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GET MOVING! Solutions to the Epidemic of Childhood Obesity

by Omar Aboulezz and Debra Lyneis

Prepared with the support of The Gordon Stanley Brown Fund

What happens when kids spend hours every day watching TV or playing video games? Could these behaviors lead to obesity and serious illness? And, if so, what can we do about it?

Omar Aboulezz, a fifth grader at the Flag Street School in Worcester, Massachusetts, was intrigued by this problem and decided to learn more about it for his school research project, as he explains in his written introduction to the project:

I decided to do this project because due to the expansion of technology and our modern ways of life, kids have been doing less fitness activity. The less activity kids get, the more weight they gain, and the more weight they gain, the higher the risk of diseases related to obesity will get. I do not want my kids to grow up to be lazy and fat, and I don't want them to get horrible diseases like heart disease and diabetes, and I am sure nobody wants their kids to be like that either. So I decided to research and find solutions to this problem.

I will be using the System Dynamics tool to solve this problem. I chose the System Dynamics tool since it really makes you think and use logic, and I also get to use a really cool software on the computer. I was introduced to this tool by my dad; he is doing a Ph.D. on System Dynamics at WPI (Worcester Polytechnic Institute). I also went to a System Dynamics program for kids [DynamQuest], which was really interesting.

Omar's interest in fitness was piqued by his own personal experience. When he first moved here from his native Egypt in the second grade, he spent much of his time playing video games. How-

ever, when he started the fourth grade in a new school, his new classmates urged him to join in the playground games. The more he played, the more he enjoyed it. He noticed that while he was becoming more physically fit and skilled at sports, he was also having more fun with his friends and feeling healthier.

Omar's dad, Mohamed, recommended that he begin the project by framing the problem with a graph sketching his "mental model" of how childhood fitness and obesity had changed over time. Next, Mohamed explained the concept of stocks and flows and taught Omar how to use STELLA© software. As Omar did

Get Moving continued on page 3

Musings on Social Studies and System Dynamics: Linking "Standards" with "Systems Citizenship"

by Jeff Potash

This is the first of three articles that explores building system dynamics tools and perspectives into

the K-12 social studies curricula. This article begins with a "big picture" perspective in identifying goals that are shared by the two fields and that suggest a natural alliance. A second article will focus more directly on the practical use of system dynamics tools within the social studies curricula, to develop a better understanding for places where these tools could help to more effectively address social studies goals. We hope these two articles will stimulate feedback, in the form of contributions to a third and final article,

Social Studies continued on page 5

THIS ISSUE AT A GLANCE

GET MOVING! Solutions to the Epidemic of Childhood Obesity	Page 1
Musings on Social Studies	Page 1
Updates: Learning in Portland	Page 2
ST&DM Conference	Page 2
EME: Curriculum Development in the Works	Page 6
K-12 Listserve	Page 10

Updates...

Learning in Portland

At the end of October, the CLE hosted an interesting training session in Portland, Oregon. George Richardson flew out to help folks expand their system dynamics knowledge. It was an exciting event, full of interesting conversation and new insights. One of the foci of the session was a discussion of revolutions. For years, many teachers have discussed and requested tools to help students gain systems insight into the process of revolution.

It was exciting to see a master system dynamicist (and teacher!) use his skills in group model building as well as system dynamics modeling. The first day, we thoroughly discussed our mental models of revolution and how the elements fit together. George showed us a causal mapping process that helped get our ideas down on paper. One of the important techniques he illustrated was looking for the relevant stocks in the system. We came up with Loyalists, Undecideds and Revolutionaries. These three stocks formed the basis for our causal map. By the end of the first day, we had formulated a map we all agreed upon.

The second day was spent transforming that map gradually into a working model. It was enlightening to see George go about it in a very methodical way and tease out what generic structures (such as an infection process and delays) were evident in the structure of the emerging model.

There were at least two major lessons learned in the two-day workshop. One was for people, mappers and modelers alike, to develop a stable of structures for which they know the patterns of behavior. Secondly, in the process of building a model, ALWAYS make sure that it works. As every new element is added, make sure that the model will run.

