DESIGNING INSTRUCTIONAL UNITS WITH A SYSTEMS THINKING/SYSTEM DYNAMICS APPROACH

Lil Williams

The study of the history and/or literature of one nation or a group of nations can be enhanced with a Systems Thinking/ System Dynamics approach. A sytems thinking approach helps students grasp several important concepts.

It is important for students to discover that in fact or fiction "the more things change, the more they stay the same." It is important for students to relate present events to the patterns of behavior created by a particular sequence of events. It is important for students to reason that these patterns of behavior show-up repeatedly, therefore outcomes might be predictable and leverage points for change could be recognized and developed. It is important for students to connect ideas, to find one truth in the light of another, and to develop a broad foundation for the depth of knowledge to be acquired.

The desired results for the students are that they learn to relate sequences of events to patterns of behavior, they learn to detect the operating structure of a system, they learn to recognize archetypes of systems, they learn to recognize causal loops operating in systems, and they learn to understand the process by which actions are prompted by beliefs "which are based on conclusions inferred from observations plus experiences." (adapted from *Fifth Discipline Field Book,* p.242, Rick Ross)

Teachers should be cautioned that students, for the most part, get [need] very little help from teachers in fitting together pieces of information into *systems* (groups) which demonstrate behavioral patterns over time. Students need to understand, however, that rather than a system being the "sum of its parts," it is a "collection of parts which interact to *function* as a whole." (Kauffman)

Students need to discover the basic rules of how systems work in order to understand that political systems and ecological systems work on the same principles. They also need assistance in developing the mind-set "to look for interdependencies and feedback within systems." (GIST) To understand the process by which actions are prompted by beliefs, students need practice applying the *Ladder of Inference* to personal actions as well as historical events.

Which?

Two questions can be asked to help identify social studies or language arts curricula which can be designed with a systems approach. Which sequences of events in history operate as a system? Which eras have produced authors whose

WHAT DOES IT TAKE TO SUCCEED?

Second in a series of "What It's Like to Be a Pioneer"

*Jay Forrester has suggested that we could speed the spread of learner-centered-learning and system dynamics in K-12 education by sharing tales of "what it's like to be a pioneer." It might help others who are starting out, or just curious, to know about other teachers' experiences, positive student outcomes, pitfalls, political issues, responses of administrators and fellow teachers, student and parent feedback, triumphs and tribulations. This paper presents one such vignette. If you have other tales to share, please let Deb Lyneis know. (*LyneisD@cle.tiac.net*)*

Introducing system dynamics and systems thinking into a school is not easy. In fact, it can sometimes be a frustrating experience. We hear about teachers who have succeeded, and their schools provide examples for others to follow. But what about those teachers who have tried and *not* succeeded? What can we learn from them?

One teacher who has been in both situations has agreed to share her story. She started out in a school where system dynamics and systems thinking

RESOURCES…

Use of Gaming as a Tool in Education:
Resources for Teachers

Dennis Meadows

I list below a variety of materials that may be helpful to teachers interested in using games to supplement other methods for conveying the principles and tools of systems thinking. This is a partial list. There are many hundreds of games in use; I have listed a set here that illustrates the diversity of the materials and that is comprised of items which, except for Bancroft, are easy to obtain. My apologies to the many authors whose valuable and relevant work I have omitted.

There are two books, one old and one new, that provide the rules for a large number of very playable games. Neither text has any explicit reference to systems. A creative teacher can, however, take many of these games and adapt them for use in making points either about conceptualizing a model of social behavior or about aspects of communication and decision making.

• Bancroft, Jessie H., *Games for the Playground, Home, School, and Gymnasium*, MacMillan Co., New York 1925.

This classic text, with illustrations for about 500 games, is long out of print. But so many 100's of thousands were sold, copies were commonly to be found in the games sections of the better used book stores. It is unique among the many hundreds of game books published early in this century for the introductory chapters that reflect on the uses of games and on strategies for making them effective. I usually pay about $15.00 for a copy.

EDITORIAL

Here in New England the weather is teasing us with promises of Spring. The snowdrops are out and the crocuses and daffodils are pushing their greens into the alternating frigid and balmy air. Spring means that our conference is just around the corner. The flurry of activity and excitement is on the rise at the CLE. Take a look at the wonderful sessions many of you have offered to present. (See list of presentations on page 9.) With George Richardson to kick off the conference and Jay Forrester to give us his wisdom, workshops on a variety of subjects, and time to share and talk—all set in the majesty of the Columbia River Gorge—we should have a wonderful few days with each other. Be sure to get your reservations in with plenty of time to spare.

Please note that we have a new e-mail address. While the old one will still work as long as we keep the current provider, the new one will work regardless of any ISP changes.

Have a happy and productive spring.

Lees Stuntz <stuntzln@clexchange.org>

• Rohnke, Karl, *Silver Bullets, A guide to initiative problems, adventure games and trust activities*, Kendall/Hunt Publishing, Dubuque, IA 1984. Fax: 800-772-9165. $18.50.

This is the reference work on simple games for many trainers engaged in team-building programs. Over 150 games are presented clearly and simply. There is discussion of safety procedures, but there is no guidance on framing or debriefing. All of these initiatives have been tested thousands of times, and they work for audiences of all ages. Pick out a couple and let your imagination suggest interesting new ways to link them to the field of systems.

• Booth-Sweeney, Linda and Dennis Meadows*, The Systems Thinking Playbook, Vols. I & II*, published privately, 1996.

