the Creative Learning EXCHANGE

Volume 7, Number 2 - Late Winter 1998

THE CC-STADUS TRAINING MATERIALS: A PROGRAM FOR DEVELOPING MODELS AND MODELERS FOR THE PRE-COLLEGE ENVIRONMENT

Ron Zaraza, Tim Joy, and Scott Guthrie

The CC–STADUS Project (a National Science Foundation funded summer institute for teachers) has trained more than 160 teachers in the use of system dynamics and computer modeling in the classroom. In the four years the project has been in existence, the actual training program has changed dramatically. This change has been driven by the way the project is staffed. While the directors have remained the same, much of the training is actually carried out by a six-person core team. This team is replaced each year. New core team members are drawn from the previous year's participants. Both old and new core team members, working with the project directors, collaboratively re-design the materials used each year. While major changes were made the first year, subsequent years saw less drastic, though still important changes.

The project has received a continuation grant from the NSF which will fund it for three more years. However, a major focus of the final year of the first project was preparation and release of the final version of the training materials developed during the grant. These materials, including full background and suggestions for use, are being released to the public domain. They include 3 hour, 2–day, 5-day, and 12-day programs. The materials will be available through the Creative Learning Exchange and through the project's own web page. The insights obtained by the project staff in developing these materials represent a unique blend of creativity and experience.

The initial training was based on the experiences of the Principal Investigators and their assumptions about how models would be used and how modeling could be taught. The three weeks were basically divided into a week of training in basic systems concepts and the use of STELLA, a week in which business, research, government, and higher education uses of modeling were explored, and a week in which participants built a cross-curricular model. The final evolutionary stage of the institute retains this rough division, although each part has been reduced from a full week to 4 days. However, the details have changed so dramatically that it sometimes seems that the first year and this fifth year of the summer institute can scarcely be part of the same project.

To understand the changes, it may be useful to examine some assumptions that are central to the project, and how reality has impacted those assumptions to mandate change. Central to the project has been the assumption that for teachers to use models in the classroom, it was essential that they work with and be taught by practitioners. As a result, all project instructors have been active teachers, using the same types of materials in their own classrooms that they are teaching others to develop. Further, it was assumed that teachers will learn new skills (computer modeling) most easily if they are presented in the context of their own subject area. Consistent with this, par-

***Program** continued on page 3*

INSIDE THIS *EXCHANGE* ISSUE

From the Editor . . .

As we enter February, we at the CLE find ourselves immersed in several projects. First, we are busy preparing for the summer conference. Registrations are starting to come in. We would urge everyone who is planning on coming to register early. The New England Center has accommodations for 160-180 people. Late registrants will have to room in the dorms or local motels.

Secondly, it is only February and, as you may have counted, already you are receiving your fourth *CLExchange* of the school year. We have had an influx of material this year and will be sending out one more *CLExchange* before the conference. If you have announcements or updates which you would like to be incorporated in that newsletter, please get them to us within the next couple of weeks.

I hope that the rest of the winter is warm and safe for all of you. Spring is just around the corner.

Lees Stuntz *(stuntzln@tiac.net)*

Updates. . .

Oregon has changed the structure of its K-12 goals and curriculum. Under a massive restructuring mandated by the legislature, students will be assessed on their mastery of key concepts and skills. The state higher education board has even adopted new admissions standards based on proficiencies. All of these documents are full of references to systems.

The sad joke is that most of the people writing these documents have no idea what systems thinking/dynamics really entails. We are in serious danger here of having “systems” become the new educational buzz-word. Our Oregon State Department of Education sent a team to the K-12 conference in Concord in ’94. They had no idea what was going on, and in fact, got into several discussions in which they revealed that they saw systems chiefly as a way of mandating change.

There has been no visible action on systems within the state hierarchy since then, although the word still crops up everywhere in documents.

In Portland itself, we have rewritten the grade 6-12 science curriculum to include systems concepts, including models. However, we know that this is a long term goal not likely to be achieved in the next 2-4 years. At two sites (Wilson HS and Franklin HS) we have magnet programs in system dynamics that include modeling classes and introduce models and systems concepts across the curriculum. Again, this is unlikely to be fully achieved in less than 2-4 years.

One problem we have seen in Oregon is that many people have heard of system dynamics/thinking (chiefly through *The Fifth Discipline*), but most have only a sketchy understanding of the ideas. They are enthusiastic, but really don’t understand the scope of the changes teaching using systems implies. We probably have more teachers trained in modeling and using models in class here in Oregon (150+) than anywhere else, but we are only beginning to have an impact on instruction. Before any large-scale change can take place, there needs to be a larger base. To attempt to institutionalize systems work without the critical mass of well tested materials and experienced practitioners is to court disaster. The key is to involve classroom teachers who successfully use systems in the process. Outside experts may not really be systems experts and they are almost certainly not experts about what happens in the classroom. This is not to denigrate the efforts made by academics or industry people. Their assistance is vital for long term change. However, if systems is to be “sold” rather than “imposed”, practitioners have the most credibility in the teaching community. For this reason we’ve resigned ourselves to a long, but we hope effective process. Changes will follow an infection model, with gradually increasing visibility/infection.