Editorial

Plans for the June conference are coming together. The conference is designed to be a learning and networking experience for all who participate. There will be workshops for everyone to increase their expertise in developing systems citizenship for the future of our world. We are welcoming back many of the people who have given generously of their time and talent in the past to help make this an exciting and stimulating conference. Because of tight funds in education, now is a good time to be looking into school district resources for professional development and travel.

We here at the CLE wish all of you a peace-filled holiday season.

Take care,
Lees Stuntz (stuntzln@clexchange.org)

George created a powerful learning opportunity for the people who were able to attend. He gave, once again, generously of his time and energy to help all of us get a little bit better at teaching kids.

For those of you who would be interested in a session with George or other experienced teachers and modelers,

come to the June ST/DM conference. It is this sort of learning experience that the conference is centered around.

Anyone who is interested in discussing revolutions, please e-mail me. If we have enough interest, I will set up a discussion with the work that we have from the workshop. Lees Stuntz(stuntzln@clexchange.org)

Systems Thinking and Dynamic Modeling A Conference for K-12 Education The Conference Center at Marlborough Marlborough, MA June 24-26, 2006

Save the date. This year's conference has been designed to maximize learning, to provide take-away practical knowledge, and to bolster opportunities to meet and network with others.

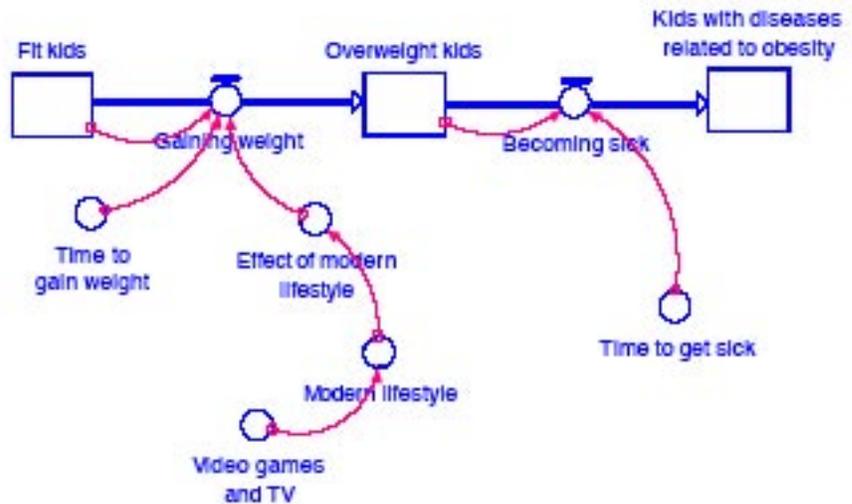
The conference brochures will be mailed in early January.

Don't forget to recruit colleagues. Make an effective team by recruiting across grades, disciplines and organizational positions. To encourage teams from the same schools, the Creative Learning Exchange will offer a discount of \$25.00 per person to all attending the conference as part of a team of three or more people.

GET MOVING! Childhood Obesity continued from page 1

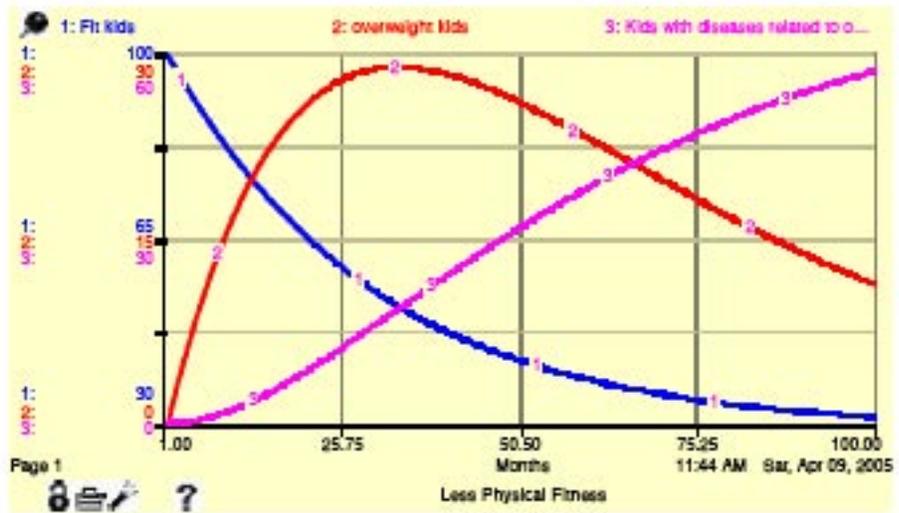
his research and worked on his model, he turned to his dad for technical help, but Mohamed is quick to point out, proudly, that this was Omar's project.

