mathematics classes.

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<sup>32</sup> Prueitt, Paul (Accepted November, 2011) - "Digital Instrumentation and the Measurement of Experience" SOA Magazine, <http://www.soamag.com/I30/0709-1.asp>

<sup>33</sup> Levine, D. & Prueitt, P.S. (in progress.) Modeling Neural Potential Fields, as Cognitive Support, to be submitted to Cognitive Systems Research

<sup>34</sup> We have set up several means to repeatedly measure the opinions of students regarding deep learning methods. We hope to develop a research publication. See [www.liftingPedagogy.com](http://www.liftingPedagogy.com)

<sup>35</sup> Prueitt, Paul Stephen (Posted on the Internet as a Draft) "The American Education Bridge, a Proposal to the American President", <http://www.educationworlds.com/book/>

It is noticed that most student perceptions about fractional arithmetic is confused. An avoidance of fractions is found even in the final college requirement in mathematics. Many or most students never overcome this confusion. The first example of the loop exercise addresses this deficit in fractional arithmetic and in elementary set theory. But more than skills, the student learns to cite the names, or phrase descriptions, of all of the focus topics in the curriculum. This learning leads to self directed learning.

An individual student outlining the curriculum is the essential first step. The second step is in the use of a Blank Paper Test. A Blank Paper Test is identified as a composition, about the topics. The student is responsible for asking proper questions as well as in communicating a narrative behind these topics. This is the type of internalization that our understanding about the behavioral neuroscience suggests will always create deep learning. The methods of deep learning are further developed in our proposals.

In the *Bridge* technology we support deep learning methodology using certain principles found in knowledge management and in behavioral neuroscience. As the class progresses, the student is asked to keep a portfolio using a data structure based on original work on knowledge encodings. This portfolio is initially to be a simple indexed repository of the topics of the curriculum. The effort during the academic year 2011-2012 was designed to demonstrate that the methods of deep learning works.

### **Student Developed Focus Topic Repositories**

A teaching/testing methodology was introduced, starting in the academic year 2011-2012. It balances skills-based and deep learning methodology. As part of this advancement, new classroom methodology is to be enriched by an innovative use of social media. However, the effort with social media had to wait until the new methodology was clearly defined and results shown to be helpful. The academic year, 2011-2012, implementation involved the Four Step Method, Blank Paper Testing and digital note taking methodology.

This revolution in college level mathematics preparation has had to evolve along more than one front. For example textbooks are to be developed which are far more minimal in nature that the current books, far less expensive and far smaller. We also must develop value to be obtained when computers aid a human in visualizing models found in

science, and comprehending the foundational concepts to higher mathematics. However, these steps will follow our work during the Spring 2012. The most important outcome must be in an improvement in the perception of the individual students. Skills based testing will balance deep learning testing in such a way that all students perform better and feel better about the experience.

The ideal situation has to be earned. In this ideal situation, all students would be responsible for the development of a set of class notes. Some students would use digital pens and post video clips to a web-based repository. Others will develop hand written notes held within a three-ring folder. This would be for the learning support courses. In addition, for college algebra and above either Maple or Mathematica software would be introduced as a means to introduce computer aided modeling.

The use of digital pens in class would create useful digital video of actual classroom notes. The technology in the LiveScribe pen, and in other related technology, would create a digital video of pen marks as they form on a flat surface. These video clips are similar to what we are all see on U-Tube and other web sites. A repository is to be built each semester by the students, under supervision by the professor. Students would be responsible for developing a digital representation of curriculum each semester, starting with digital note taking and computer aided modeling tools.

A community is developed based on the active participation of learners. Community pride would be achieved from positive results. Topics could be placed on a web site as students submit digital video after class has completed. LiveScribe note taking is ideal for this activity. The LiveScribe software supports community based sharing of “pen-casts”. These pen-casts when played on a computer may be captured for editing.

The development each semester of a student-produced Focus Topic Repository gives the students the sense of building, each semester, a class resource. We expect a sense of pride and dedication to develop, as well as evidence each semester of deeply learned topics.