This small red binder contains 20 exercises with extensive narrative about how each can be linked to the skills, attitudes, and habits required of a "systems thinker." It is presently priced for the corporate training market, so it costs $69.95. E-mail Tracy L. Botting for a brochure. tlb@christa.unh.edu *The Systems Thinking Playbook*, http://www.unh.edu/ipssr/Lab/playbook.html

• Meadows, Dennis and Amy Seif, *Creating High Performance Teams of Sustainable Development: 58 Initiatives*, University of New Hampshire, 1996. $25.00.

This manual is the first of a two-volume set created to provide a very detailed teacher's guide and material collection for an intensive 4 day seminar that teaches systems thinking, skills of high performance team work, and principles of sustainable development. This text is the detailed presentation of 58 games. The exercises range from 1 minute to several hours in duration. There are detailed instructions for framing and debriefing the exercises along with half-page reproductions of the overhead slides you need to introduce and debrief each game. The games are divided into 12 categories according to their function

Designing Instructional Units with an ST/SD Approach*, cont. from page 1*

works have become classsic examples of the dominant philosophy of the era? [The suggestions in this article refer to curricular units developed by the GIST teachers and available from the CLE.]

1. Take all like-events in the history of a nation, e.g., U.S. Wars:1776-1996, and study the patterns of behavior to answer the question: "Why does America go to war?"

2. Take a time period in the history of a nation, e.g., Westward Territorial Expansion of the U.S.:1780-1880, and study the impact of the Doctrine of Manifest Destiny on societal factors which influenced this movement.

3. Take a concept and analyze the effect of historical events on it, e.g., The Changes in the Role of Women in American Society.

4. Take a topic, e.g., The Holocaust:1930-1945, and read the literature about the era to study the "Impact of Bigotry on Humanity."

When?

In the normal flow of a Georgia Studies/U.S. History Course, when it's time to study the American Revolution, take four weeks to study all of the major American wars as a unit to answer the question: Why does America go to war?

When it is time to study the Louisiana Purchase/Lewis & Clark Expedition, take three to four weeks to study the factors in operation in the U.S. which motivated the Westward Territorial Expansion of U.S.,1780-1880. Review the settling of the Original Thirteen Colonies in light of the Doctrine of Manifest Destiny, then assess its impact on territorial expansion of the U.S.

When the timeline rolls to the Twentieth Century, take three weeks to review the events of the Nineteenth

Century and how women reacted to these events to effect changes in the role of women in our society. Then, as an ongoing study, canvass the Twentieth Century for events which might predictably impact women.

In literature, especially in conjunction with the historical studies, the tools of Systems Thinking can be used with individual selections. The tools can be used effectively with groups of selections combined to demonstrate a concept, e.g., The Language of War; Literature of the Holocaust.

How?

For most teachers, the classroom is the principal study site, with safaris into the computer lab.

Use these general procedures for any unit: Prepare a method of grouping students for group inquiry, and pull into your classroom as many as possible printed resources, fact and fiction, dealing with the topic.

For the war unit, the classroom can be made to look like a strategic planning war room complete with 1-2 computers, wall maps, timeline, posters, and packets of trade book materials on each war era.

The classroom can be marked with tape into two six feet by ten feet Conestoga Wagons for following the Oregon Trail west upon completion of the westward territorial expansion study. Use the timeline with influencal factors and western scene pictures which is already in place.

The classroom can be divided into sections to represent state legislatures, the U.S. Congress, suffragette headquarters, military recruiting office for the role playing/study of the changing role of women in our American society. The bulletin board can display19th and 20th century timelines.

Specific suggestions for activities in the classroom:

1. Prepare a packet of printed material for each student group.

2. Present a dramatic lead-in to the unit to engage students' interest. For example:
   • Re-enact the Boston Tea Party as lead-in to war unit.
   • Hold a town meeting with the teacher dressed as U.S. Land Agent or Wagon Master to discuss reasons for going West.
   • Arrange for a group of girls to march into class carrying placards and demanding the right to enter the state university. It is the 1800's and females are not allowed entrance to the hallowed halls of higher education. The ensuing debate initiates the study of women's role and/or rights in society.

ST/SD Tools

The systems tools used in the GIST curricula are computer models, behavior-over-time graphs, causal loop diagrams and stock-flow diagrams. Use these tools with two rules of thumb.

• **First rule of thumb: Don't re-invent the wheel!**

• **Second rule of thumb: Do adapt the wheel to move your curricular vehicle forward!**

Computer Models

Computer models give students a chance to ask "what if...?" questions, to predict the outcome of answers to the questions, and to see the outcome of the prediction on the model's graph.

Designing Instructional Units with an ST/SD Approach*, cont. from page 3*

"THE GIVER" is an excellent model to use with students at the start of a school year to demonstrate the need for rules. A synopsis of *The Giver* society (*The Giver,* Lois Lowery) is all that is necessary for a week's unit on class/school rules. (Model created by Catalina Foothills School District, Tucson, Arizona)

"AMERICAN REVOLUTION" model works well at the start of the U.S. Wars unit. This model allows students to see how people's reactions to events create patterns of behavior. The entire class studies the American Revolution model as a model for the study of the major conflicts in U.S. History. (Model created by GIST)

"WAGON TRAIN" model is used effectively upon completion of the Westward Territorial Expansion of U.S., 1780-1880 unit. This model is designed to demonstrate the importance of a high level of *community spirit* to the successful completion of a wagon train's arduous journey from Independence, Missouri to the Oregon Territory. (Model created by GIST at Trinity Institute, Summer 1997)

"SOCIETY'S ALLOWANCE vs. GROUP'S PERCEPTION" model can be used to study the assumption that society, in general, assigns roles to a specific group according to the value it allows the group in the managing of society at any given time in its history. Using the timeline of the women's suffrage advancement, students use the model to predict how the group's (women's) perceptions of its own worth changed. (Model created by GIST at Trinity Institute, Summer 1998)

Behavior-over-Time Graphs (BOTG's)

This ST/SD tool allows students to examine, on a timeline or a graph, a behavior/variable over a series of events.

