

## **Pre-College Course of Study**

**from**

**Paul Stephen Prueitt, PhD  
Founder, SecondSchool.net  
January 2, 2012**

**Abstract:** A six-week program is outlined, with skills-oriented learning objectives involving skills in fractional arithmetic. In addition to this first objective we focus on elementary set theory as related to understanding what the set of real numbers is. There are also deep learning objectives related to the concepts that allow an individual to compare and contrast the ten laws of set union and intersection with the nine laws of arithmetic on fractions. Study habits and class note taking are emphasized. The student will learn how to write in the language of the college algebra mathematics professor. A historical context is given to the two topics, sets and fractional arithmetic. It is noted that, for complex social and psychological reasons, most entering freshman are very uncomfortable with these two topics. The primary objective is to reduce or eliminate this dis-comfort. Most have poor skills, no skills, no clear understanding, and/or specific misunderstandings about subtopics. Adding or multiplying fractions is an illustration. Multiplication of negative numbers is another. The six-week program is suggested as part of a high school to college recruitment program, one that increases the capacity of the student, decreases learning support enrollments and increases the likelihood of college graduation.

## **Table of Contents**

[Under-preparation, Causes and Cure](#)

[Enrollment into the Second School](#)

[Testing Methods and Acceleration Policies](#)

[Why is there a Problem?](#)

[Four Step Method <sup>TM</sup>](#)

[The six-week Transition Program](#)

[Self Evaluation about Current Courses](#)

[Programmatic Objective](#)

[Student Engagement, the First Step](#)

[Security over Private Information](#)

[Transition Program Syllabus](#)

[Transition Program Learning Objectives](#)

[Measurement of Learning Objectives](#)

[Additional Learning Objective](#)

[After the Transition, Acceleration](#)

[Future Peer-to-peer technology use](#)

## **Under-preparation, Causes and Cure**

Learning support and developmental mathematics offered by colleges have large failure rates, sometimes as high as 75%. Mathematics under preparation is a well-known factor in over all college performance. In some cases, the expected graduation rate for students starting in learning support is under 5%. However, work on restructuring learning support is often not of sufficient interest to departments of mathematics. The department generally focuses on higher-level courses and on the math major. In the best universities the students have study habits and a background sufficient to passing the core requirement. The stated belief is that re-training after unsuccessful K-12 experiences is not possible. There is a difference of opinion, however.

We see the eventual spread of a community center based social infrastructure, designed to help colleges receive better-prepared students. The Second School network will help individuals to learn to the level of deep learning the elementary topics of set theory and arithmetic. We give this a rich historical and cultural context, but no word problems and very little “algebra” will be developed. The first elements of pure probability will be developed, but only very slightly. An appreciation of the cultural and historical relevance to these foundational topics is seen as essential.

In the Second School, poorly or under prepared students are prepared to study higher mathematics. Part of what is learned is how to handwrite elementary mathematical notation essential to set theory so as to solve linear equations in one variable. Specific note taking skills are developed. The focus is on depth, not on covering what some feel is required in traditional math learning support courses. Such math learning support programs are not working, have poor graduation rates, and are likely to be harming more students than are helped. Specific neurological theory suggests that students are overwhelmed in these traditional courses due to a specific acquired learning disability.

An internalization of a few elementary topics is achieved, in six weeks, at a deep level. When properly acquired, this knowledge may be retained through the lifetime of the individual.

## **Enrollment into the Second School**

Completion of nine learning objectives entitles the individual to register and be part of a virtual classroom infrastructure, using an extension of Second Life™ type three dimensional multiple avatar based software program, called Education Worlds (EW)™.

After a six-week Transition Program, the EW virtual classrooms are to be made available to a life long learning experience, outside of the need for commercial payments. How a community center based support system for the EW virtual classroom infrastructure is maintained is discussed below.

STEM (Science, Technology, Engineering and Mathematics) college level mathematics courses are easily observed to be underperforming for various reasons, including classroom attendance and classroom behaviors. These behaviors, such as leaving class and returning often or back talking in class, break down the learning process for others. The matter is not merely behavioral in nature. Underperformance indicates that categories of basic mathematical concepts are not retained from one semester to the next. Students try to hide from responsibility over this personal flaw. This matter affects all students at each of the Nation's colleges or universities. Non-retention of basic concepts is commonplace. The value to society, were this problem to be over come, is priceless.

The Second School network will use the EW three-dimensional learning environment, with avatars, and a learning theory based on cognitive neuroscience and immunological theory. A number of position papers on Lifting Pedagogy are available for public reading<sup>1</sup>. The Education Worlds software infrastructure is also described publicly. These resources are made available to transitioning high school students and freshman college students as part of the Second School Community Center™.