One piece of evidence for the possible validity of such an approach is a recent grant. A consortium of Oregon colleges and universities have been awarded a 5-year grant to re-design teacher prep programs for math and science teachers, as well as to redesign part of the common curriculum for all undergraduates. The CC-STADUS/SUSTAIN Project will be working with them to introduce systems into the common curriculum courses and pre-service classes for teachers. In addition to our regular summer training, Diana Fisher will be teaching a System Dynamics course for teachers at Portland State University this summer, and I am working with the University of Portland to include System Dynamics in their required course on computer tools for all education majors. (In fact, my class meets in 2 hours.) We are also working with a local utility to provide courses during the regular school year for both pre-service and in-service teachers. Rather than working with the Oregon Department of Education, we’re looking for leverage points within various structures to move gradually toward change. Right now, mandated, state-level change has a very bad name here in Oregon.

Ron Zaraza, Wilson HS
CC-STADUS Principal Investigator

Updates *continued on page 12*

CC-STADUS Trains Teacher-Modelers, continued from page 1

ticipants are instructed in the basic construction of STELLA models in three groups: Mathematics, Science, and Social Sciences. Teachers are divided into these broad concept areas to allow them to work within the comfort of well understood problems in their own disciplines.

The approach and assumptions proved successful, but also produced some early false starts. Initially, only two of the Principal Investigators had more than a year of experience with STELLA or any experience in teaching STELLA to others. Initial planning for the institute gave all instructors an opportunity to participate in designing the instructional materials. The focus on content groups, however, caused the learning experiences to be very different. Instruction focused on uses for models in the curricular areas. As a result, there were few common experiences. Each group used very different models and covered different structures. The debriefing after the institute, in which both old and new core team members participated, resulted in strong recommendations that all groups cover the same modeling structures. It was generally agreed that the structures were more important than examples of models used in courses. In subsequent years these structures have remained the same. However, our understanding of why focusing on these structures is important has changed.

Through the work of Peter Senge, systems thinking has gained a great deal of popular exposure. He and others have proposed the idea of system archetypes as a means of understanding system behaviors. Thus, many look for patterns when looking at systems, such as the “success to the successful” archetype. High Performance Systems, in their workshops, deal with structural model archetypes, like the co-flow. In looking at where and how models are used in K–12 classrooms, it is clear that patterns of growth and decay may be the most useful way of identifying systems used in the classroom. The decision to teach all participants how to build and recognize linear growth and decay, exponential growth and decay, quadratics, and S–shaped growth was based on trying to insure that all participants had common experiences and skills, to equip them with a common toolkit.

> It has become increasingly evident that comfort and confidence in modeling skills are among the most critical factors in successfully using systems models in the classroom.

In retrospect, it seems that identifying growth patterns is the key to developing classroom models. The patterns chosen for basic instruction fit 90% or more of all classroom modeling situations. Emphasizing those few patterns to the exclusion of others has ensured that participants develop confidence with the patterns that will allow them to use models in the classroom. The importance of this emphasis has become more obvious each year. The greater the experience with these patterns, the greater the comfort level. The greater the comfort level, the more teachers use the models, and the more likely they will be to build new models. Further, the high comfort level developed through the repetitive use of the basic patterns has allowed a higher percentage of teachers to move on to other patterns (primarily oscillatory) when appropriate. Their confidence allows them to build onto what they already do well.

It has become increasingly evident that comfort and confidence in modeling skills are among the most critical factors in successfully using systems models in the classroom. This was revealed through tracking of institute participants and looking at the types of assistance they requested. Even though most teachers indicated they felt they had learned the mechanics of modeling, many still had difficulty identifying simple topics to model and/or building the models. They frequently tried to build relatively complicated models, while making very basic mistakes. Participants in the first two years often had difficulty in building models during the regular school year. More recent participants have reported less difficulty. This may be attributed to two factors. The first is a general increase in “computer literacy” among participants. This has resulted in a steeper learning curve for STELLA. Participants have less difficulty with the mechanics of using a computer, so they are more easily able to focus on the modeling. The second factor is the increased emphasis on learning a few structures well. The increase in basic computer skills has made it possible for participants to cover more material during the portion of the training devoted to learning basic modeling. However, no additional structures have been added. Rather, more exercises with the basic structures have been included, with many more optional activities for those moving fastest. Using a sequential approach, beginning with simple models illustrating the structures and advancing through more involved models, participants build two to three times as many models as they did the first two years. They are actually building models without specific directions more quickly and for a greater percentage of the training.

