

## **Systems Education for Kindergarten through Twelfth Grade in the United States: A View from the Creative Learning Exchange**

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### **Abstract**

In the United States the use of system dynamics in Kindergarten through Twelfth grade education is growing but it has not yet approached the steep slope of an exponential curve. STELLA, a user-friendly system dynamics program, stimulated the first few uses of system dynamics in the classroom in Brattleboro, Vermont and Orange Grove Middle School in Arizona. The number of schools using system dynamics has grown to include, not only the schools of the STACI<sup>®</sup> project from ETS but also schools in Ann Arbor, Michigan; Portland, Oregon; Brunswick, Georgia; Ridgewood, New Jersey; and Concord, Massachusetts. Each of these schools has started down this path through different portals. These differing starts give an insight into how other school systems might approach the venture.

The Creative Learning Exchange is a non-profit organization set up to encourage networking and curriculum sharing among teachers and schools who are using system dynamics in the classroom as well as those interested in initiating the process. Over the three years of our existence, this network has grown across forty states and into almost a dozen other countries.

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### **The Creative Learning Exchange**

The Creative Learning Exchange was established as a non-profit organization in July of 1991 to support and promote the use of systems education in Kindergarten through Twelfth grade. Systems education helps students to make sense of their changing world by giving them tools to explore complex, dynamic systems. This is achieved through a learner-centered approach where students are guided in learning rather than being lectured at by teachers. Systems education starts with a more general introduction through systems thinking and then proceeds into the principles drawn from the field of system dynamics.

Jay Forrester generated the concept of creating a non-profit organization to encourage the dissemination of information to K-12 schools and teachers. His ideas were implemented through the generosity of John R. Bemis from Concord, Massachusetts. John felt it was critical that all students be able to understand the complex systems around them in order to start solving some of the earth's very complicated problems. He believed, as did Jay, that starting at the K-12 level was a necessary component for creating a society in which all people could think on a systemic level. John is often wont to say that we are all born with the equipment to learn to understand dynamic relationships. It is our educational system which trains us to think solely in a linear mode.

The Creative Learning Exchange has a two-fold purpose. One is to gather curricula and information from those who are actively involved as teachers or administrators in schools using systems thinking and system dynamics. This information is disseminated to those interested. The other is to facilitate communication among teachers and schools to help create a network of schools using systems education.

After almost three years, the Creative Learning Exchange has about 2000 people on the mailing list for its quarterly newsletter and is in close contact with the six to eight systems in the country who are the most actively pursuing systems education. There have been over 450 requests for packets of introductory information within the last year. This is a two-fold increase over the previous year.

The Educational Reform movements in the United States have fueled an increased awareness that the curricula in the public schools needs revamping. There are a number of teachers and school systems who are looking into utilizing the extraordinary conceptual and interdisciplinary power of system dynamic modeling combined with systems thinking to create positive reform. We at the Creative Learning Exchange are providing information and support to anyone who is interested in utilizing this approach.

### **What Is Going on Throughout the United States?**

A detailed description of the projects throughout the country are better given by those who are actively participating in them. What I can give you is a general overview of what I have observed. Since I am in contact with many projects, I am able to see some emerging patterns.

### **Curricular innovation with inside funding and administrative support**

One place this type of innovation occurs is in school systems which are adequately funded. If such schools have a teacher or administrator enthusiastic about the concepts inherent in systems thinking and system dynamics, there are the resources readily available to get started. These schools already have the history of active involvement of the teachers in the planning of the curriculum. They have money set aside for professional development and encourage their staff to take advantage of it. The staff of these systems have been expected to grow and reach for new ideas. Support from others is likely to be generated by dedication to a good idea.

Two examples of this are the Ridgewood, New Jersey Schools and the Concord, Massachusetts Schools. These systems had both administrative support for the ideas of change in the direction of systems education as well as at least one very enthusiastic and dynamic teacher.

In Ridgewood, Rich Langheim, the Director of Management Information Services and Tim Lucas, the Director of the Critical Thinking program ( who was then a fourth grade teacher), "discovered" system dynamics in the form of the STELLA program. Both of them thought that system dynamics would be a logical adjunct to their already thriving professional development seminar program. So they started giving courses. Over the two and a half years they have been working on systems education they have given numerous workshops and encouraged many teachers to start incorporating systems thinking and dynamic modeling into their curriculum. Tim, now an elementary school principal, finds that he uses and teaches systems thinking as a part of his daily life. He has started courses for both parents and teachers in his school and is actively using the concepts in all aspects of his work.