Examples:

A BOTG is used with the American Revolution model to reveal the build-up of anger in British and Colonial partisans as events occurred.

In the study of World War II and the literature of the Holocaust, BOTG's can be used effectively in several ways.
•To trace the relationships between Hitler's rise to power, Germany's military strength, and the persecution of the Jews.
•To look at tension between the characters as the fear of discovery increases in *The Diary of Anne Frank.*

BOTG's can be used to chart the return of Buck's "primordial instincts" in *The Call of The Wild.*

BOTG's can be used to illustrate the overland trail emigration numbers from 1840 to 1880.

Causal Loops Diagrams and Stock-Flow Diagrams

These diagrams demonstrate how a system works and how the pieces interact with each other. They are most effective when used in the de-briefing culmination of a unit of study. These diagrams allow students to see graphically the outcomes of their predictions. Study of them helps students identify leverage points when the predictable outcome might have been changed. Examples:

1. At the end of the American Wars unit, the use of these diagrams enables students to achieve an overview of the causes of armed conflict; to discover commonalities among the wars, as much as a century apart, as to causes; and to recognize leverage points in the sequences of events wherein the outcome might have been changed.

2. In the Westward Expansion unit, use of the diagrams helps students look for

the interdependencies and feedback between the variables which motivated U.S. expansion, e.g., immigration, population growth, Doctrine of Manifest Destiny.

Examination of causal loops provides students a method of applying learnings to real-life situations. From the study of the Wagon Train community, students learn to estimate the effect of the feeling of community on behavioral decisions and patterns. The concept of community is important in helping students to apply information and intuition toward better real-life decisions.

From the study of the dynamics of conflict, students learn to look for leverage points for conflict resolution in U.S. History. In the best-case-scenario, students begin to make the transfer from history to the resolution of their real-life conflicts.

The tools of ST/SD blend naturally with the interdisciplinary approach to instruction. A unit can be studied in Language Arts, using drama, journals, speeches, and posters; in Social Studies, using group inquiry, debate, predictions, and societal factors; in Math, working with graphs of trends, statistics, and timelines; and in Science, studying weather, land forms, inventions, etc.

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Ed. note: The units referred to herein are available from the CLE and the website, catalogued as
• *CC1999-09DevelopngTeamRules*
• *EN1997-02TheGiver*
• *EN1999-09DiaryOfAnneFrank*
• *EN1999-09RulesVsChoice*
• *EN1999-09TheCallOfTheWild*
• *SS1999-09GenericCivilRights*
• *SS1999-09IntroAmRevolution*
• *SS1999-09JewishRoleGermany*

WHAT DOES IT TAKE TO SUCCEED? *, continued from page 1*

eventually became an integral part of the curriculum and school culture. As one of the first two teachers in the school with system dynamics training, she watched as more teachers became curious about the approach, saw the benefits for kids, and sought training for themselves. Over the years, there have been setbacks along the way, but somehow the growth process in this school has kept going.

Looking back, the teacher can attribute the steady progress to three factors.

- First, there was very strong support from a *forward-looking admin-istration*. One person had heard about systems thinking in other applications and was willing to take the chance that it could bring improvement to his school. The administrators never "pushed" these new ideas onto teachers, but they did convey their enthusiasm for the accomplishments of students and teachers who gave them a try.
- The second factor was *time*. Teachers were given time for training workshops in the summer and for collaboration during the school year. Our teacher gave in-service workshops and mentored teachers who wanted to go further. Block scheduling helped too.
- Finally, there was adequate *technology*, both hardware and software, to do a good job. The

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Units with an ST/SD Approach *, cont. from page 4*

- SS1999-09WestwardExpansion
- SS1999-09WExpaWagonTrainSim
- SS1999-09WhyAmericaGoesWar
- SS1999-09WomensPoliticlRole

This article also is available from the website and the CLE, catalogued as SE1999-09DesigningSTSDUnits. Written for 8th grade level students in Social Studies or Language Arts, it is adaptable for all grade levels and curricula.

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administration wanted to use their new computer lab for "learner-centered, high-level thinking applications to enhance students' learning." They encouraged the teacher to write grants which secured much of the school's technology, they provided funding for STELLA, and they made the lab easily accessible to teachers and their classes.

Once progress got rolling, it became its own positive reinforcement. Because the administrators were open to change, they encouraged system dynamics which then became an instrument of further change. As more teachers became interested, the training and collaboration increased, bringing other teachers along. As the useful application of technology increased, the school was awarded grants to buy more computers. Surprisingly, the students themselves became "ambassadors for change" as they took what they had learned in science classes and applied it in other classes, making the connections for teachers. Students also garnered recognition for their work at a regional exhibition. Parents began requesting placement at this school based on the systems opportunities for students. Systems education may be small still, but it is there to stay.

That's the success story. Two years ago, our teacher moved to another school and faced an entirely opposite set of circumstances. Convinced by experience that system dynamics could fundamentally improve education for kids, she hoped that she could introduce it in her new school too. Unfortunately, she had little success. As before, she used system dynamics and systems thinking with her students, she explained the ideas often to other teachers and administrators, she wrote and received a small technology grant, and she mentored a few teachers in their classes. However, it seemed a losing battle against inertia the whole way.