### **The Loop Exercise**

Any loop exercise is designed to assist an individual in developing a memory of our perception into mathematical knowledge. Modeled after the action perception cycle; a theory of awareness

from cognitive neuroscience, a loop exercise will connect a perception into a mathematical topics to repeated past experiences. Cognitive neuroscience indicates that awareness of experience is encoded into parts of memory that then are “re-membered”. The desired perception is of some single aspect of mathematics, a focus topic.

The process must be under the complete control of the individual, to be most effective. The reason is that the natural process of learning requires an internalization of experience. This internalization breaks down the parts of experience into the elements of human memory, which is then remembered as part of the activity of making sense of the world. It is a marvelous process, this human experience.

**The Preliminaries:** The Loop Exercise is consistent with Blank Paper Tests and with the Four Step Method. The Four Step Method is given as;

- 1) **Illustrate:** Find an illustrative example of a focus topic. The focus topics are a minimally enumerated set of topics that cover the curriculum. Each topic is distinct and yet all of the topics together will cover the complete curriculum.
- 2) **Name:** The student gives the exercise type a name. Naming the exercise type provides class mates with a means to talk using a common terminology. Peer-to-Peer learning is enhanced.
- 3) **Revise:** The student develops one or more exemplars of a specific exercise type. Some of these “illustrative exemplars” will be easier than the first exemplar. Some will be more difficult.
- 4) **Extend:** Develop an ability to expisit the theory, or cognitive process, underlying any specific exercise type. Students will connect exercise types together by making a blank paper presentation involving five to ten exercise types. The hand written presentation should start by listing the topics in a curriculum. The student may choose to present topics in any order chosen by the student. This selection signals synthesis and deep learning.

The Blank Paper Test is a means to test deep learning. The student is required to learn how to descriptively enumerate a topical cover consisting of a set of focus topics, where the set of focus topics “cover” the target curriculum.

A chapter test will require that the student list on paper from memory a set of topics. The set will be “complete” in the sense that for that individual his or her set of topics allows conceptual access to all instructional elements in the chapter. The focus topic cover is an outline. The outline is often different from one individual to another individual.

The central elements of a Blank Paper Test is as follows:

- A) **Copy Paper:** Blank Paper Tests are written in pencil onto blank sheets of copy paper, on one

side only so that the tests can be easily scanned into a digital file. The value of non-lined paper is noted, as the student must learn to write in such a way so that the topics in the chapter are clearly explained to the professor.

**B) List of Focus Topics:** For individuals, each list will not necessarily be the same. However, the list is to be written without aids from memory as the first section of the test. Once the list is written the student may modify the list as he or she writes the test. The list is a guide.

**C) Lines Drawn to Separate Topics:** Each topic in the student's list will be illustrated and discussed using the Four Step Method, to the degree possible. A horizontal line will be drawn to separate the description of each topic.

**D) Grades:** The header, to the test, is three drawn-lines at top of first page. The first one is for name, one for class and class time, and one for the grade to be assigned. The grade is a subjective grade produced by the professor, and is not a ratio as in the traditional test. However, the grade will be an indication of A, B, C etc work so that an 83 indicates a low B grade. These grades may then be averaged at the end of the semester.

Students are empowered to learn and to express what is learned, without worry about what will be on the test.

## **Comparison to Traditional Teaching and Testing**

A model of teaching and testing may be represented with the labels: exercises and selected exercises. A large number of exercises are available as exercise sets in the textbook, or in a computer aided drill and practice software package like myMathLab.

In the traditional classroom, lectures are made over the target curriculum; e.g., the chapter. The lecture activity is replaced with drill and practice software where the student is presented a selection of problems to be worked. These are labeled "homework". The use of some means to create the questions may be seen as an aid to student preparation for computer aided testing.

These labels may be contextualized within two teaching/testing procedures; one for myMathLab and one for classroom use of a textbook.

### ***Model One, Classroom use of Textbook:***

**Lecture:** Step one is to lecture over the material.

**Homework:** Step two is to assign selected exercises from the textbook, as homework.

**Quiz:** Step three is to quiz students over the material by selecting from the set of possible exercises a representative set.

*Model Two, Use of myMathLab:*

**Homework:** Step one is to do Homework exercises, where the computer software selects representatives from a large number of examples.

