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

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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. The core team is selected from among the most able modelers. Both old and new core team members, working with the project directors, collaboratively re-design the materials used each year. The core team consists of two science teachers, two mathematics teachers, and two social science/humanities teachers. If possible, a mix of fields within each discipline is chosen (one physical science and one non-physical science teacher, one upper level and one introductory level math teacher, one history and one literature teacher). 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. While the entire project staff still believes that the 12–day training is necessary to prepare teachers to model on their own, the other length training sessions can provide a useful start in educating teachers about the potential of systems. As more models become available, the 5–day training may become a viable alternative for teachers whose primary goal is the use of models rather than the development of models. The materials will be available through the Creative Learning Exchange and through the projects own web page after August 15th. 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 learn new skills (e.g., computer modeling) most easily if it is presented in the context of their own subject area. Consistent with this, participants 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 from one group to the other. Instruction focused on building models for use in the curricular areas. As a result, there were few common experiences. Each group used very different models and covered different model 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. The intent was to provide all participants with experience building a few basic types of models, with a basic “toolkit” to begin working with. Linear growth and decay, exponential growth and decay, quadratic growth, and S–shaped growth were identified as a reasonable set of structures to be learned in the limited time available. 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 the growth patterns chosen was based on an attempt to ensure that all participants had common experiences and skills. Fortuitously, the patterns allow teachers to build almost all the models they are likely to use. 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 or actually building the models. They frequently tried to build relatively complicated models while making very basic mistakes. A significant number of the participants in the first two years reported 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 the increased emphasis on learning a few structures well. The second 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 increase in basic computer skills has, in turn, 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, 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.

The first four days — an introduction to Systems and STELLA

**Day 1**

- **8:00 – 9:30** Registration, introductions, distribution of software, general orientation, presentation of final schedule for workshop.
- **9:30 – 9:45** Break
- **9:45 – 12:00** Fishbanks Simulation Introduction and Activity
- **12:00 – 1:00** Lunch
- **1:00 – 2:30** Fishbanks Simulation Activity
- **2:30 – 2:45** Break
- **2:45 – 3:45** Fishbanks Simulation Debriefing
- **3:45 – 4:00** Daily wrap-up

**Day 2**

- **8:00 – 8:30** Introduction to STELLA II software
- **8:30 – 10:30** Population Tutorial
- **10:30 – 10:45** Break
- **10:45 – 12:00** Group Formation (ideas, requirements)
- **12:00 – 1:00** Lunch
- **1:00 – 2:30** Instruction and activities in the Core Area groups (Math, Science, Social Sciences)
- **2:30 – 2:45** Break
- **2:45 – 3:45** Core Area Activities
- **3:45 – 4:00** Daily wrap-up

**Day 3**

- **8:00 – 10:00** Core Area Activities
- **10:00 – 10:15** Break
- **10:15 – 12:00** Core Area Activities
- **12:00 – 1:00** Lunch
- **1:00 – 2:30** Core Area Activities
- **2:30 – 2:45** Break
- **2:45 – 3:45** Core Area Activities
- **3:45 – 4:00** Daily wrap-up

**Day 4**

- **8:00 – 10:00** Core Area Activities
- **10:00 – 10:15** Break
- **10:15 – 12:00** Core Area Activities
- **12:00 – 1:00** Lunch
- **1:00 – 2:00** Developing group modeling ideas
- **2:00 – 2:15** Break
- **2:15 – 2:45** Development of Fishbanks STELLA model from MIT
- **2:45 – 3:45** Activities using Fishbanks STELLA model from MIT
- **3:45 – 4:00** Daily wrap-up
The initial four days of training, after dealing with organizational and administrative work, begin by looking at one of the traditional opening activities in systems institutes: The Fishbanks simulation. While some of the participants have a broad background in systems concepts, some are relative novices. The Fishbanks simulations provides a common starting point for all participants. The group (35–40 teachers), is divided in half, each half working with one of the project directors. Each half forms six teams/companies and plays the simulation. Breaking the group up insures that “companies” consist of 3–4 teachers, allowing maximum involvement for each. Instruction about the simulation is kept to a minimum, with the basic purpose of the game, “maximizing wealth” being presented along with copies of the basic handouts provided by the publisher. This, predictably, produces a rapid economic and ecological disaster. Some groups do recognize the impending disaster and try to prevent it, but they are almost never successful. This produces extensive discussions, especially as the outcome becomes more evident. Participants focus on the simulation, dissecting it in great detail. That sets the stage for the debriefing.

The debriefing begins by focusing on what happened to the fish in the simulation. It quickly moves to what is actually going on in the simulation – what factors are included, what are excluded, and why. This tends to lead to a general discussion of what can be included in simulations and what topics can be modeled. The participants look back at the Fishbanks simulation and begin to discuss how they would change the simulation. The debriefing closes by looking at how to start a simulation – how to identify a few key factors that form the core of a model.