Omar's first model diagram presents his theory of how inactivity can lead to obesity and illness. Fit kids become overweight kids over time if they sit around watching TV and playing video games. With time, these kids develop obesity-related health problems. Kids progress from one stock to the next, causing the number of fit kids to decline as the numbers of overweight and obese kids rise.



Omar's first model diagram, above, and graph, below

Omar's model produced the following graph. It replicated his first reference behavior sketch of the problem – childhood fitness is falling while obesity is rising. Initially all the kids were in the stock of “Fit kids.” As they gained weight over time, these kids moved into the stock of “Overweight kids” causing that line on the graph to rise. The number of “Kids with diseases related to obesity” rose slowly as overweight kids became sick and moved into that stock over time.



In his project, Omar writes about this alarming trend:

There are many reasons that kids are becoming overweight and getting less physical activity. The main cause of overweight among children and getting less physical activity is that video games, the computer and the television are taking up more and more of kids' free time. Kids are becoming very addicted to them today. Most of the kids today are at their living rooms, staring at the television lying on their couches like lumps, eating chips. Watching television for five hours a day is not good for your health. Another cause for getting obese and having less physical activity is that schools are not having daily physical education classes. Also, technology and our modern daily life

are causes of overweight among children. Cars, for example, are taking the effort and physical activity out of walking. Elevators and escalators are greatly taking the effort out of walking up and down the stairs.

This problem has become an epidemic among children. The number of children that watch 5 hours or more a day has increased greatly in the past few years. Inactivity increases the risk of diseases related to obesity such as cancer, diabetes, high blood pressure, strokes and heart disease. Inactivity also makes kids lazy and often tired. Overweight children grow up to be

obese adults. I would rather be physically fit and you should too.

What to do? Omar's research found that kids need more physical activity and proper nutrition. Using his model to test that hypothesis, he added “Awareness” of the problem leading to more physical education classes in school. (That awareness could be raised directly by the growing number of “Kids with diseases related to obesity,” a feedback loop that Omar might build into his next model.) If overweight kids get more exercise and eat well, they can become fit kids again.

Get Moving continued on page 4

Musings on Social Studies and System Dynamics continued from page 1

which will constitute a larger collaborative or “community” effort to brainstorm future efforts (both topical and, more generically, pedagogic) to further extend the benefits of system dynamics into the social studies classroom. Please feel free to send any thoughts or ideas stimulated by this piece to potashj@clexchange.org. Let's begin the collaborative process of [planning where we go from here!](#)

What exactly is “social studies?” The simplest definition conjures up Winston Churchill's famous description of Stalin's Russia as a “riddle wrapped in a mystery inside an enigma.” At its most “basic” level, social studies encompasses a diversity of disciplines and their respective tools, including anthropology, archaeology, economics, geography, history, law, philosophy, political science, psychology, religion, and sociology. It focuses on the entirety of human experience; and it employs “lenses” or perspectives that run the gamut from local and

regional to national and international, and from personal and cultural values to “universal truths.”

While that definition would seem to unleash an infinite universe of pedagogic possibilities for developing K-12 curricula, the teaching of social studies can exhibit an overarching logic. The starting point for understanding social studies rests in its distinctive purpose. The National Council for the Social Studies' “Curriculum Guidelines” (<http://www.socialstudies.org/positions/powerful/>), echoed by many state curriculum standards, are impressive both for their brevity and clarity of purpose:

“Social studies is the integrated study of the social sciences and humanities to promote civic competence...The primary purpose of social studies is to help young people develop the ability to make informed and reasoned decisions

for the public good as citizens of a culturally diverse, democratic society in an interdependent world.”