**Quiz:** Step two is to do a Quiz.

**Diagnostic:** Step three is to use a Diagnostic tool to identify exercise types that have not been mastered.

These two models are to be balanced with Deep Learning Methods.

### **Loop Exercise, the Procedure**

The Loop Exercise connects awareness in the moment with memory of past experiences.

A specific loop exercise targets three focus topics

**Topic 1:** Replacement set, when the replacement set is the set of real numbers.

**Topic 2:** The solution set

**Topic 3:** The variable

The following Loop Exercise is provided to students in four levels of instruction at AMC during the first two weeks of class in the Spring Semester, 2012.

**The Set of Real Numbers:** The set of real numbers is characterized in several ways in our classroom lectures. Each class period starts with a repeat of lectures on the characterization of the set of real numbers. The purpose of repeating these lectures is to demonstrate to each student the profound difficulty in describing completely this set of numbers.

The student becomes responsible for an individualized presentation in pencil on blank paper of his or her perception about this set.

Developing two formal constructions exposes the relationship between the set of real numbers and the variable

**Algebraic Expression:** Illustrated by something like  $2x + 1$

**Arithmetic Expression:** Illustrated by something like  $\frac{1}{2} + 4$

The selection of a real number from the set of real numbers is then the means to “close” an algebraic expression to produce an arithmetic expression.

The characterization of the set of real numbers is developed repeated times, over the two week period beginning each class section. One way to characterize this set is to talk about “the set of

all possible lengths. The set of additive inverses is then defined, along with the concept of a zero. A second way to characterize the set of real numbers is to develop the set of integers, using Peano's axioms, and then the set of ratios. The question is then asked about whether the set of ratios is the same as the set of real numbers. A discussion of the ancient Greek views on this question may be made.

Several other characterizations may be made, including the characterization of the "size" of sets. This discussion reveals two types of infinities, countable and uncountable. The fact that the set of positive integers is the same size as the set of positive ratios can be shown and appreciated by some students. The question can also be asked, "what is right next to the number zero?". This question introduces topics from the foundations of mathematics and from real analysis.

**Use of Four Step Method:** The Four Step Method requires that the student make up, or find an example or illustration of a focus topic.

**Step 1 (Illustrate):** Consider the algebraic expression,

$$2(3x - 1)$$

This expression "simplifies" using the Nine Laws of Arithmetic to the expression:

$$6x - 2$$

When we take any element from the replacement set, this element will close the original form of the expression to produce an arithmetic expression. The same element will close the simplified expression. If no error is made, then the two arithmetic expressions will be the same number.

Let  $1/3$  be selected to replace the variable  $x$ . Then the original expression becomes

$$2(3 * (1/3) - 1).$$

The simplified expression becomes

$$6 * (1/3) - 2.$$

The two arithmetic expressions are both the same number; 0.

**Step 2 (Name):** The focus topic is "The Replacement Set"

**Step 3: (Revise; e.g., illustrate again):** Consider the algebraic expression,

$$(2x - 1/3) * (3x - 1)$$

This expression "simplifies" using the Nine Laws of Arithmetic to the expression:

$$6x^2 - 3x + 1/3$$

If we use  $x = 1$  as the replacement element then the two algebraic expressions are both closed to

produce the number  $10/9$ .

**Step 4: (Extend; e.g., talk about**

The student develops in his or her own words a discussion about the nature of the replacement set.

The first test is given in two parts. The first part is a take home Blank Paper Test. The second part will be an in class Blank Paper Test, having the same target curriculum.

**Community Based Collaboration**

Self-organized peer-to-peer learning create a new dimension to the study of mathematics at adopting colleges.

We hope to see the following:

- 1) Each semester, an upper list of names of topics would be included in the course syllabus. The upper list will be extended using a two-level topic taxonomy.
- 2) Each semester, the course would start with no topics in the focus topic repository.
- 3) Students will meet to review video and to work on video clip submission to the professor.
- 4) Students might prize note taking, even though all posting to the community of practice will always be missing name and voice.
- 5) Topics would develop both in number and as additional notes on a specific topic is submitted.

Skills based midterm and final exam tests will be used to measure learning outcomes.

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