The factors that had fostered growth in the first school worked to stifle any change in the second.

- There was *inadequate admin-istrative support* for change. Although the superintendent voiced interest, she referred the new teacher to the academic council, a body whose tacit goal was to oppose any change in the curriculum. Teachers in the school were also very resistant to change; they seemed to feel that they did not have time or support for anything new. This response was understandable; the school had had five principals in two years and many other issues to address.
- There was no *time* to learn or share new curriculum ideas. Teachers were expected to substitute during their preparation periods, in addition to teaching six classes.
- *Technology* was an obstacle. The computer lab was used exclusively for keyboarding and only one other teacher integrated any technology into the curriculum. The technology committee disapproved of laptops; the math department even discouraged using calculators. Our teacher had one computer for her class and a STELLA site license (from her grant), but it took the school three months to install the software on the library computers where her modeling lessons had to be taught. She was not allowed to write a larger technology grant. The idea of system dynamics, or any technology in the classroom, seemed a threat to this very traditional small school.

Our teacher recently decided to leave this school for one which sought her systems skills, although she is "sad to leave behind so many wonderful, bright students before having the time or energy to reach them all with even just an exposure to systems thinking." She has had the unusual experience of working at two schools at opposite ends of the continuum: one very open to change, the

New Materials Now Available from the CLE

The following new documents are now available from us or the Web site http://sysdyn.mit.edu/cle/

SYSTEMS EDUCATION

SE2000-03GamingResources   **Use of Gaming as a Tool in Education: Resources for Teachers.** Dennis Meadows

A partial list of a variety of materials that may be helpful to teachers interested in using games to supplement other methods for conveying the principles and tools of systems thinking. [Systems Education, Cross Curricular, K-Adult] ($1.00)

SE1999-12Decisions&Closure   **Decisions and Closure Dynamic.** Carol Ann Zulauf

The "Decisions and Closure" dynamic looks at the Shifting the Burden archetype from the perspective of describing a fundamental, structural thinking process within individuals that is universal as they make decisions. The leverage in this dynamic lies in taking time, engaging in a dialogue, and reflecting on the pros, cons, and consequences of the decision to be made. [Systems Education, K-Adult] ($1.00)

CROSS CURRICULAR

CC2000-02ArtOfMoneyInArt   **The Art of Money in Art: Understanding the Value of a Collectible.** Maureen Byrne

From Catalina Foothills School District. Developed for an 8th grade Visual Art course, this unit uses Behavior-over-Time Graphs, causal loop diagrams, and a STELLA model to help students learn many systems concepts as well as their studio art and art history lesson. [Cross Curricular, Behavior over Time Graphs, Causal Loops, Simulation, Middle School, High School] ($1.00 paper only, $6.00 paper + model on disk)

CC2000-02GlenCanyonDam   **Glen Canyon Dam Simulation.** Heidi Taylor and Debbie Gevirtzman

From Catalina Foothills School District. Students use a simulation to assume the role of operating Glen Canyon Dam, working with the many factors to be considered when regulating water flow over the dam. [Cross Curricular, Social Studies, Math, Science, Behavior over Time Graphs, Simulation, Middle School, High School] ($1.00 paper only; $6.00 paper + model on disk)

CC2000-02MarathonSimulation   **Marathon 5.0 Simulation.** Randy Valentine

From Catalina Foothills School District. Updated and modified 2/1/00 from the Marathon 1.2 simulation. Marathon 5.0 simulation is designed to be used in conjunction with a handout to guide students through the simulation. The simulation is used as a culminating activity for a Human Biology unit. [Cross-Curricular, Science, Dynamic Modeling, Simulation, Middle School, High School] ($1.00 paper only; $6.00 paper + model on disk)

ENGLISH

EN2000-02AnimalFarmPhysiSim   **Chocolates, Vanillas, Strawberries, and Orwell: An "Animal Farm" Physical Simulation.** Nancy Campbell with Ron Michalak

From Catalina Foothills School District. Following a physical simulation, students use Behavior over Time Graphs to study the "Animal Farm" and "chocolate" systems, and make oral and written connections between the novel and the simulation. After reading the novel, students relate it to the Success to the Successful archetype. [English, Behavior over Time Graphs, Middle School] ($1.00)

EN2000-02ExplicitLyrics   **Explicit Content in Music Lyrics.** Beth Horn

From Catalina Foothills School District. Using the Ladder of Inference and Behavior over Time Graphs, students study patterns and trends, interdependencies, trade-offs, and the concept that structure generates behavior, while discussing music with explicit lyrics. [English, Behavior over Time Graphs, Middle School] ($1.00)

EN2000-02Folk&FairyTales   **Focus on Folk Tales and Fairy Tales.** Tori Christopher and Anne LaVigne

From Catalina Foothills School District. Students read folk tales and fairy tales and use systems concepts and tools to analyze the events, patterns, structures and mental models within them. [English, Behavior over Time Graphs, Elementary School, Middle School] ($1.00)

EN2000-02PublicSpeaking   **Drama - Public Speaking: Factors of Success.** Pat Burrows and Anne LaVigne

From Catalina Foothills School District. Practicing their speeches in order to improve their final performance, students learn to understand how various factors relating to performance affect one another and learn to give specific information about patterns observed. [English, Cross Curricular, Causal Loops, Behavior over Time Graphs, Middle School, High school] ($1.00)

SOCIAL STUDIES

SS1999-11SixBillionCounting   **Six Billion and Counting: World Population 2000-2100 Model.** Len Skillings, Jr.