Promoting “civic competence” is both an admirable and an ambitious goal. But how is it operationalized? The challenge is really twofold: first, students need to develop a “capacity” or understanding for the issues, concepts, and tools that can assist them in framing “informed and reasoned decisions.” But more than that, they need to be “motivated” or inspired to apply that knowledge in affecting changes that support “the public good.” In the remainder of this piece I hope to develop the idea that system dynamics, with its conceptual tools that are particularly well suited to address contemporary issues, and its “problem-solving” methodology that emphasizes actively managing change, can powerfully assist in operationalizing the goal of social studies.

Social Studies continued on page 7

GET MOVING! Childhood Obesity continued from page 4

builds confidence for them. You should work at your own level of sports activity and you should also join a team. Get involved in school sports, dance classes or gymnastics. If your school doesn't have sports, try community resources like the YMCA, the JCC and local parks. If you are a kid who doesn't like team sports, try biking, walking or hiking, skating or swimming. Even in the evenings, if you have time, go for a walk. You could (at least) go out after dinner and play a game of catch with dad, jump rope or hopscotch. Other active chores can also get kids moving, such as raking leaves, washing the car or the windows, sweeping and vacuuming, walking the dog (he/she also needs to be active) and simple gardening.

Kids who are very resistant to outdoor activities could try exercise video tapes; there is a wide selection

of these tapes. Sit-ups, push-ups and lifting small weights are great ways to exercise and they keep your muscles strong. Being in good shape gives you a strong heart and strong lungs. You need to do aerobic exercise two or three days a week and each activity should be at least thirty minutes. It is very important that you include physical activity in your daily life. Exercise is a great way to reduce stress and relax, and when you reduce stress, it helps in preventing diseases. Yoga is a great way to relax, stretch and strengthen your muscles. Other sports do that too, such as tae-kwon do, karate and ballet. Doctors say that you should never stop exercising! Even older adults who use walkers or wheel chairs should do some simple exercising. Physical activity will help them feel better, it will keep their muscles from getting stiff and it will also make them develop better

balance, which will keep them from falling. Jump roping is a fun way to get kids moving. Try to walk to places with your friends instead of taking a ride.

Omar says that he really enjoyed doing this project and plans to continue with both his physical activities and system dynamics because “System dynamics is a great way to solve problems.” Although Omar loves sports now, he admits that he still likes to play video games once in a while. He urges everyone to get up and get moving! Omar can be very proud of his project and of the prize ribbon he very justly earned for it.

This article is available on the CLE website <clexchange.org> listed as "GET MOVING! Solutions to the Epidemic of Childhood Obesity," under Student Work.

Educational Modeling Exchange Curriculum Development in the Works

CLE's new initiative, "Educational Modeling Exchange," (see *CLExchange*, Volume 14, Number 3, Fall 2005) was started in September 2005, with several clear objectives for its activity:

- Refine and organize the existing CLE collection of curricular and organizational applications.
- Develop new curricular and organizational applications.
- Provide training and support for educators to use and to develop such materials.
- Seek additional support and collaboration to pursue an expanding set of those activities.

Subsequent issues of the newsletter will provide more complete explanations of those goals and how we hope to engage our readership in those activities. In this issue, we begin with the building of new curriculum (primarily the second and fourth bullets above), not because that is necessarily the most important task for us, but because it has a potentially quite long developmental time-line. We need to begin to move quickly to see results in a reasonable period of time.

EME provides a new focus and greater direction and support for CLE's long-standing curricular focus, and adds a proactive capacity. As we 1) define topics for development; 2) establish and support teams for their development; and 3) assess, refine, and disseminate resulting materials, we will be guided by several important considerations. These materials will be:

- **Of high value to students.** Student learning is central; the new CLE material will:

- Provide added way(s) to engage various learning styles,
- Provide connection of classroom lessons to the 'real world,'
- Empower students to direct their own learning,
- Empower students to define policy(s) for controlling the system in question, and/or
- Provide systemic structures and insights that can be transferred to other settings.