Day two begins with a short introduction to STELLA. The four basic building blocks (stocks, flows, converters, and connectors) are defined. After using a variety of different analogies, ranging from bathtubs and faucets through home heating systems and flush toilets, the core team finally evolved one that cut across all disciplinary lines. Stocks are like nouns. Nouns act through verbs, or are acted on by verbs. Similarly, flows act on stocks. Adverbs modify verbs, converters modify or control flows. Finally, connectors function as conjunctions. This introduction to the “grammar” of STELLA is followed by an introductory tutorial on population. This tutorial “walks” participants through building a few basic population models without really giving much background – a “follow the numbers” modeling experience.

This activity is followed by a step backward. A short presentation on group formation is given. Participants are expected, working in groups of 3–4, to build a cross-curricular model and develop accompanying curriculum. The first step in this process is identifying a suitable topic. Options for topics are presented, as well a process for forming groups.

Next, the actual work in discipline groups begins. Each discipline group works in an individual room. Using materials that are generic for the content group, participants begin learning how to
build the basic structures. All groups begin with linear growth and decay. In the Social Studies group, for example, the first work involves building a model of how papers build up on a teacher’s desk. It is a simple one stock, one inflow model. The model is then extended with some additional, open-ended problems: breaking the paper load into different classes, with different numbers of students and different rates of paper production. The Science group begins with a simple model of motion with a constant speed (flow) and a changing distance (stock). Again, the model is extended without changing the structure.

Groups continue, working through exponential growth and decay, quadratic growth, and S-shaped growth. Each year, more extensions of the basic model structures have been added. This has been made possible by the greater speed with which participants have mastered the basic models. These extensions have also allowed some additional material to be introduced.

In the first year of the grant, only graphical inputs were taught. Little work with logical functions was done. The materials now used introduce If-Then statements, Pulse, Step, and other operators through the model extensions. In most cases, these operators and functions are not explicitly described in the handouts used for the training. Instead, they are developed one-on-one, a process made possible by the large staff used for instruction. Each summer institute is staffed by the two directors, six core team members, and one or two student assistants. This means that there are 9–10 instructors for 35–40 participants. Two are working full-time with each group. The rest float from group to group, assisting where needed.

When the Science group is doing the quadratic structure, participants will build a model of an object thrown vertically. After they build the basic model, it is pointed out that if the model is run long enough, it will describe an object burrowing into the ground and continuing to accelerate, an obvious impossibility. When one of the instructors points that out, the participant usually asks something along the lines of “Well, can I tell the model to stop accelerating and moving when it hits the ground?” The response is usually another question: “What would need to change, and when?” This results in a discussion about how to use If–Then statements. Similarly, in the Social Studies group, participants build models of stock prices when learning about S-shaped growth. One of the extensions involves modeling rapid changes brought about by panic selling. This is done through a pulse. Again, this is usually done one-on-one. The instructor works with the individual participant until they can use the operator. The participant almost immediately begins working with the adjacent participants. Students become instructors almost immediately. This pattern spreads the information through the group. The mutual support and instruction reinforce understanding.

If participants complete all the basic modeling activities and extensions, they are generally given models to build that begin to bring together the structures to build more realistic models. The Science group, for example, begins to work on “That Dam Model”, a succession of 5 models.
describing the behavior of a real dam. The simplest model begins with a reservoir and the pattern of water inflow. In this first model the goal is to keep the dam from overflowing (keep the reservoir from overfilling). Successive models deal with more problems: adding turbines to produce a constant level of power, maintaining a minimum water level, variable power demand, and finally, providing seasonal spills for salmon. These types of models anticipate both the next four days of training and future work in their own classes.

After participants have completed work in their discipline groups, they return to the Fishbanks Simulation. Now, in two groups, they discuss how to build a fishing model. The discussion focuses on identifying the core pieces of the model, the most essential pieces, and the types of growth they should exhibit. In many cases, they never actually build the model. However, the discussion provides an example for their own work with models and establishes a pattern for analyzing a problem and developing one or more models to describe it. Finally, participants close the first four days of the training by actually running the Fishbanks tutorial developed at MIT. This provides an experience of how a model can be used to help learn about complex systems.