This sequential approach carries over to their own model building,

Program *continued on page 4*

CC-STADUS Trains Teacher-Modelers, continued from page 3

as well as their teaching. Increasingly, teachers who develop new models for their classroom develop a succession of increasingly complex and accurate models. Often such models are being developed through interaction with students in class or group discussions.

After teachers begin to develop a minimal facility with constructing and running computer models within their field, they are brought back together to deal with a few simple problems. Next, they are given examples of how models are being used in research and college-level instruction, as well as the basic mathematical concepts behind computer modeling. Current work in pharmacokinetics and cross-curricular work in history and science allow participants to gain more experience building and working with models. The mathematical background of systems models and limitations of the STELLA software are discussed. Particular attention is paid to choice of dT, integration method, and ways to determine whether or not the model is robust. These topics proved troublesome in the early years, since instruction addressed them in passing, rather than directly. It is vital that teachers understand these ideas well enough to prevent easily avoided modeling errors.

At this point, demonstration teaching and questions of pedagogy begin to be addressed. In their final form, the institute materials have shifted emphasis toward increased discussion of classroom use of systems concepts and appropriate methodologies for facilitating their inclusion into the secondary classroom. This reflects the second most common need identified by past participants: how to actually use models in the classroom. Some of this work is done during the first four days of training. However, most is done after teachers have developed basic proficiency in modeling. These topics continue to be interspersed with other activities the remainder of the workshop.

It is important that participants see several different approaches, since the teachers will be working in a variety of different environments. Participants, through their own training, have had ample opportunity to experience individual work building models on computers. This is one option some will be able to use with their classes. More often, either they will have their classes use pre–built models individually or in small groups, or they will use a presentation device (projector, overhead panel, etc.) to develop or use a model in a whole class/large group discussion. Both approaches are demonstrated and their advantages and pitfalls are discussed. This has allowed teachers to more easily adapt systems concepts for their own classroom use.

The final four days of the institute are devoted to cross-curricular group work on projects. These projects include both models and supporting curriculum materials. Since the models are intended for general use, two important considerations, simplicity and documentation, are emphasized. Novice modelers, as well as experienced modelers, can be easily seduced by the power of models. They often attempt to do highly detailed models. While these are appropriate for research or for business, where the model should exhaustively describe the subject, in education, broader, more general models are more appropriate, lending themselves to broad use in the curriculum. Participants are also urged to fully document models, both within the model and in their support materials. They are edited by CC–STADUS staff, then released through the Creative Learning Exchange and the project's own web page.

In the first years of the project, participants received no formal support after the conclusion of the summer session. Attempts were made to provide support through phone contacts, e-mail, and individual visits by core team members, when requested. Where these

It is clear that support is among the most critical elements in bringing systems into the K-12 environment.

were systematically done, participants were very successful. Those who did not receive systematic support, who were left to their own devices, generally made less use of models and built fewer models. The final version of the institute includes three full-day meetings during the first year after the summer training, with increased individual support during the year. This has proven critical to the success of participants. While successful use of modeling has always been high among participants (>70%), the sophistication of models and curriculum developed during the final year of the grant has been markedly more advanced than in years where formal support and meetings were not part of the process. It is clear that support is among the most critical elements in bringing systems into the K-12 environment.

References

Forrester, J. W. 1971. *Principles of Systems.* Portland, OR: Productivity Press.

Richmond, B., and S. Peterson. 1993 .*STELLA II An Introduction to Systems Thinking.* High Performance Systems, 45 Lyme Road, Hanover, NH 03755, USA

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N.B. A longer version of this article, including a schedule and description of the 12 day program, is available from the website <http://sysdyn.mit.edu/> or the CLE. The 8-character title is PROGRARZ. ✥

GORDON STANLEY BROWN FUND

To support preparation for distribution of materials for using system dynamics in K through 12 education

May 1, 1998 is the application deadline for funding for Summer 1998 activities.

Be sure to submit your proposal prior to the deadline.

The Gordon Stanley Brown Fund was established to promote system dynamics and an understanding of dynamic behavior in feedback systems in kindergarten through 12th grade schools. The Fund's purpose is to make teaching experiences available to others. Small and medium sized proposals are encouraged.

The Gordon Brown Fund can support teachers for:

- Released time or summer time used to put into transmittable and usable form materials and methods that have already been used in schools and that could be of help to others,
- Communicating experiences that did not meet expectations so that others can be forewarned.

Work supported by the Fund is to be available for distribution through the Creative Learning Exchange and any other channels that the author arranges.