Exploring the world's population, this paper presents the facts for a model-building project with a complementary question/answer assignment. [System Dynamics, Dynamic Modeling, Social Studies, High School] ($1.00)

VIDEOS from the 1998 SD&DM Conference (not available on Website)

VID80198   **...to enable Freshmen to do what once strained Newton's powers....** Dr. George Richardson

(Cost $15.00) From the 1998 ST&DM Conference, Durham, NH. Dr. George Richardson. With his own special charm and humor, in this keynote address George asks, "Why are we here?" He then proceeds to talk about "What is systems thinking" and "what is system dynamics." He explores the question, "Why should kids learn this?" He says the patterns of thought these disciplines employ are implicit in the thinking of our greatest natural and social scientists and in current policy analysis, and he gives examples. George's presentation will be a valuable addition to anyone's library. (81 min)

VID80298   **Innovation Model as a Framework for Looking at SD as an Innovation, and Refining Strategies for Implementing It within K-12 Curricula.** Gary Hirsch

(Cost $15.00) From the 1998 ST&DM Conference, Durham, NH. The focus of this session is an "ithink" computer model of school innovation that Gary and others have worked on for a number of years. He uses the model in "real time" as a framework for examining system dynamics as a curriculum innovation. Gary takes the participants through a detailed analysis, including "what if" changes to the model and the subsequent computer runs of that particular change. He then leads a discussion of where the leverage might be in this complex system. (64 min)

VID80398   **Roundtable Discussion.** Dr. George Richardson (Moderator)

(Cost $15.00) From the 1998 ST&DM Conference, Durham, NH. Dr. George Richardson, Moderator, Panel: Jay Forrester, Jim Lyneis, Dennis Meadows, and Barry Richmond. Using questions from the audience, George leads the panel through a lively and often humorous discussion of some of the early days of system dynamics, personal system dynamics mistakes, and many stories. Each panelist has more than 25 years of experience in the field of system dynamics. They share stories, insights, and recommendations for the future in this historic gathering. (77 min)

VID80498   **5th Graders: What Can They Do? Building Their Own Models.** N Gill, G Richardson K Prendergast, P Zawacki, S Wiseman

(Cost $15.00) From the 1998 ST&DM Conference, Durham, NH. Nan Gill, Gayle Richardson, Kerry Prendergast, Pat Zawacki, and Shannon Wiseman. This tape is a must for the beginner in systems thinking in elementary level education. The five teachers speak frankly about how they each "took a risk," what kind of classroom exercises they did, beginning with 1st grade and on up. The teachers in turn share some experiences they have had and show graphs students have created which culminate in using STELLA computer models. Their enthusiasm and insights make this session very exciting. (93 min)

VID80598   **From Physical Models to Dynamic Modeling.** Larry Weathers, Organizer

(Cost $15.00) From the 1998 ST&DM Conference, Durham, NH. Larry Weathers, Organizer, Will Costello - free fall, Robin Goldstein - Tragedy of the Commons, Marti Lynes - soda bottle rockets, Al Powers - chemical equilibrium, Rob Quaden - velocity and acceleration down a ramp, Larry Weathers - air friction in a coffee filter. Six experienced teachers from varied disciplines and grade levels share brief examples of how they incorporate dynamic modeling into the hands-on experiments they offer their students. In this lively presentation, the teachers show how using many kinds of teaching aids, including STELLA models, helps their students understand complex scientific principles. (85 min)

VID80698   **Systems Thinking in Education: Realizing a Fuller Potential.** Dr. Barry Richmond

(Cost $15.00) From the 1998 ST&DM Conference, Durham, NH. Using the language of stocks and flows, Barry suggests how we can strive for fuller potential using systems thinking in education. The purpose of our educational system is to help the student learn both content and concept assimilation. He stresses the importance of using a global boundary in teaching, and helping the student develop a capacity for sharing understanding (such as emphatic skills and listening skills). He believes that students teaching students is valuable, with teams of 3-4 developing models together. Using systems thinking, students not only can build a deeper understanding of the world around them, but also learn to communicate more effectively and expand their boundaries. (There is intermittent audio loss throughout.) (60 min)

VID80798   **Letting Students Learn about a Complex World.** Dr. Jay Forrester

(Cost $15.00) From the 1998 ST&DM Conference, Durham, NH. Part of the challenge of using system dynamics in the classroom is for the teachers to have enough self-confidence for the students to get ahead of them. Jay discusses, "What is system dynamics?" and describes some of the advantages of using this approach with students as aiding both their communication and writing skills. Jay challenges teachers to start their own system dynamics clubs. He also discusses how students might use system dynamics when they graduate to understand the nature of complex systems such as cause and effect, low leverage policies, and the problem of eroding goals. He closes by talking about the future of system dynamics, pointing to the next frontier as the "deep, useful, effective understanding" of our social, economic, and managerial systems. (60 min)

VID80898   **Moving Systems Thinking into the Mainstream of Our Schools: Questions to Consider.** Dr. Peter Senge

(Cost $15.00) From the 1998 ST&DM Conference, Durham, NH. Using questions from the participants, Peter discusses a number of different concerns about current school policy and problems. He comments at length on his vision of the long-term desired end results of using systems thinking in the school districts and classrooms. (97 min)

VID80998   **How Systems Thinking and System Dynamics Have Changed My Teaching Life.** Alan Ticotsky, Jennifer Hirsch, & Tim Joy

(Cost $15.00) From the 1998 ST&DM Conference, Durham, NH. In this free-wheeling discussion between the panel and audience, many topics are discussed, including what mistakes you made, how do you grade using this approach, stories of successes, and finally some advice from Jim Waters: "Stay loose and juicy." (There is intermittent audio loss)

<p style="text-align:center">◇</p>

Decisions and Closure Dynamic: *Oh, Decisions, Decisions…*

by Dr. Carol Ann Zulauf

We make thousands upon thousands of decisions in our lifetime. And a few of those decisions represent the few truly crucial junctures in any life. Make an unwise decision at such a point, and it will shape the rest of one's journey.