**Learning about Research and Higher Education Uses of STELLA**

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1:00–3:45 Plagues and People - talk and computer hands-on work
3:45 – 4:00 Daily wrap–up

**Day 7**

Trinity College System Dynamics Group (Jeff Potash and John Heinbokel)

8:00 – 10:00 Plagues and People
10:00 – 10:15 Break
10:15 – 12:00 Plagues and People
12:00 – 1:00 Lunch
1:00 – 2:00 Anxieties and concerns
2:00 – 3:45 Jeff and John - possible group modeling projects
3:45 – 4:00 Daily wrap–up

**Day 8**

8:00 – 9:30 Dynamic Systems and the mathematics behind STELLA
9:30 –9:45 Break
9:45 – 10:30 Euler and Runge–Kutta Methods – What is really happening in computations
10:30 – 10:45 Break
10:45 – 12:00 Pitfalls and problems in Stella modeling
12:00 – 1:00 Lunch
1:00 – 1:45 Tim Joy - “Lord of the Flies” - modeling in English classes
1:45 –2:00 Break
2:00 – 3:45 Begin working on Group Model Project
3:45 – 4:00 Daily wrap–up

The first four days provide basic instruction in building STELLA models. However, those models are simple, and unless the participants have had an opportunity to do all the advanced/extended models, they have not had a chance to work with models that combine structures. They next four days give them that opportunity as they begin to see how models can be used in research and higher education.

The first day of this section is devoted to models developed by Dr. Ed Gallaher, a research pharmacologist at Oregon Health Sciences University. He has used STELLA for more than eight years, and has done work with secondary students for six. The models he uses with the participants are essentially simplifications of the models he uses in his pharmacokinetic research. They focus on drug assimilation, drug elimination, and drug effect within the body.

The models participants explore begin with a linear input and exponential output model, often referred to as the rain–barrel model. It describes the actual water level of a rain barrel as it fills with water and is drained by a single hole in or near the bottom. The variations of the models that they work through include different types of inputs, including steady input, initial high input followed by steady small input, and pulse inputs. These variations are presented because the “rain barrel” behaviors are excellent approximations of the way the human body interacts with drugs.
These basic models are followed by exploration of actual drug interactions. First, participants look at the behavior of intravenous drugs, low level continuous inputs into the system. Next, in “Take Two Aspirin . . .” they look at discrete doses, like taking two aspirin or some other drug administered orally. This model adds some additional complexity. It is a two compartment (stock) model. The two connected stocks are represented by the amount of the drug in the stomach and the body (effectively, the bloodstream). Further exploration follows, with different patterns and strengths of doses, as well as IV inputs. Exploration of the problems encountered in maintaining the drug level between the therapeutic and toxic levels closes the day.

The next two days are devoted to work with Dr. John Heinbokel and Dr. Jeff Potash of Trinity College in Burlington, Vermont. They have developed and taught an interdisciplinary course entitled “Plagues and People”, first taught at the college level, but since used at the secondary level. This course looks at how a biological phenomenon, disease and epidemic, affect history. Their presentations to the participants give them an opportunity to explore some of the models developed for the course. This provides four important experiences. The most obvious is the chance to work with true cross-curricular models and to experience how courses can be taught with such materials. The second key experience is simply the opportunity to work with models, to gain experience in manipulating and understanding fairly complex models. Third, all the models are basically exponential growth/decay models. The sequence of increasing complexity displayed in their models is exemplary practice in secondary model usage. Finally, Dr. Heinbokel and Dr. Potash have described modeling as a tool to encourage interesting and enlightening “conversations”. They, and we, believe that these “conversations” may be the key to systems and modeling work in schools. They can truly open up problems and ideas for students. The “Plagues and People” materials are masterful examples of how to stimulate these conversations. Working with the materials provides participants the opportunity to participate in such conversations, to see the potential of the conversations, and to learn how to design models that facilitate them.

The last half day, Jeff and John discuss model ideas and assist participants in finalizing cross-curricular models. Their experience in developing models makes them unusually well suited for this task. They begin by resenting a few general ideas and “do’s and don’ts. Then they move on to specific ideas being explored by participants, suggesting ways to limit the scope of the model, concepts to focus on.

The final day of the middle block is something of a “catch-all” day. It is used to deal with several important needs. The morning is devoted to the mathematics behind STELLA. Most participants have limited mathematical experience. To attempt a rigorous treatment of what STELLA does and how it does it would be impractical. Instead, these presentations focus on how to choose the correct integration method, how to choose a reasonable dT, and how to determine the stability of a model. Participants are taught simple, easily learned criteria for each. As an
extension of these ideas, some common problems are discussed as well. The focus is on problems based in the mathematics, problems specific to STELLA (such as choice of uniflows and biflows, non-negative stocks), and general problems commonly experienced in building models. 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. Therefore they have become the final formal part of the instruction. At this point, participants know enough for them to profit from the information. Earlier introduction would only serve to add confusion.

The afternoon of the last day of the middle block also serves as a transition day, a day when the participants begin working on their models. At this point, demonstration teaching and questions of pedagogy also 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.