The Fund honors Gordon Brown, who pioneered the theory and practice of feedback dynamics and engineering control systems at the Massachusetts Institute of Technology in the 1940's. Brown went on to be head of the Electrical Engineering Department and Dean of Engineering at MIT. During retirement, he devoted energy and skillful leadership to bringing system dynamics into the Catalina Foothills school system in Tucson, Arizona.

There is no standard application form. Address applications, with an outline of the proposed project, to:

Jay W. Forrester, Committee Chairman
Massachusetts Institute of Technology
Building E60-389
Cambridge, MA 02139

REVISING A CLASSIC

A group consisting of Martin Grossmann, Nancy Roberts, Steve Roderick, and Hank Taylor is considering revising one of the classic system dynamics textbooks, *Introduction to Computer Simulation: A System Dynamics Modeling Approach*, by Roberts, *et. al.*, originally published by Addison-Wesley. The current target audience is students and teachers at the High School and Undergraduate College levels.

We have developed a survey to help us in this endeavor. The purpose of this survey is to get a sense of what people are interested in today. A draft of the survey is available on the web at:

<http://jdmacomber.mit.edu/book.htm>

We would be very pleased if you could take a few minutes and give us comments on the survey (for both form and content). Please email any comments to me at htaylor@mit.edu. Feel free to respond to the electronic “web form” version using your web browser; it is fully functional and I would like to test it (currently works with Netscape 4.03 and Internet Explorer 4.0).

If you don’t have web access, I have an email version of the survey that I can send you. Just let me know.

Thank you very much for your help!

Hank Taylor <htaylor@mit.edu>

Resources for Models of Biological Systems

The following two notices are gleaned from the K-12 listserve. The exchanges occurred during a discussion of teaching biology. LNS

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Mary Ellen Verona (Maryland Virtual HS of Science and Mathematics) posed a question to the K-12 listserve regarding resources for developing models that capture the feedback relationships inherent in biological processes. I wish to inform subscribers of the upcoming release of High Performance Systems, Inc.'s new Learning Environment, "Design a Cell." This interactive multimedia learning tool allows students to experience how the organelles within a cell work as a dynamic system. The underlying model of the LE, which has been created with STELLA Author, captures the complexities of the feedback relationships that link the organelles and shape their behavior. For more information about "Design a Cell" and/or modeling biological feedback relationships, please contact us at the information below. Thank you.

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High Performance Systems, Inc.
45 Lyme Road, Suite 200, Hanover, NH 03755-1221
603-643-9636 fax: 603-643-9502
email: <support@hps-inc.com>
web: <http://www.hps-inc.com>

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I have followed the recent exchange about leads on models of biological systems and would like to direct the attention of interested students and teachers to:

Bruce Hannon and Matthias Ruth (1997) *Modeling Dynamic Biological Systems*, Springer-Verlag, New York, 399 pp.

The book covers models from a wide range of fields within biology and ecology, all of them developed in STELLA. All models, a run-time version of STELLA and MADONNA software are included with the book on CD ROM. (Total price: $59.95, ISBN 0-387-94850-3.)

Modeling Dynamic Biological Systems is part of the Modeling Dynamic Systems book series published by Springer-Verlag. For more details on the series see: <http://www.springer-ny.com/biology/moddysys/>

Currently in press for that series, and closely related to biological modeling, is

James Hargrove (1997, in press) *Dynamic Modeling in the Health Sciences*, Springer-Verlag, New York.

That volume will also contain STELLA models that accompany the book on CD ROM.

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Systems Thinking Playbook

The Systems Thinking Playbook can be ordered directly from Luisa Fowler at this e-mail address: <lgf@christa.unh.edu> You can get more information from this web site: <http://www.unh.edu/ipssr/Playbook.html>

If you are an educator, please ask for the educator's discount. Volume III should be ready by the end of June. We are always eager to hear how the Playbook is being used (what works, what doesn't) so please let us know.

Linda Booth Sweeney
e-mail: <boothsli@hugse1.harvard.edu>

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

- On the web page at **http://www.sysdyn.mit.edu/**
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<milleras@cle.tiac.net>

Systems Thinking and System Dynamics in K-12 Education

A study supported by the Waters Foundation—School Year '95-'96—by Mary Scheetz

The Spring 1997 issue of the Creative Learning Exchange newsletter featured Mary Scheetz's study of twelve school districts around the country which are integrating systems thinking and system dynamics into their programs. In that issue (Volume 6, Number 2) we included the summary from the Carlisle, MA, Public Schools. Our Late Fall 1997 & Winter 1998 issues (Vols 6.4 and 7.1) held the summaries from the Lawton Elementary School in Ann Arbor, MI and Harvard, MA. Following is the summary from the Glynn County Schools, Brunswick, GA.