I have been giving much thought to the processes of decision-making. We have all had the experience of feeling one way about something, and thinking another way about it. With the myriad decisions that we need to make every day, some are so routine as to be automatic. This particular dynamic seeks to shed light on those decisions we are faced with that possess far-reaching implications. As educators, I see our responsibility to help our students, no matter what their age, but especially in formative stages, to really be able to think through those crucial decisions and to consider the intended and unintended consequences of a decision.

Parallel to Shifting the Burden Archetype…

The "Decisions and Closure" dynamic can be looked at as a very specific expression of the Shifting the Burden systems archetype. In the Shifting the Burden archetype, there is a symptomatic solution applied to a problem instead of a fundamental solution. The "Decisions and Closure" dynamic looks at the STB archetype from the perspective of describing a fundamental, structural thinking process within individuals that is universal as they make decisions.

What is happening in this dynamic is that there is a shift in perspective from solving a problem to making a decision. A lot of times, people can make decisions in haste for a whole lot of reasons. When decisions are made in haste, side effects or unintended consequences occur. Some of those side effects include:

- Attaining only *temporary* closure to the original decision
- Having unresolved feelings
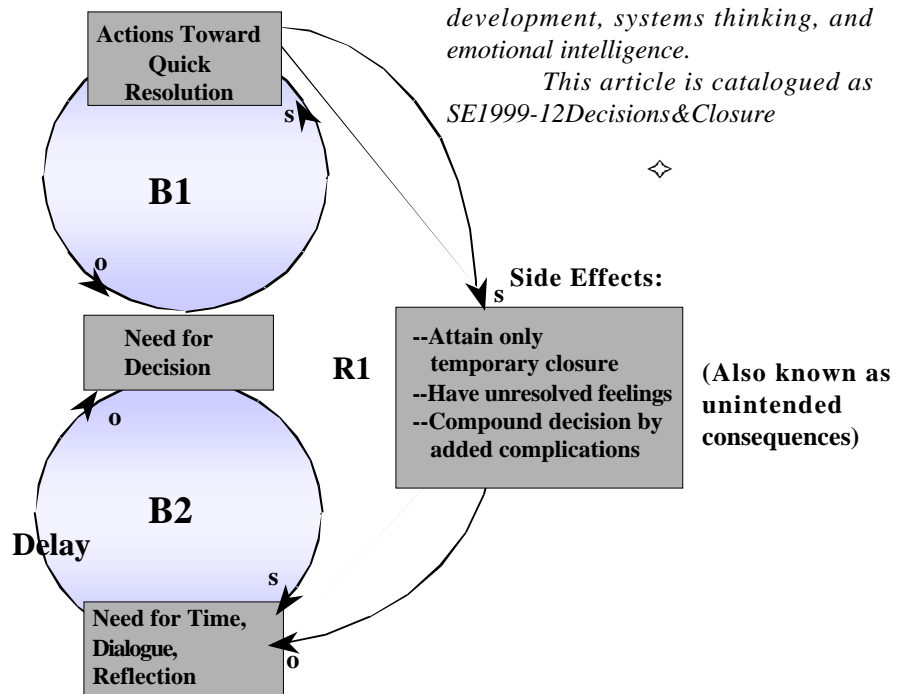- Compounding of the original decision by added complications (this can be a biggie!)

Now, if a person were able to (a) reflect on the decision to be made, (b) engage in a dialogue with a few key individuals who could act as coaches, and (c) utilize the benefit of time, that person would be in a position to make a more informed choice. The benefits of engaging in this process would be that the person would achieve more permanent closure to the decision. It's that feeling of "knowing you made the right decision." This Decisions and Closure dynamic is illustrated as follows:

Long-term Opportunities for All…

The major benefit to this "Decisions and Closure" dynamic is that it gives everyone that very much needed "pause" to make the best possible decision for all the affected parties to the decision. We need only pick up the daily newspaper to see myriad examples of people making rash decisions with dire consequences. Promoting the fundamental benefits of dialogue, reflection, and time for the optimal choice to emerge aids us all in our efforts in evolving towards long-term, sustainable growth.

Dr. Carol Ann Zulauf is an Assistant Professor in the Adult and Organizational Learning Program at Suffolk University in Boston, Massachusetts; she is also President of Zulauf & Associates, a consulting and training organization specializing in leadership and team development, systems thinking, and emotional intelligence.

This article is catalogued as SE1999-12Decisions&Closure

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Reading the Dynamic

In a Decisions and Closure dynamic, there is a decision to be made. If a quick resolution is implemented, side effects will ensue: attaining only temporary closure; having unresolved feelings; or a compounding of the (original) decision by added complications. The leverage in this dynamic lies in taking time, engaging in a dialogue, and reflecting on the pros, cons, and consequences of the decision to be made.