- **Of high utility to teachers.** Here we are looking to identify and develop material that will:

- Clearly contribute to meeting national standards in at least one subject area (we assume that various state standards will be in overall congruence with national standards),
- Be dependably covered by schools around the nation at one or more grade levels, and
- Provide clearly added value (in terms of knowledge acquisition, concept development and understanding, and/or active student engagement) to current approach(s) to the topic.

- **Supportive of higher level learning goals and strategies**, such as those identified in the National Academy of Sciences' "How People Learn" and "How Students Learn."

- **Effective for recruiting, engaging, and supporting classroom teachers.** Both the selected topics and the approaches need to excite sufficient classroom teachers that we can develop a working team of knowledgeable and excited professionals for each project.

- **Engaging for SD professionals and teacher-training professionals.** We will need expertise and oversight in several areas, not least of which will be learning assessment.

- **Attractive to funding sources.**

So, what projects are we considering? A rich mix of specific disciplinary and cross-disciplinary topics has crossed our minds. They are appropriate for diverse ages, and could make use of the full range of SD's systems thinking and dynamic modeling tools: e.g., personal finance, health, math for the computationally challenged, sustainability, great literature in its worldly systemic context, revolution and other social transitions, and that's just a taste. We cannot do them all at once, so we will have to be selective. And that's where **we need your assistance**:

- **Are we missing possibilities** (actually, *which* possibilities are we missing)?

- **Which is the "best"** with which to begin? **Why** do you think so?

- **With which would you like to help?**

Please help us make these efforts as powerful and quick to fruition as possible. We welcome individual notes via e-mail (heinbokelj@cleexchange.org or potashj@cleexchange.org).

We will also launch a discussion thread in the K-12 List Serve to encourage more give and take interactions. (If you are not already a member of the List, see the box on page 10 for instructions to join.) Ultimately, however, your full engagement and creativity will be needed to make available these powerful tools that our students need and deserve.

The Shape of Change

The November 2005 issue of *Mathematics Teaching in the Middle Schools*, page 208, carries a review of the CLE book, *The Shape of Change*. The reviewer writes, "This book is well organized, making it easy to use and adapt... This is an excellent resource for any classroom, particularly math and science."

To order *The Shape of Change*, go to cleexchange.org.

Musings on Social Studies and System Dynamics continued from page 5

Prior to considering the virtues of system dynamics, let's first examine how the social studies curriculum currently organizes and structures student learning. That rests with standards, or, most practically, with state standards. Standards provide a rigorous sequenced structure though which goals are incrementally set at specific grade levels to facilitate student achievement, and its measurement, over a twelve-year career. Notwithstanding the all-encompassing definition of the social studies, pragmatism and time constraints necessitate a more limited content and disciplinary focus.

A selective review of several states' standards (Pennsylvania, Arizona, California, Washington, and Vermont) reveals that the focus of social studies education is consistently confined to geography, economics, history, and civics/government. The rationale for these choices clearly reflects the recognition that, both individually and collectively, these four disciplines provide a conceptual foundation for examining the overarching or most significant themes that underlie the purpose of social studies. In its presentation of the frameworks of social studies education, the state of Washington explicitly articulates the logic for developing students' "understanding" of the particular concepts underlying each of the four disciplines. Geography "help[s] students become aware of humans' impact on their environments and how geography impacts how we live"; Economics "help[s] students realize how decisions about scarce resources are made"; History "help[s] students become aware of the impact of history on the world around them"; and Civics "help[s] students become active, engaged participants in our democracy."

Embedded in these "understandings" is the recognition that each of these disciplines effectively constitutes a key building block in constructing

a larger reality. And implicit in these understandings is the belief that the relationships/interactions between these variables account for many of the important dynamics of change that underlie the human progression from past to present and, even more importantly, inform the course of possible futures.

Let me switch hats here and introduce system dynamics. While I would suggest that an understanding of the conceptual foundations of each of the four disciplines is both desirable and "necessary," it may not be sufficient to address the NCSS' ambitious purpose. To begin, we might consider the NCSS' own recognition that "current civic issues – such as health care, crime, and foreign policy – are multidisciplinary in nature" and, as such, require a "multidisciplinary perspective." Knowledge in any single discipline may be useful for exposing some facet of the problem, but will unlikely, in isolation, be sufficient for effectively managing the problem.