GIST—Glynn County Schools Brunswick, GA

Setting

Glynn's public education system provides instructional programs for nearly 11,500 students (K-12). The school system includes nine elementary schools (K-5), three middle schools (6-8), two high schools (9-12), an adult education center, a night high school, the Risley Learning Center, the Coastal Academy and a partners in Education program. The system is governed by an appointed superintendent and a 10-member Board of Education whose members are elected by the districts they represent. Glynn County has a strong educational heritage which began in colonial days. The Glynn County school district is classified as a small urban area. It has a diverse population, ranging from those who live on resort islands to those who live in federal housing. The northern part of the district also includes a rural segment.

District Mission Statement

In partnership with the home and community, the mission of the Glynn County school system is to provide a high quality teaching/learning environment which assures that every student learns. Guiding principles: We are all students. Every student can learn. Learning is a life-long process. Learning is facilitated in a safe, healthy, caring environment. Education fosters self-worth and self-discipline. Education promotes responsible citizenship and democratic ideals. Education provides opportunities to become productive and contributing members of society. Education instills an obligation to protect our environment. Education develops effective communication and adaptability in our complex world. Our mission will not be compromised.

Project Goals/Philosophy

The original goals of the project reflected in the partnership with Georgia Pacific were to 1) build systems thinking skills among 1st to 12th graders, 2) increase the capability for using these skills to accelerate learning, 3) increase the capability of Georgia Pacific employees to use systems thinking skills in their jobs, and 4) create a capability within the community for applying Systems Thinking to issues affecting the Glynn County populace. Current goals are focused on systems thinking/system dynamics skills and include developing the ability to do the following:

- change the way one sees the world
- make thought processes visual and explicit (mental models)
- move from self-centered to other-centered (big picture)
- understand other mental models
- trace the history/future of an event—discovering causality, recognizing/predicting effects over time
- deal with dynamic complexity (relationships)
- predict unintended consequences
- see connections between today's decisions and tomorrow's consequences—(both short and long term)
- see non-intuitive connections
- generate options and identify leverage

History Of Project

The Systems Thinking Project in Glynn County began in the spring of 1992. The project represented a partnership between the Glynn County Schools and Georgia Pacific, a pulp and paper company. The goals of this unusual partnership were far reaching and evolved from a stated need to improve the math and science skills of the students in the district.

In March of 1992, a group from Georgia Pacific and Glynn County administrators attended a conference in Tucson, AZ to learn about systems thinking in schools. Discussions with a representative from High Performance Systems, a software company, resulted in making arrangements for training and support from High Performance Systems for the development of a project focused on the use of dynamic modeling in the design of curriculum and instruction.

The project began with teams of teachers from the three middle schools during the 1992-93 school year. The primary operational focus of the first phase of the project was to train teachers to deliver systems thinking-based materials and learning environments (units utilizing STELLA models). Three teams of three teachers each (one from each middle school) were provided with ten weeks of release time and classroom substitutes for the purpose of training and learning environment development.

During the 1993-94 school year, the first learning environments were implemented. Students and staff reported positive results. However, the partnership with Georgia Pacific and

***Glynn County** continued on page 8*

ST and SD in K-12 Education in Glynn County continued from page 7

the related support from High Performance Systems ended during that school year. The trained teachers (the Core Team) worked with their school-based grade level teams to incorporate the systems thinking units into their lesson plans. Two members of the Core Team eventually left the school district and two new teachers were added. Without the support of the partnership and related funding, the Core Team continued to attend summer conferences and to develop related instructional materials that would support the learning environments.

During the 1994-95 school year, funding was acquired from The Waters Foundation to support release time for monthly Core Team meetings and the hiring of a mentor to begin in the fall of 1995. The Core Team met on a regular basis for discussions and decision making. In addition, they continued to implement the learning environments and to facilitate the planning/ training necessary for other members of grade level teams to implement the units. They also developed a summer professional development course to introduce other teachers to systems thinking.

This arrangement continued during the 1995-96 and 1996-97 school years. The addition of a mentor during these years allowed for increased support for teachers using the learning environments and an expansion of their use. The mentor was also able to model the teaching and use of systems thinking concepts and tools for several middle school classes in order to encourage interest and support for their expanded use in the classroom. During that year, the need for additional training for the core team and for a new organizational design became obvious. The Core Team, in conjunction with district and building administrators, is entering into a new phase of the project in collaboration with a representative from The Waters Foundation, to incorporate new structures and practices that will increase the skills of the teachers and administrators involved and will serve to sustain the project over the long term.

Learning Environments currently in use include a predator/prey simulation, a career education and financial planning unit, an alcohol and tobacco unit, a hurricane simulation, a communication unit, math lessons, and an American Revolution simulation. In addition, a lesson plan designed to teach the concept of modeling a system with STELLA icons has been developed and is in use in the gifted program. Plans are in place to involve more teachers in the revision of the existing units as well as in the development of new units directly related to the middle school curriculum. A long term goal is the expansion of the project to the K-12 program.

