

National Science Foundation Grants

Cross-Curricular Systems Thinking and Dynamics Using STELLA (CC_STADUS) 1993-1997

The purpose of this grant was to train approximately 100 high school teachers of mathematics, science, and social science to analyze complex systems by building simple models using the Stella software. The participants were to build models that would be appropriate to use in their classrooms. They were then to develop lessons around those models and implement the lessons during the year following their summer training. Applications from cross-discipline teams from the same school were given preference for the summer training.

The summer training consisted of three weeks of intensive work, about 8 hours per day. The first week the participants were divided into separate disciplines and were given instruction by trainers who were themselves high school teachers of the same discipline as the participants. This allowed common background, common language, common understanding of curriculum to lay a comfortable foundation upon which the new systems theory and tools could rest. It kept participants in their comfort zone as much as possible as they built small models that directly related to their curriculum.

After the first week cross-discipline activities were introduced. Speakers from Oregon Health and Sciences University (lecture on how drugs work in the human body), from Bonneville Power Administration (lecture on Daisyworld, a simplified climate model simulation, and the Gaia Hypothesis), from Trinity College in Vermont (lecture on Plagues and People - relating history and science to the spread of epidemics), among others, provided thought provoking material. Participants built or manipulated models to gain understanding about the topic being presented.

Finally, participants were placed in cross-curricular teams and developed an original working model that could be used across disciplines and wrote an explanation of the model and curriculum to use in their high school classroom.

Following the summer training teachers were required to do a faculty presentation at their respective school, were to use models at least three times in one or more of their high school classes, and were to submit a second model they had created during the school year.

A few quick summary results:

Year	Number of Participants	Percent who presented to their faculty	Percent who used model(s) in class
1993	35	52	82
1994	30	63	67
1995	34	86	85
1996	31	90	77

1993: 82% completed at least one of the requirements. 31% completed all requirements.
1994: 77% completed at least one of the requirements. 43% completed all requirements.
1995: 91% completed at least one of the requirements. 35% completed all requirements.
1996: 94% completed at least one of the requirements. 55% completed all requirements.

83.3% of the participants felt the training "Exceeded" their overall expectations.
73.9% of the participants rated the effectiveness of the overall organization of the seminars as "Very Effective"

Cross-Curricular Systems Using STELLA: Training and Inservice (CC-SUSTAIN) 1997-2000

The purpose of this grant was to refine the previous training experience and expand the participant list to groups outside the state of Oregon. Three core sites around the US were established to provide future training within their respective regions. Training materials were formalized and made available to the participants. The summer training was reduced from 15 to 12 days adding three follow-up sessions during the subsequent school year. Modeling activities were expanded to include lessons for more diverse student populations. A set of cross-discipline and single-discipline models were made available via a website (which is no longer active).

The summer training was essentially the same. The principal investigators and the core training team also provided additional short training sessions for non-grant participants during the school years this grant was active. In addition to the evaluation of teacher participants, the third-party evaluators (Northwest Regional Educational Laboratories) surveyed about 66 high school students during the last year of the grant, regarding their attitudes about the new systems thinking/dynamic modeling lessons.

Some of the findings from both NSF grants and related training activities are given below.

Conclusions drawn by the principal investigators and core training team:

1. A critical factor in modeling success is time creating models with an instructor present. Short-term training activities (less than 8 -10 days) yielded a lower percentage of modelers who actually used models in classes. Ongoing support/consultation can ameliorate that to a certain extent, depending upon the brevity of the training.
2. Access to more quality instructional materials with accurate models and well-developed sequencing of topic development was a critical missing component often requested by teachers. The materials developed for the summer training experiences for the teachers was a good start, but the teachers wanted more examples to take back to their classroom.
3. It was necessary to expose teachers to a wide variety of high quality models. Such models led to more confidence in the model building process and greater use of models in the subsequent school year.
4. Team participation from an individual school or schools in close proximity to a training site was desirable for building capacity in training new teachers and supporting them in their use of system dynamics tools and concepts.
5. The cross-discipline nature of the group (trainers and participants) structure and cross-discipline training activities reinforced the principles of system dynamics. The participants associated system dynamics study with issues and instruction that transcended any single discipline.
6. Some women from outside the Portland metro region were unable to attend the summer workshops due to family responsibilities. This suggests an alternate model of offering the training to remote sites should be pursued.
7. A strong need that was not met by the grant was high school student (achievement) assessment. Parents, business persons, academics, although impressed with student work, wanted a more formal assessment tool that showed student learning gains compared to traditional instruction. This was not provided as part of the NSF CC-SUSTAIN grant since the grant was to focus on teacher training, but should have been built in as a grant responsibility.
8. More access to system dynamics professionals should have been built into the grant.

9. Publicity for student accomplishments in their model creation and analysis was unavailable. High school students were producing models and insightful analyses of significant world problems and none of the schools had been able to get this message out to the general public. Repeated attempts to interest the press had been largely ignored. It was felt that formal student assessment would help this process, but critical friends needed to be made with those who have access to public relations and publicity.

Conclusions drawn by Northwest Regional Educational Laboratories, the third-party evaluation team (from their final report):

1. According to trainee reports, staff development offered by CC-SUSTAIN was highly effective in training them in how to model and employ the software. This finding holds over the last four years in which training was offered. However, these reports were strongest in the last year of the training, suggesting that the training program is improving.
2. Teachers trained by CC-SUSTAIN were likely to return to their buildings and apply their concepts and skills learned in training by developing their own systems models and employing systems thinking in their classrooms. More remarkably, for a significant proportion of teachers, this teaching practice has continued up to seven years later.
3. Most remarkably, a significant number of teachers who utilize the training over time are likely to train other teachers, administrators or interested parties. These effects are again long term, with teachers who were trained up to six and seven years ago still training others.
4. Students who participated in the classes of CC-SUSTAIN teachers are very satisfied with the program. They report high levels of understanding of complex concepts and skills, and their attitudes and behaviors towards systems thinking are most positive. However, the most apparent impact on students is exhibited by the quality of their work.