The Second School Community Centers are to be established in all fifty states of the United States of America, as public-private partnerships, dedicated to the support of the Second School network. The Centers will offer health teas, baked goods and educational resources as a commercial franchise, and be administrated by a state level registered Corporations; e.g., educationWorlds of Georgia, Inc.; educationWorlds of Texas Inc.; etc.

### **Testing Methods and Acceleration Policies**

Not meeting reasonable learning outcome goals is not unique to any one college or university. This problem is addressed by the Second School network's high school to college transition program. The program is designed to deepen conceptual category

---

<sup>1</sup> Our websites include the following <http://www.liftingPedagogy.com> <http://mathPedagogy.com>, <http://www.secondSchool.net>, and <http://www.educationWorlds.com>

separation involved in common cognitive perception about “math” class experiences <sup>2</sup>. It starts with a six-week course designed to teach the individual how to internalize all notation and concepts essential to demonstrated knowledge of arithmetic and set theory.

The Transition Program is taught to convey an understanding of the elements of Lifting Pedagogy™. A three-dimensional, virtual, study hall is available to the individual only after having “passed” the six weeks Transition Program. Once in, students must maintain strict behavioral guidelines under the risk of expulsion. The EW technology provides a complete monitoring of all in world activities, and protects the individual information with a high level of encrypted data security. The Lifting Pedagogy is based on theory and practice as discussed in published papers developed by the Second School.

### **Why is there a Problem?**

Almost all students need learning support. Mathematics faculty members agree that learning support is not passing sufficient numbers of students to advance the goals of a four-year mathematics program. Even with students interested in higher mathematics, underperformance is common in all entry-level mathematics courses; probability, college algebra, pre-calculus, calculus I, and linear algebra. The Second School network advances individuals from learning support status into a four-year program in higher mathematics, if the individual so chooses. The door is opened.

Education World’s virtual classroom system is a means to achieve deep testing of any individual’s skill and knowledge about the elementary topics in mathematics, and its history. As such, these resources are made ready to end the crisis in American education.

So what are the underlying similarities and differences between under performance and accepted performance?

***. . . the system that translates mathematical knowledge into value and ability for the next generation—is broken and must be fixed. This is not a conclusion about teachers or school administrators, or textbooks or universities or any other single element of the system. It is about how the many parts do not now work together to achieve a result worthy of this***

---

<sup>2</sup> Prueitt, Paul Stephen (publication in process – 12 pages) Learning Management System, Based on a Four Step Method™ to be submitted for publication during the month of July 2011.

### ***country's values and ambitions”***<sup>3</sup>

This description by the U.S. Department of Education will play a key role on our work. The system does not accept responsibility for its own failure.

The idea that program wide under performance is entirely the fault of “our” students is not feasible. The Second School network, and its considerable technological and methodological resources, is designed to create an alternative school, one that is largely virtual in nature and individualized. A technology based on stratified Service Oriented Architecture and tools derived from national intelligence technologies is made available<sup>4</sup>.

### **Four Step Method™**

The Lifting Pedagogy based on a Four Step Method™. The four steps are:

- 1) Find an example of an exercise type, in the book or made up by a student; and work the exercise completely on blank paper using a pencil, good notation and handwriting.
- 2) Give the exercise type a name or select from a list of focus topics<sup>5</sup>.
- 3) Make up a second illustration of the same focus topic; e.g., exercise type, and work it completely
- 4) Provide a hand written discussion about the conceptual narrative underlying the exercise type.

### **The Six-week Transition Program**

A presentation of the foundations of set theory and arithmetic is proper and appropriate. But the six-week EW Transition Program is at a much more rigorous level than high school math class. In addition to teaching how to write statements about sets of real numbers, and linear algebraic equations, the Transition Program curriculum includes a full presentation of the concepts of replacement set and solution set.

The conceptual foundation underlying linear equations in two variables, and underlying systems of linear inequalities are addressed. With these topics deeply learned, and

---

<sup>3</sup> **From Foundation for Success: The Final Report of the National Mathematics Advisory Panel** March 2008, U.S. Department of Education

<sup>4</sup> Prueitt, Paul Stephen (2011) Virtual Worlds, Will this be the next Learning Platform?; a presentation to the Faculty and Students at Atlanta Metropolitan State College. Oct 21<sup>st</sup>, 2011 and published at <http://www.educationworlds.com/pdf/nextLearningPlatform.pdf>

<sup>5</sup> This naming process leads to a grid of framework-based measurement of student learning at the focus topic level.

retained, the entering freshman college student is well prepared to take either pre-calculus or the college required liberal arts mathematic class.