Quotations from Project Participants

Notable Results

- "The development of LE's which support interdisciplinary instruction, student decision-making, and the introduction of ST/SD skills and system characteristics in a meaningful way."
- "Not "pushing" the use of modeling is the way to go—a desire to make ST/SD understandable to all teachers and students in theory as well as application. The ability to simplify the language and introduce ST/SD as an enhancement rather than a replacement to reduce the threat factor."
- "People (especially other teachers) are asking questions about systems and the project."
- "Teachers who have been relatively stagnant in the recent past are beginning to try new things."
- "We have worked to create systems-based curricula."
- "Students who participate in the LE's seem to have a different focus after the LE's."
- "Some kids feel more empowered to think about their future."
- "Some students are very excited about learning to model although we haven't done much with this yet."
- "This project has helped to break down barriers among the three middle schools."
- "We've created a great deal of systems curriculum."
- "We seem to have fostered a surge of computer use (directly & indirectly)."
- "There has been a change in our own thinking and associated personal growth."
- "Students who have come in contact with our ST/SD units seem to grasp the information more easily and retain it longer. They also demonstrate the ability to apply what they have learned."
- "Students can recognize 'levers' and possible consequences (or tracks)."
- "There is a hesitation before arriving at a decision (brain engages first)."
- "Students are beginning to confidently approach problem-solving."

Individual Learnings

- "By not rushing we have been able to experiment with how to make ST/SD meaningful to students and teachers. We have attempted to demonstrate how ST/SD can enhance what is already going on in classrooms, not replace it. By reducing the threat to teachers, they are more willing to try things."
- "A large LE is not necessary in order to change a teacher's style of teaching; as a matter of fact, the use of an LE will not insure permanent change. They are a vital aspect for general distribution, but any long term change must come with teachers interested in using small pieces in lessons they are already doing, such as behavior over time graphs, causal loop diagrams, stock/flow diagrams."
- "Teaching ST/SD as a separate 'subject' to students is not as meaningful as introducing the concepts while they are studying something they are familiar with. Better phrased—teaching it in context rather than separately."

• “I have come to the realization that interdependence is not just something to talk about in natural systems. It is a necessity in human created systems/ projects.”
• “ I have become more acutely aware of the levers that I control in both my personal and professional lives.”
• “Contrary to the direction that we were led in the beginning, systems thinking is much more than STELLA II.”
• “I am much more aware of the mental modeling that occurs.”

> "The importance of the model is in the making, not in the final product. The discussion that takes place to create the model clarifies thinking. . ."

• “I am seeing the interconnectedness of all things, especially in light of how my actions affect those around me, whether they be my family, my students, or my fellow travelers on the interstate.”
• “I have gained an understanding of the ubiquity and power of accumulations.”
• “I can now appreciate the power of supporting negative feedback instead of fighting positive feedback.”
• “I realize now how hard it is to get people to change how they think: you must ‘come back to it’ time after time before they start to internalize it.”
• “The absolute most important thing that I have learned is that I have control over my decision-making and reactions to life.”
• “I’ve come to understand that interdependency is a necessity.”
• “I now understand that nothing just happens.”
• “ST/SD goes beyond modeling (become more aware of mental models).”
• “ST/SD has increased my ability to carefully think through problems and to arrive at a sensible solution (some of them, sometimes).”
• “For every cause it is important to look for the effect.”
• “I have an increased sense of needing to recognize my own responsibility for actions.”