2000 Systems Thinking and Dynamics Modeling Conference Draft Program

Conference registrations are arriving steadily at the CLE. The program is shaping up nicely, with lots of exciting sessions and workshops being offered. Send in your registration forms as soon as possible, and begin to plan which of the presentations you'd like to attend.

KEYNOTES

- George Richardson: Insightful Little Models
- Jay Forrester: Insights from Forty Years of System Dynamics

PANEL OF STUDENTS AND TEACHERS: LEARNING SYSTEM DYNAMICS

AN EXPOSITION OF STUDENT WORK FROM THE PORTLAND AREA SCHOOLS

WORKSHOP SESSIONS FOR BEGINNERS

- Introduction to Systems Concepts and Tools
- Introduction to System Dynamics Modeling

HANDS-ON WORKSHOPS FOR EVERYONE

- Celebrating the Writing Metaphor: Accelerating Learning of Systems Thinking by De-coupling the Learning Curves
- Play the Systems Way
- Using Systemic Communication to Improve Problem Solving
- Learning about Systems Thinking and Thinking Systemically about Learning
- Staff Development in Support of Systems Thinking and Dynamic Modeling Learning
- Systems Thinking/System Dynamics—The Fourth R?
- Model Building Skills For Experienced Modelers
- Community Dynamics of Moving toward Systems Thinking: A Dialogue—"Grounding Community Action in System Dynamics"

PARALLEL SESSIONS

- A Look at Change in Fourth Grade
- System Dynamics and Systems Thinking in the Curriculum: Strategies for an Integrated Approach
- The Dynamics of Health Education
- Developing a School-wide Approach to System Dynamics
- Integrating Systems Thinking and STELLA Modeling throughout the Mathematics Curriculum, K-8
- What Was the Impact of the Industrial Revolution on England, and Ultimately, on the Rest of the World?
- Right on Target! Developing Classroom-based Observational Assessments
- How Classrooms, Schools, and Communities Have Implemented and Applied ST to Learning.
- System Dynamics Models Created by High School Students
- What Behaviors are Desirable in Students Creating System Models? A Step before Assessment
- Materials for Introducing Systems Modeling in Mathematics, Grades 9-12
- Middle School Students Indulge in Risky Behavior: Their Cognitive Development and the Applicability of Systems Thinking Skills
- How We Got Started: A Story of Four Different Approaches
- The Impact of Simulation Models as a Tool for Chemical Concept Acquisition
- Students' Experiences with System Examples from *Modeling The Environment*
- Personal Resource Systems Management: Managing for Health, Wealth and Happiness
- SyMBowl Update: Encouraging and Recognizing Student Proficiency in Systems
- Dynamic Modeling

2000 ST & DM Conference—Draft Program*, continued from page 9*

- From Classroom Idea to Published Curriculum
- System Dynamics in the Real World, Building a Model of the Immune System
- Developing Systems Thinking Skills through Story
- Systems Thinkers Needed for Today's Science Research
- Elementary Gifted Curriculum
- Scientific Method and Sixth Grade Physics
- System Dynamics as a Vehicle for Collaboration and Questioning Administrative and District Level Decision Making
- Systems Thinking in 5th Grade Social Studies
- Mining for Understanding: A Chemistry Unit
- Fifth Graders Create the Future
- Using Systems Tools to Construct Knowledge of Linear Equations and Other Middle School Math Skills
- Using Systems Concepts and Tools in Counseling and Guidance
- Designing a Skills Matrix
- Integrating Systems Thinking and System Dynamics into a K-8 School
- Using Systems Thinking in School Administration
- A Systems Approach to Education Policy & Administration
- Model Building Skills, advanced (Richardson)
- SD in Psychology or Economics (WPI)
- Utilizing SD to Build Community Skills in a School
- Group Model Building Exercise to Address Local and Regional Growth and School Populations.
- Education for a Sustainable Future: a Technology Grant Project.
- When Do the Tools of Systems Thinking Make Sense in the Developmental Stages of Learning?
- Action Learning Lab: Using the Electric Maze as a Tool for Learning for Adults and Students

Use of Gaming as a Tool in Education:
Resources for Teachers*, continued from page 2*

within the workshop: warm-up, problem-solving, communication skills, trust, conflict resolution, ethics, systems, feedback, and related topics. *Creating High Performance Teams: 58 Initiatives*, http://www.unh.edu/ipssr/Lab/Initiatives.html

- *Fish Banks, Ltd.*

A computer-assisted role playing board game on the dynamics of renewable resource use. One game kit serves groups of up to 50 participants for a game session that takes about 2 hours. The exercise can be divided into shorter periods and spaced over several class periods. Works for ages 12-100. Available from the University of New Hampshire, $110.00 The Creative Learning Exchange has a valuable set of STELLA-based simulation exercises and a student guide to complement this game. *Fish Banks Ltd*., http://www.unh.edu/ipssr/Lab/FishBank.html

- *STRATEGEM.*

A computer-assisted role playing board game on the dynamics of long-term regional development. One game kit serves a group of up to 10 participants. This is essentially a gaming version of the World3 model that underlies the two books, *Limits to Growth* and *Beyond the Limits*. The game shows the interrelation of population growth, energy production, industrial output, agriculture, environment, human services, and international trade in determining whether a country will develop sustainably or overshoot its carrying capacity. The World Bank recently bought 100 copies for use in its training programs. The game is also used widely in high schools of many nations. Available from the University of New Hampshire, one kit costs $75.00 and a classroom set of 4 kits costs $200.00. *STRATAGEM*, http://www.unh.edu/ipssr/Lab/Stratagem.html

- *Beer Game.*

The System Dynamics Society now publishes the original Beer Game. The complete set consists of a vinyl game board, instructions for running and debriefing the game, a videotape of the game being led by John Sterman, and a short bibliography of writings about the game. One kit serves a group of 8 players. The complete set costs $125.00, and extra game boards are $85.00 each, though you can make them for yourself on a long sheet of wrapping paper for almost nothing. The price includes postage in the US. *Beer Game*, http://www.albany.edu/cpr/sds/Beer.htm

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DynamiQue*ST*

An exposition of student and teacher work in System Dynamics and Systems Thinking, Grades 5-12

Join us for an exciting, first time ever, fun-filled event.