The six-week Transition Course prepares each student individually for any college level entrance exam by looking at mathematical concepts at a deeper level using the Four Step Method™. The Four Step Method trains the individual in how to acquire real mathematical concepts and to write in pencil on, unlined, blank paper or digital pen a demonstration of expert level knowledge of these concepts.

### **Self Evaluation about Current Courses**

The EW Transition Program is taught with fewer topics, so that each individual student might have the time to go into those topics at a deeper level. This possibility has many difficult to analyze aspects, with some controversy. Mathematics curriculum is often used as a weeding out course. The current school curriculums are written as textbooks, having very large cognitive dependencies. Information over load is the predictable result of the use of these textbooks. Textbook companies profit from the cottage industry created due to the crisis in American education, and thus will not resolve the crisis.

Systems theory can and should be applied to understanding the systemic nature of the crisis. It is not in the “short term” education sector’s interest to end the crisis. The departments of mathematics are not really interested in teaching those whom the system has failed. However, what an individual person needs is to feel good about what they know and who they are. This is a necessary first step if we are to wake up to the value and beauty of higher mathematics.

Learning arithmetic at a deep level is possible. For example, while Chair of the Mathematics Department at Talladega College (2006-2007), Dr Prueitt used bases other than base 10 to teach how to graph linear and quadratic functions. This curriculum was given over the course of an entire semester, and is reduced to fit a six week time period. Because the college was near bankruptcy, there was no campus book store, and no required textbook.

Seeing the underlying coherence of arithmetic, preformed in various number bases, opened the eyes of all of the Talladega students, during the one year that Dr Prueitt was teaching. The learning objective was to demonstrate skill and knowledge necessary to graph equations using hand computed arithmetic and algebraic expressions, in any number base other than base 10. This learning objective represents a significant but

achievable objective as shown in handwritten tests, from 2006-2007, now archived in EW professional records. After relearning arithmetic in a base not base 10; fear of fractions, in base 10, was then set aside because the coherence of arithmetic was seen, often for the first time.

Set theory was developed and the ten laws of set theory was compared and contrasted with the nine laws of arithmetic. Each student was required to write in pencil onto unlined standard size paper, the statement of the two sets of laws and a comparison between the two systems, sets and arithmetic with addition and multiplication. The concepts of inverse with respect to addition, multiplication and composition, of functions, were added as the Transition Program was finalized in November 2010, while Dr Prueitt was teaching at Atlanta Metropolitan State College.

### **Programmatic Objective**

The Transition Program provides a clear measurement that entrance exam grades may be increased. The foundations may be developed as an experience. The individual may internalize this experience and from this experience describe what the individual knows about these foundations, into a handwritten “Blank Paper Test™”. The syllabus for the six-week Transition Program identifies the concepts underlying set theory, arithmetic on fractions, algebraic and arithmetic expressions and graphing of linear systems in one and two variable. Once the Transition Program is passed, the individual is allowed to enroll in a long-term membership with access to Education Worlds virtual classrooms.

A new pedagogy, handwritten testing methods and the Four Step Method is learned. The development of handwriting note taking skills is achieved, so that when the individual goes “in-world” to the classroom he or she will use handwritten message exchanges as a primary means to communicate to Second School professors and other students. The policies of the virtual classroom, as well as movement and design skills in Second Life type virtual worlds are also learned as part of the six week program.

### **Student Engagement, the First Step<sup>6</sup>**

The practices associated with Lifting Pedagogy are to be adopted as class policy.

---

<sup>6</sup> This section is shorten from a thirty page Education World document, posted at <http://www.educationworlds.com/pdf/theLiftingPedagogy.pdf>

However, training in the Lifting Pedagogy, and Four Step Method, do not provide all necessary skills to be in-world in an avatar. A number of social skills are needed, as well as skills at existing in world as an avatar.

Two changes are

- 1) Use of the Four Step Method
- 2) Use of a different Testing Philosophy.

In class and using homework assignments, students are asked to make up problems on their own. These are composed onto unlined paper in pencil or with a digital pen. They are graded on the quality of the problem as well as on how well the solution is presented.

Handwritten responses to the question, “What have you learned?”; is the primary testing methodology. This testing response “lifts” to web-based interaction using the LiveScribe pen, or I-pad writing tablet<sup>7</sup> to create a simulation of handwritten materials, class notes, professor lectures or tests, as a digital video. The “pen-casts” are archivable into a digital database; where these resources are available to peer-to-peer learning experiences.

### **Security over Private Information**

A high-resolution digital video, of hand written responses, eliminates the question of who is making the response. This creates a one way trust between the EW system and all individuals brought into the EW virtual classroom. The reverse trust is also established, by federal law; and by an encryption technology that is based on stratified Service Oriented Architectures<sup>8</sup>.

### **Transition Program Syllabus**

The six-week Transition Program reveals a small portion of core topics.