Challenges

• “There was no “how to” book—we had to take a method designed by non-educators or upper-level educators and bring it down to a practical level for us. The project , up until now, has been open experimentation. We recognized the 'experts' might not know the right way either and that we needed to try different things. We are still learning.”
• “Not everyone needs to be able to model—there is so much more. The importance of the model is in the making, not in the final product. The discussion that takes place to create the model clarifies thinking—a person who has problems modeling solo can be talked through building a model and learn just as much. Or building a model according to their picture for them and trying to run it might make them realize some errors in their thinking. They don’t have to build it themselves.”
• “Teacher training and classroom implementation—a mentor is vital to support teachers—teaching teachers in classes is only one step—they then need support to actually try things in classrooms.”
• “We have to have enough patience to allow things to develop slowly. If we force change upon people it will be temporary and superficial. We must allow people a chance to learn at their own pace, as we did, and to use ST/SD in ways that make sense to them.”
• “We must continue to explore and experiment with ways to implement and teach ST/SD.”
• “Classroom implementation of ST/SD is not enough. We must figure out a way to bring the ideas of organizational applications into the structure of our project, schools, and school system.”
• “The original structure of the project was idealistic. When it 'collapsed' due to loss of funding, we did not set up a sound second structure. Our original vision was too broad and general and we 'assumed' we were all headed in the same direction. Actually, we were, but each of us was on a different road, so instead of helping each other over roadblocks, we caused roadblocks on each other’s road. Going back and making sure we are on the same road, etc. is a much more painful process than it would have been at the beginning. Of course, at the beginning, we did not know enough to decide on a road. A heck of a loop!!!”
• “Questioning one’s paradigms is always a challenge. Being aware of these paradigms and how they were created precedes shifts.”
• “Modeling!! The only times in my life that I have actually felt stupid are those times when I attempted modeling with STELLA. We have to help people get past the “STELLAphobia” stage.”
• “Developing a Core Team that can work together is an ever-present challenge.”
• “We are realizing that there is a lot more to ST/SD than STELLA models.”
• “Defining ourselves as a project: what are we trying to do?”
• “Continuing to produce LE’s—especially ones that key in on ST/SD skills, not just interesting simulations.”
• “Expansion of the project to the use of ST/SD in all Glynn County Schools will be a major challenge.”
• “Maintaining community among nine busy, strong-willed individuals who have been committed and involved since the first days of the project, but who see each other only once a month, is difficult.”
• “Putting what we are trying to share in understandable & meaningful terms has been difficult.”
• “ We need some type of formal assessment instrument/plan.”
• “We need to win the ongoing support of administration.”

Please note: The entire text of the article from which this piece was excerpted is available from the CLE and the web site <http://sysdyn.mit.edu/>. The 8-character title is SUMMARMS.

❖

THE COST OF HEALTH CARE

Below is a brief post to the K-12 listserve from Mary Ellen Verona, with an interesting response from Sherry Immediato, printed here with permission. I think it is a good example of exchange possible to get people thinking along systemic lines. LNS

MEV: I heard a report today that gave startling news: if the percent of smokers decreased sharply, the total cost of health care would initally go down, but then go back up. Seems like a nice doable problem for students to tackle.

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SI: As someone who does alot of work with health care providers, including microworlds to test health improvement strategies, I liked the example that Mary Ellen Verona offered regarding the consequences over time of a reduction in smoking. Many articles on other health improvement strategies usually quote only the near term impact. I can't remember the actual intervention, but another article this week reported that if the improvement were made, deaths would decrease by 40,000 per year. While clearly this could happen in the short term, it is also clear that in the long term, we're all dead. I suspect that the authors of the article Mary Ellen mentions are making the related assumption that the costs of old age and illness are merely postponed and perhaps increased for reasons of longer life expectancy.

Does this mean that it's not so bad from a pubic policy standpoint for people to smoke? What about the effects of second-hand smoke? Are the cost dynamics similar? I don't think so. But clearly these are questions that young modelers can start to address. I am particularly encouraged when students take on issues like this and share their work in the community. I know from work with Boards of Trustees of health care providers that these types of issues are of great interest to them, but day to day concerns often keep them low on the priority list. I suspect that a well-prepared presentation could make it onto many of their agendas. This exposure to systems thinking could help them think differently about many issues and give students a chance to make a contribution to their communities on a substantive issue and to improve decision making processes.

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617-354-6506

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SYSTEM DYNAMICS SKILL LEVELS

We are printing a reply from Jay Forrester which appeared on the system dynamics listserve in answer to a member's concerns. The discussion is an interesting one to engage in. LNS

Some on this list seem to have argued in favor of SD being practiced only after serious study in a university program (at the graduate level?) with the opportunity for the prospective SD person to receive feedback on their modeling efforts. I can see the benefits of such study. Some in the SD community (vendors, perhaps?) seem to suggest the "democratic notion" that SD can be done relatively easily by using today's tools and the admittedly good manuals they provide.

— — —

JF: I often liken system dynamics to the profession of medicine. There is a continuum of skills from a person having attended a two-hour first-aid course to one who has the skill to do a heart transplant. The issue is not so much the level of skill as the recognition of the skill one has and the willingness to work within the boundaries of that skill level, even while increasing the skill. My major concern here is with those who attend a rather superficial three-day "systems thinking" conference and then propose that they are ready to be consultants on major corporate system dynamics challenges.

— — —

How concerned are you about the work someone does who is working through the Road Maps and using SD in a practical sense? What risks do you see in the conclusions they may be drawing which they should take special pains to avoid? Must those risks be ameliorated through undergraduate or graduate courses, or is there another way?