That fundamental recognition was actually surfaced more than thirty years ago by the inventor of system dynamics, Jay Forrester, in his monumental 1971 essay, entitled "Counterintuitive Behavior of Social Systems." (<http://www.sysdyn.clexchange.org/sdep/Roadmaps/RM1/D-4468-2.pdf>) The vast majority of society's most challenging and enduring problems, he observed, persisted largely because policy makers misunderstood and subsequently mismanaged the behavior of social systems: The problem, he observed, derived from the fact that the ever-growing complexity of contemporary social problems (belonging to "the class called multi-loop nonlinear feedback systems"; this will become clearer shortly!) had vastly outstripped our mental capacity to address them. "Orderly processes in creating human judgment and intuition lead people to wrong decisions when faced with complex and highly interacting systems.

Until we reach [or, as educators, develop in our students] a much better public understanding of social systems, attempts to develop corrective programs for social troubles will continue to be disappointing." [As an aside, it was gratifying that Jay chose, in his keynote at the CLE's 1994 *Systems Thinking and Dynamic Modeling Conference*, entitled "Learning through System Dynamics as Preparation for the 21st Century," to provide educators with powerful guidance on "how to" think about and advocate for using system dynamics with students to help them better recognize and subsequently to manage the counterintuitive behaviors of social systems. (<http://www.sysdyn.clexchange.org/sdep/papers/D-4434-3.pdf>)]

The challenge, then, in preparing students to address current "civic issues," is to provide them with more than a set of individual disciplinary tools or concepts. They also need tools that allow them to recognize and then to more deeply understand how relationships or feedbacks connect multiple "systems" and generate oft-times complex, non-linear behaviors. Rather than relying on traditional intuition-based tools that imply immediate, linear cause and effect relationships between single variables within a particular disciplinary sphere (e.g. economics or government), we need to embrace the wisdom of Jay Forrester's mentor at MIT (and, coincidentally, the "citizen champion" who introduced system dynamics to K-12 education when he delivered a copy of STELLA to the Orange Grove Middle School in Tucson, AZ in the 1980s), Gordon Brown, when he observed, "the message is in the feedback and the feedback is always interdisciplinary."

While the challenges of operationalizing this systems perspective to illuminate the non-linear behaviors of complex civic issues cannot be fully ad-

Musings on Social Studies and System Dynamics continued from page 7

dressed in this brief piece, it is reasonable to at least initiate the conversation. My colleague, John Heinbokel and I developed a generic three-sector feedback map as a conceptual tool to illustrate the possibilities (<http://www.ciesd.org/pdf/loekeynote.pdf>). Our basic premise is that most developments of interest to social studies hinge *on the interplay between (1) dynamically changing populations* (whether they be local, regional, national, or global in scale) *and (2) resources as mediated through (3) beliefs, perceptions, or attitudes*. This conceptual framework helps to visualize the interconnections between the disciplines as they inform “real world” problems or events. At their core, the disciplines of politics and economics revolve around institutional structures, rooted in beliefs and attitudes that organize how finite resources are accessed and distributed. At the same time, these same processes are influenced by changing geographic factors (involving the availability of those resources, for instance, land or food) and/or dynamically changing populations. Critically important, as any one element in the system changes, that change will reverberate through the other sectors before feeding back on itself. These feedback dynamics are illustrated in Figure 1.

In its most generic form, this three-sector feedback map permits us to explore dynamic processes of change rather than single discrete facts and processes that are within single sectors. Does an event—war for instance—emerge solely out of a single short-term political issue? Or is it more likely to be an outgrowth of longer-term evolving disparities involving changing populations and/or resources where causes and effects are blurred by the closed circular nature of feedback loops? Alternatively, how do changing economic, political, or socio/religious attitudes factor into the equation, either contributing to or being affected by these dynamic populations and geographic landscapes? And to what extent can we make the critically important unintended consequences of actions more comprehensible to us than to those actors in the past who lacked a systems perspective? In tracking the causes and effects of change over time, social studies becomes an active process of defining then connecting the feedback loops.