The Concord schools award paid sabbatical leaves to their teachers. High school chemistry teacher Al Powers took advantage of the opportunity and spent the year exploring the field of system dynamics, writing curricula, and giving workshops for other teachers. The school system also undertook the expense of providing conference opportunities for three middle school teachers. There has been significant administrative support for Al's efforts. This year, as he has returned to the classroom, the school has provided him and a physics teacher also interested in system dynamics with seven Macintosh computers in each of their classrooms. Al has continued to make himself available to teachers within the system to give them information and support.

#### **Curricular innovation with outside funding and administrative support**

A second pattern is that of an enthusiast (teacher or administrator) within a school system implementing systems education with the help of outside funding. Another characteristic of these schools is that the support, even if not initially there, very soon came from both the teaching and administrative sides. This has happened in Tucson, Arizona in the Catalina Foothills District as well as in the Glynn County Schools in Brunswick Georgia.

A citizen advocate, Gordon Brown, introduced Frank Draper , a teacher in the Orange Grove Middle School in the Catalina Foothills District, to system dynamics in the form of the STELLA program. Frank and Mark Swanson rapidly implemented the use of system dynamics through the STELLASTACK and STELLA simulations in their eighth grade science program. Support for them came from the superintendent and the principal who became interested in the administrative applications of system dynamics. The principal at the Orange Grove Middle School, Mary Scheetz, has actively pursued the creation of a learning organization in her school. Her support and encouragement of teachers has produced fertile ground for the implementation of the use of system dynamics in the school.

For five years the work at the Catalina Foothills system has been supported through a grant from Jim and Faith Waters. Funding has been made available for professional development and support for the teachers to use system dynamics in the classroom at Orange Grove Middle School as well as at the new high school and across the district.

The Glynn County, Georgia project was developed by Pam Lewis, now the Assistant Superintendent in charge of curriculum, in collaboration with Georgia Pacific. Pam was able to get significant funding from Georgia Pacific to give interested teachers release time during the school year to work on curriculum. That project is now running with little or no funding but is bolstered by the continuing support of Pam Lewis and the very enthusiastic core of teachers generated by the first year of the project..

#### **Curricular innovation with outside funding**

There have been at least two examples of projects in system dynamics or systems thinking which have educated and encouraged teachers without consistent administrative support within the school systems. One, the STACI <sup>n</sup> (Systems Thinking and Curriculum Innovation and Networking) project run by Ellen Mandinach and Tony Cline of the Educational Testing Service, has been in process since 1987. It is an extensive project involving eight schools across the United States. The project has given the teachers involved extensive support in developing curricula and in using system dynamics in the form of STELLA software in their classrooms. The one high school which has been the most successful in using system dynamics in the classroom has the largest teacher base as well as some overt administrative support . There may be a critical mass factor for teachers as well as an administrative support factor working also.

The second project is the one created by a National Science Foundation grant which is being described elsewhere in these proceedings by Diana Fisher, one of the principal investigators. Their project is dynamic and exciting. Their summer institute for teachers in Portland, Oregon resulted in curricula with great potential. Ron Zaraza, one of the other investigators, states that through the summer institute they have achieved a critical mass of interested teachers at his high school, Wilson High. Their long-term success may depend on increasing administrative support and creating a critical mass within individual buildings. Or they may, however, be able to create a critical mass within the Portland Public Schools or the Portland area to alleviate the need for administrative support.

There is yet one more school with significant progress on the systems education front. That is the Angell Elementary School in Ann Arbor, Michigan. The efforts there have been directed by the principal, Nan Gill. She has encouraged the use of system dynamics in the curriculum and has concentrated on building a learning organization, such as Peter Senge describes in The Fifth Discipline, in her building. When she started, she was encouraged in her efforts by her superintendent who has since moved to another district. She, like Al Powers, was able to take a sabbatical to explore the possibilities inherent in system dynamics. Since then, she has kept the school moving without extra funding. Her enthusiasm and drive have been sufficient to make substantial progress.

It is an unanswered question as to how long systems education would thrive in the schools I have described if the people who had spearheaded the effort left the schools. At what point does systems education become self-sustaining?

The combination of administrative support with a teacher who is enthusiastic seems to be a powerful one throughout all the more successful examples of implementation. Some financial support is needed to create a system-wide base. The power of one directed, enthusiastic, and hard-working person, teacher or administrator, can not be underestimated.

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