The first “sample teaching” involves the most unusual model developed in the first two years of the project. Tim Joy, a member of the core team and one of two participants selected to take over as Co–Director of the project, developed the “Savage Instincts” model. This literature model uses a simple model to motivate a discussion in literature classes. Students track the changes in civility of a character from the William Golding novel *Lord of the Flies*. The time scale of the model is in chapters. As the model runs, messages or prompts come up periodically. These messages refer to events in the book. Students adjust a slider that controls a flow from a stock labeled “Civility” to a stock labeled “savagery”. Students document their reasons for the shift, citing the novel. When they have finished their model run, they print a graph of the change in civility. These graphs are displayed in class. They become the focal point of the discussion of the book. Students with different shaped graphs for the same character discuss their reasons for the difference. This results in an unusually spirited discussion.

These ideas are presented, along with a sample run of the model. Next, participants are advised how to lead the discussion, as well as how to adapt the model for other books.

The remainder of the last day is the first opportunity for teachers to work in their groups on the cross-curricular models. This short period is usually used to define individual tasks, including identifying what literature research will be needed.
Building Cross-Curricular Models

**Day 9**

8:00 – 9:00  Teaching strategies modeled  
9:00 – 9:30  Approaching modeling ideas  
9:30 – 12:00 Group Work  
12:00 – 1:00 Lunch  
1:00 – 4:00 Group Work  

**Day 10**

8:00 – 9:00 Finding modeling ideas  
9:00 – 12:00 Group Work  
12:00 – 1:00 Lunch  
1:00 – 4:00 Group Work  

**Day 11**

8:00 – 9:00 System/modeling theory  
9:00 – 12:00 Group Work  
12:00 – 1:00 Lunch  
1:00 – 4:00 Group Work  

**Day 12**

8:00 – 9:30 Use of models in classes  
9:30 – 12:00 Group Work  
12:00 – 1:00 Lunch  
1:00 – 2:00 Final evaluation  
2:00 – 4:00 Group Work  

The final block of four days begins with more demonstration teaching. 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. That is one option some will be able to use with their classes. More often, they will either 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 first activity the morning of the first day focuses on these topics.

The “Bathtub” model is used to illustrate how whole group presentations can be done. This model of a filling and draining bathtub is designed to allow students to explore the mathematical concept “slope” without ever being given a definition of the concept. They develop an operational
definition by doing repeated runs and answering a series of questions. The participants become the class, as one of the instructors leads them through the model. Questioning strategies are explained as the “class” deals with them. After the model is run and the discussion completed, use of the model by individual students is then discussed.

After the demonstration teaching, participants move on to the day’s main activity. The bulk of the final four days of the institute is 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 attempted 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. As participants begin focusing on their cross-curricular models, institute staff circulate, making certain that the topics are appropriate and can be developed into a simple model or, preferably, a succession of models of increasing complexity. The process of narrowing the problem can be time consuming, but is vital to the success of the group.

The next step is actually building the basic model. As the group looks for the necessary supporting data, the task often changes. Even the best idea may prove to be impossible to model if no data is available. This has proven to be a particular problem in developing models based around chemistry. Often, groups are forced to develop models that rely on data that is generated to illustrate assumed behaviors, not based on actual data. These models are still useful, since they may still illustrate phenomenon reasonably.

Participants are urged to fully document models, both within the model and in their support materials. Experience with some of the models previously released showed that it was not always evident why values were chosen, or why the model was built with the structure chosen. Even relatively simple models had “holes” that could not be easily filled. Participants are reminded that documentation “put off until later” is often not done. They are told to use the STELLA “document” feature to explain each piece of the model as it is built. As they began to write the curriculum and instructions for use that accompany the model, they are encouraged to amplify their documentation, so that there are no ambiguities.

Once the models have been completed, they are edited by CC–STADUS staff. This editing consists of checks for mathematical validity and stability. Problems are ironed out by the editor, staff, and model developers. Similar work is done with the curriculum materials. They are 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 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. Local participants who have been able to come to the Saturday sessions have been willing to attempt more interesting models, and have generally built more models than past 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. Any attempt to develop teachers as modelers must include a strong support component. Effort in this area will pay huge dividends. Many teachers begin using models with no difficulty. Others have problems. Often only a small nudge is needed to get teachers building and using models in the classroom.

Follow–up and support encourages teachers to take risks. However powerful systems models may appear to advocates, it is important to remember that for most, using models is a step away from their normal teaching, a risk not to be taken lightly. Even the best planned and most carefully presented training in building and using models is useless if participants are not assisted in bringing models into their classroom. Implementation must be regarded as every bit as important as model building itself. The best ideas will not spread unless they are supported.

References

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