### **Transition Program; Learning Objectives**

- 1) **LO1: Ratios:** The learner will understand the difference between whole counting numbers and the set of ratios. The set theory describing the irrational

---

<sup>7</sup> See reference at #1

<sup>8</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.

numbers is to be learned.

**2) LO2: Expressions:** The difference between an arithmetic expression  $1 + 1 = 2$  and an algebraic expression,  $2*(3x - 1)$  will be understood.

**3) LO3: Nine Laws of Arithmetic:** The nine laws of arithmetic with addition and multiplication are to be understood and used in the simplification of arithmetic or algebraic expressions.

**4) LO4: Ten Laws of Set Theory:** The ten laws of set unions and intersections is to be learned, and these ten laws compared with the nine laws of arithmetic.

**5) LO5: The concept of a Replacement Set:** The student will demonstrate skill at “closing” an algebraic expression from a replacement set; e.g., a set of numbers or of points in the plane. The concept of a solution set is to be distinguished from the concept of a replacement set.

### **Measurement of Learning Objectives**

**1) LO1** Measurement will be as follows. Students will learn to add, multiply, divide and subtract fractions in a base other than base 10. This unexpected learning task maybe the key to changing orientations. Measurement will be via a subtest of 15 mins during a 50-minute test. This test will require each class participant to make up addition, division, subtraction and multiplication problems, after choosing a favorite number base. Addition and multiplication tables are constructed onto blank paper, along with sufficient student created arithmetic exercises so as to demonstration capacity to perform skill.

**2) LO2** measurement is achieved using a test instrument very similar to current Chapter One 0097 tests. This subtest will measure the student’s ability to simplify five algebraic expressions. A replacement number is to be substituted into the un-simplified expression. The same number is to be substituted into the simplified expression to produce a fraction. This fraction is to be reduced to its simplest form in base 10. The fundamental theorem of arithmetic is to be recited and illustrated.

**3) LO3** measurement is made with a twenty-minute handwritten test. Students will list and illustrate each of the nine laws of arithmetic. Illustration of knowledge achieves LO3 measurement. This test section will be developed onto blank copy machine paper, one to two pages.

**4) LO4** measurement is made with a twenty-minute handwritten test. Students will list and illustrate each of the ten laws governing set unions and intersections. Illustration of knowledge achieves LO4 measurement. This test section will be developed onto blank copy machine paper, one to two pages.

**5) LO5** measurement is achieved through demonstration of understanding about the various sets that are included in the set of real numbers, including whole numbers, fractions and irrational numbers. The notion of topological nearness is to be examined by each participant, so that paradoxes such as the set of all sets is understood as being part of real number mathematics. This is a synthesis-learning objective, measured by subjective evaluation by a mathematician.

### **Additional Learning Objective**

**1) LO6: Two Laws of Equality:** The nature of mathematical laws is discussed in class and practice is made using the nine laws on expressions and the  $9 + 2 = 11$  laws with simple linear equations in one and two variables.

**2) LO7: Exemplar problems on the Two Laws of Equality:** The law of addition is treated by itself. The law of multiplication is treated, again by itself. The two laws are then combined. Student will demonstrate ability to illustrate the use of the two laws of equation.

**3) LO8: Using All Laws Together:** To the nine laws of arithmetic we add two laws of equality. To the ten laws of set theory we add the definition of a probability on the assumption of equal likelihood of selection from a set. A contrast and comparison is made to Constitutional law and to judication in court by a judge. The student is responsible for demonstrating an understanding of this comparison between legal education and working elementary problems in college mathematics classes.

**4) LO9: The concept of a Solution Set:** The concept of a replacement set is extended to include algebraic to arithmetic closure producing truth statements. An introduction to statistics is made. The student is responsible for demonstrating using hand written notes that a distinct is made in his or her mind about the difference between a solution set and a replacement set, both in algebra and in statistics.

### **After the Transition, Acceleration**

If and when the individual student's perception about mathematics shifts, then a second strategy is used. The second strategy is to accelerate learning.

A critical test of readiness is related to the skills and understanding needed to graph lines as solution sets over the replace set of the real numbers, and finding the intersection of two lines; e.g., systems of linear equalities and linear inequalities.

To support acceleration, a hybrid on-line, and face-to-face, course is recommended using Education Worlds virtual classroom software in a standard way. Each accelerating student will be required to attend study hall sections two full hours per week, with an accommodating schedule.

### **Future Peer-to-peer technology use**

Group-work may be reported using web technology. As a general principle, students have the option of not using web-based support, only if they meet at regular times in face-to-face study halls. Students who are accelerating may use physical class according to a schedule, but will meet either one line, or in a classroom once a week.