May 19-20, 2000
Trinity College, Burlington, Vermont

This exposition will be a forum for students to
- Showcase their work
- Share their experiences
- Educate others about their work in Systems Thinking/System Dynamics

The exposition is open to any 5-12 grade student. Students may enter any ST/SD related materials—utilizing any or all of the tools—for evaluation with the appropriate rubrics. Each student who achieves a standard of work in any of the five areas (Behavior over Time Graphs, Causal Loops, Stock-Flow Maps, Computer Simulation Models and Overall Understanding) will be recognized for meeting the standard. Judges will be working from rubrics that will be available to all teachers and students in the packet of information available in November.

There will also be the opportunity for teachers to share their current work utilizing System Dynamics and Systems Thinking to further understanding.

DynamiQue*ST* will kick off with an evening of getting acquainted and participating in interesting, challenging group activities. Saturday morning, May 20th, there will be a showcase of student and teacher work, followed by optional trips and activities in the Burlington area. Meals and lodging will be provided for nominal cost at Trinity College.

This is a unique learning opportunity for students, parents and teachers. For more information (details, rubrics, etc.), e-mail Lees Stuntz <stuntzln@clexchange.org> or visit <www.trinityvt.edu/waters/dynamiquest.html> or <sysdyn.mit.edu/cle/>.

DynamiQue*ST* Committee: Dan Barcan and Sue Jamback, Chelmsford Public Charter School; Alan Ticotsky and Rob Quaden, Carlisle Public Schools; Larry Weathers and Dick Maki, Harvard Public Schools; Will Costello, Waters Grant Project and Chittenden South School District; Steven Roderick, Lincoln-Sudbury Regional School District; Lees Stuntz and Deb Lyneis, Creative Learning Exchange

Corrections to the List of Materials and Website Lists

The list names and categories of two documents have been changed, to more accurately reflect their primary discipline. Previously filed under Social Studies (SS) and/or Science (SC), *Hurricane Plotting* is now listed under Cross Curricular (CC), but will still come up in a web search of either of the other two categories. *Developing Team Rules* was under English (EN), and is now listed as Cross Curricular (CC). These changes are reflected in the "CC" now beginning the list name.

CC1999-09HurricanePlotting   **Hurricane Plotting.** Jan Mons
From the GIST Project. A practice/final activity for the study of longitude and latitude, where a STELLA model gives the coordinates of a hurricane approaching Brunswick, GA, and students plot its path. [Cross Curricular, Social Studies, Science, Middle School] (50¢ paper only; $5.50 paper plus model on disk; plotting maps available in paper only.)

CC1999-09DevelopngTeamRules   **Developing Team Rules.** Jan Mons
From the GIST Project. Students and teachers work together in an inductive lesson leading to a stock/flow diagram of a positive learning environment. [Cross Curricular, Elementary School, Middle School] ($1.00)

Newsletter Subscription Information

The Creative Learning Exchange Newsletter is available in three different formats:

- On the web page at http://sysdyn.mit.edu/cle/
- As an attached file to an e-mail
- In paper via US mail ($15.00 outside the USA)

Since we vastly prefer electronic distribution to paper because it so much less expensive, please e-mail us at any time when you would like to have an electronic subscription.

<milleras@clexchange.org>

What Does it Take to Succeed? *, continued from page 5*

other strongly resistant to anything new. And, she has learned a great deal which may help the many other innovative teachers who find themselves at schools somewhere in between.

- Once she had seen her students flourish with the learner-centered systems approach, she could never go back to the lecture mode again. Holding a vision of how much better education *could* be keeps you going.
- Don't try to do too much at once, especially if there is resistance to change. Maybe she should have just focussed on her own classes in the hope that "other teachers would look in to see what is going on as they hear rumblings." Change takes time.
- Let the kids, and their parents, be "ambassadors for change."
- Use whatever technology you have while scraping for more. Without computers, start with behavior over time graphs and causal loops. With one computer, build models as a class (although it is not truly learner-centered until kids do it themselves.)
- Find support among other teachers in the broader systems education community.
- Finally, "the hardest thing about this whole ST/SD endeavor is convincing people that it is a good thing, that it is useful, and that it can enhance our kids' learning in K-12 education….It seems that people who truly believe this have to be pioneers." Success comes in the long run if you can stick with it. Good luck!

This document is availabale from the CLE or the Web site catalogued as SE1999-09Pioneer3-ToSucceed

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INTERESTED IN INVESTING?

If you would like to invest in our effort here at *The Creative Learning Exchange*, your contribution would be appreciated. You may donate any amount you wish; perhaps $50.00 is a reasonable amount for a year. All contributions are tax-deductible.

Enclosed is _____ to *The Creative Learning Exchange* to help invest in the future of K-12 systems education.

Name _____

Address_____

_____

e-mail _____

Thank you!

The Creative Learning Exchange, **1 Keefe Road, Acton, MA 01720**