But let's not lose sight of the “standards” as they frame student learning. The connections with standards would seem to be a natural for developing conceptual and deeper thinking. Systems

tools provide a method for real world problem solving; however, the standards ultimately define the important problems or issues for students to master. The key, then, is in linking systems and standards. Start with a problem or issue posed by a standard, and then connect that standard into a network or web of important interacting feedbacks or relationships.

Consider the possibilities for deepening student learning with an illustration. One of Vermont's geographic standards stipulates that students understand “human interactions with the environment over time”; another “how and why cultures continue and change over time relative to geography”; and still another, “the interaction/interdependence between humans, the environment and the economy.” Is this not a perfect opportunity to begin to craft “feedback” thinking? To what extent, for instance, is cultural change relative to geography an “effect” of changing attitudes, resources, and/or populations as well as a “cause” of change in any one of those areas? And, assuming we can identify ongoing feedback dynamics between sectors, can we begin to think about the relative rates of change and/or the influence of delays as each informs non-linear patterns of behavior? And might these patterns further help us to develop a better understanding of some of the “counterintuitive” processes in history that underlie the textbooks' “great events” (e.g., recurring patterns of war, including the Revolutionary, Mexican, Civil, Spanish-American wars; technological breakthroughs; political and social changes)? And, most importantly, might our deepened understanding of these processes have applicability for better understanding the problems of the contemporary world?

This is simply one of a number of opportunities for rethinking how and where the linking of multiple standards with system dynamics can facilitate a deeper understanding for real world is-

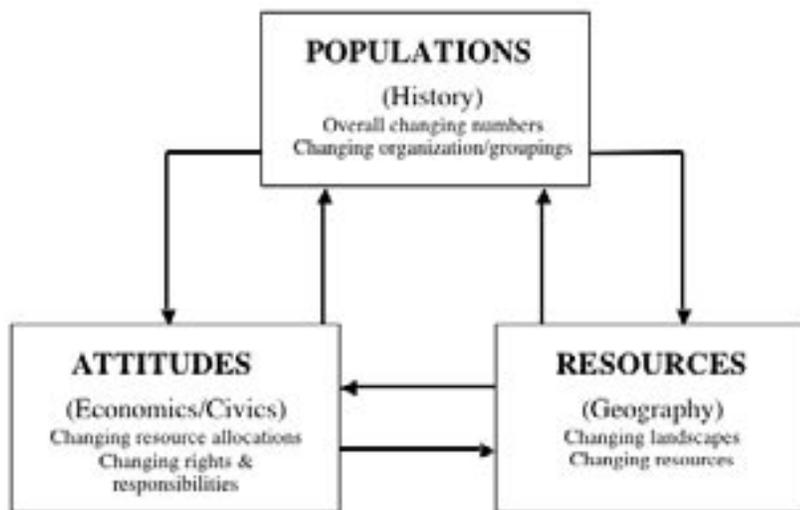


Figure 1. A Three-Sector Feedback Map Depicting the Dynamic Interplay Between Social Studies Disciplines

sues and problems while still doing full justice to the original standards. A single competency, as in the case of Washington's economic standard stipulating students' understanding "of the concepts of scarcity, choice, and incentives to explain the use of a resource" may be currently developed in a discrete economics lesson. That single standard, however, can be connected to other discrete social studies standards, to "analyze and evaluate positive benefits and negative consequences of people's different uses of the environment" and to use the insights generated to develop a better understanding for "how characteristics of economic systems may advantage or disadvantage particular groups of people." The resulting possibilities for students to more fully grasp the dynamic interplay between dynamic groupings of available resources and economic/political/social attitudes (and institutions) generates an abundance of exploratory topics and real world learning opportunities to better understand structural causes of change.

The linking of standards with a "systems" perspective, as illustrated by our three-sector feedback map, offers a powerful opportunity to think about what historians J.R. and William H. McNeill called *The Human Web* (2003; Norton), the networks of relationships and structures that underlie the human experience. Played out in recurring patterns of war and peace, the ebb and flow of social movements, technological development, and economic cycles, among other patterns, these networks provide a critical foundation for developing in our students an understanding of the "multi-loop nonlinear feedback systems" whose behaviors Forrester found to altogether elude us.