— — —

JF: System dynamics skill should be considered in the context of skills based on mental models alone because today's decisions come almost exclusively from mental models. Is system dynamics modeling (at any level of skill) in danger of making the decisions based only on mental models worse? I doubt it. The thought that goes into making even a poor system dynamics model will probably sharpen up the mental models. If the mental models that will otherwise be used are so bad that they can not benefit by some modeling, they probably can not be made worse even by very unskilled SD modeling. Having said that, it is important to keep in mind that small increments of improved thinking via elementary modeling will fail to achieve the factor of ten or a hundred in improved outcomes that might result from the best modeling practice. Going back to medicine, system dynamics is probably now in about the state of development that medicine was a century ago. So, do the best we can today, don't think it is the ultimate, and keep the door open to learning in all ways that are possible.

— — —

I recognize I wouldn't presume to teach myself a skill such as playing a musical instrument, for example, without a private teacher, unless it were purely for fun. These may be primarily characteristics of physical activities, though.

— — —

JF: No, not just physical activities. An engineer is not prepared for the most demanding work in the field on graduating from college. Practice, apprenticeship, and experience are necessary. Likewise in system dynamics.

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Alexander Pugh, Program Chair, 49 Bedford Road, Lincoln, MA 01773, USA (e-mail: JandJpugh@aol.com)

Abstracts are due February 1, 1998.

For further information, contact Roberta Spencer, Executive Director, System Dynamics Society, Milne 300 - Rockefeller College, University at Albany - State University of New York, Albany, New York 12222 USA (e-mail: System.Dynamics@albany.edu)

K-12 LISTSERVE

A lot of information comes to us from the K-12 Listserve. You, too, can become a part of the K-12 Discussion Group.

<k-12sd@sysdyn.mit.edu>

To join contact Nan Lux: ***<nlux@mit.edu>***

Correction

When ***Using System Dynamics to Enhance the Learning Potential of Dyslexics*** was published in the last newsletter, figure 1 was misaligned, and in figure 2, one of the notations on the loops was mislabeled, which changes the meaning of the picture, and consequently, the story. Below are the corrected figures. If you have any questions, please let me know.

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Figure 1

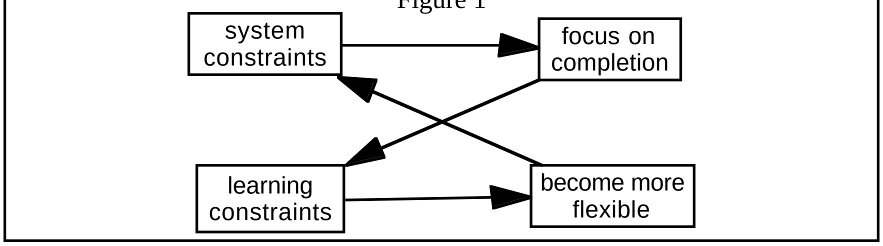
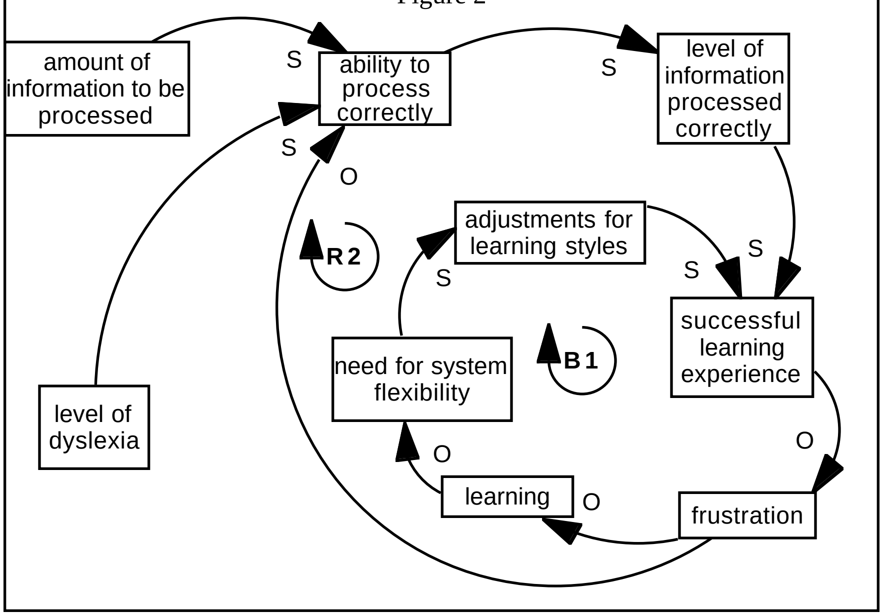


Figure 2



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Thank you!!

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Updates... cont. from page 2

Based on further classroom use, I have made a second revision to my "Vensim PLE Quick Reference and Tutorial." Specifically, the tutorial has been expanded to include coverage of custom graphs and lookup functions. The revised version is seventeen pages long. It can be downloaded through my web page at

<http://www.public.asu.edu/~kirkwood>

Follow the link from that page to the "System dynamics resource page" to find the Quick Reference and Tutorial. This will be the last revision since the class where I am using it is almost over.

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