Using our three-sector concept map will not unleash the full power of system dynamics for developing students' capacity to manage the great civic challenges or problems that stand before them. For this to happen, students (and teachers) will need to learn how, where,

and when to use the full range of system dynamics tools, including behavior-over-time graphs, causal loop diagrams and/or stock/flow maps, and computer models. In the next article in this set, I intend to offer some concrete illustrations, using our "Ladder of Engagement" model of learning (<http://www.ciesd.org/pdf/lo-keynote.pdf>), for how social studies teachers might use these tools to enhance student understanding.

Before concluding, I need to close one final loop. At the outset, I mentioned the importance of building both "capacity" and "motivation" in our students. We have addressed the potential for system dynamics to provide a deeper conceptual framework for building knowledge. But there still remains the willingness or motivation to be engaged in making decisions "for the public good."

Here, I am reminded that system dynamics is not simply an intellectual tool but an instrument for managing change and for engaging stakeholders in that process of change. The challenge of mobilizing knowledge and understanding to foster positive change was the focus of Barry Richmond's concluding keynote address delivered at the 2002 CLE Conference in Durham, New Hampshire, shortly before his untimely death (Powerpoint slides from Barry's presentation are available at http://www.clexchange.org/conference/cle_2002conference.htm). In this presentation, Barry coined a new term that in many ways captures the spirit of the NCSS Guidelines: "systems citizenship." A passionate believer in (and role model of) the principle that system dynamics was not only about thinking differently but acting differently, Barry insisted that the personal acquisition of intellectual skills imparted through systems thinking (which he characterized as "filtering," "representational" and "simulational" skills) should not be pursued as ends in and of themselves. Rather, mastery of these skills should be

linked to a powerful awareness of what he called "systems being." Integral to that "being," Barry observed, were four attributes: expanded self-boundary, deep empathy, excellent communication, and respect. Supporting students in appreciating that the true measure of a skilled systems thinker rests in their "being," or their motivation to actively apply or exercise understanding toward some common good, was for Barry the proper means to develop "systems citizens."

In concluding these musings, I suggest that social studies and system dynamics share a common purpose: bolstering people's capacity and motivation to address contemporary issues and manage them for "the public good." Our challenge is to knit the language of social studies standards with the capacities and attitudes developed in system dynamics to cultivate the deeper learning needed to achieve this ambitious goal. When students develop the capacity for and the interest in understanding the powerful role of dynamic feedbacks between populations, resources, and attitudes in the past and, more critically, when they can see the relevance of that learning when applied to their own world, we will have truly made progress in our efforts to bring social studies to the level of creating systems citizens.

This article is available on the CLE website <[clexchange.org](http://www.clexchange.org)> listed as Musings on Social Studies and System Dynamics: Linking "Standards" with "Systems Citizenship" under Social Studies.

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milleras@clexchange.org>

The K-12SD listserve

The K-12SD listserve is a wonderful way to make connections and find resources within the K-12 community, share your experiences, and ask for help. If you are not yet a member, please join us.

To subscribe to the K-12SD listserve, send an e-mail message to listserv@sysdyn.clexchange.org with the line "subscribe k-12sd first-name last-name" as the only thing in the message's body (no footer, no signature, etc.) The subject line is immaterial. "First-name" and "last-name" should be your first and last names; for example, "subscribe k-12sd Lees Stuntz" if you are Lees Stuntz. Remember that the quotation marks are not to be included in your message, just the words.

The list is not an overwhelmingly active one, so it will not burden your in-basket, unless there is a lively discussion going on. Our most recent one centered on the conceptual difference in a stock and a flow and why these are important concepts for students to understand. Bring your ideas and questions! Where else can you get answers from both experienced teachers and world-class system dynamics experts?

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.

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The Creative Learning Exchange is a trust devoted to encouraging exchanges to help people to learn through discovery. It is a non-profit educational institution and all contributions to it are tax deductible.