Murdoch Middle School, Part III

The summer after the Murdoch Middle School’s second year, a year that had ended, surprisingly enough, with children in tears at the prospect of having to leave for two months, the teachers convened in Burlington, Vermont, to continue their training. Two professors at Burlington’s Trinity College (the College has since closed its doors), John Heinbokel and Jeff Potash, had invited the faculty to join their summer professional development sessions on systems thinking and dynamic modeling in K-12 curriculum. Nearly everyone went.

During the week the staff spent together at Trinity, they pushed themselves beyond where they had gone the previous summer in their dynamic modeling training. The first training had helped five teachers improve a specific skill; this one engaged a group of ten or twelve in deep conversation about how things really worked at the school, using the tools of system dynamics to improve the dialogue. Together, with the professors serving as facilitators, they created copious loop diagrams in an attempt to capture the dynamics of the subjects that, though they were not strictly academic, interested many of them the most: Why didn’t all kids do their homework? How come the bathrooms always looked horrible? What was the best way to keep students from hitting each other?

Nearly everyone who attended remembers the week as one well spent—a time when they thought hard all day, about topics directly related to their jobs, with the aid of their colleagues. While there was little, if any, formal instruction or practice in actual dynamic modeling, the more pencil-and-paper (and Vensim) approach did not bother anyone.

Returning to Massachusetts, the seventh and eighth grade team began to plan a project that incorporated much of what they had worked on in Burlington, but that was directly based on yet another training session they had attended. This project was sponsored by a local environmental advocacy group and had as its main assignment the creation of an “action plan” to help solve an environmental problem. Never mind that the team had recently finished a week—the Trinity College session—in which they had spent hours and hours trying to find reasons why kids didn’t bring pens to class. Somehow, the same group of kids and teachers was going to clean up a nearby lake, ensure the opening of a town bike trail, and fight a proposal to enlarge a local highway. It would be, to say the least, a tough project to run.

Why did this complicated project seem so attractive? For one thing, the training, support, and materials were free. For another, teachers from the local district middle school were also at the training, and the charter school’s teachers had made tentative plans to have the students from the different schools collaborate in some way. Since relations with the district were always iffy, at best, this chance seemed like one not to be passed up. And the whole thing supported the state curriculum frameworks. But really, it was what those required action plans implied: Looking for causality. Leverage. Feedback. Archetypal behavior. Their summer had prepared them perfectly.
What they had forgotten, of course, as they planned out the different assignments for the project, which went by the name “Earth Force,” was that creating even a small set of loops had required quite a bit from them. They had five or six adults working on each one. An experienced university professor guided each discussion. They spent hours each day, over the course of a week, settling on loops that they all considered fairly representative of the problem in question. And, perhaps most importantly, each of their loop sets was about a problem that they each had already spent time thinking about, nearly every day. What teacher doesn’t walk around with a head full of data and theories about why his class doesn’t do X, or won’t stop doing Y? All they had to do, really, was get their ideas onto the white board, then argue about how to link it all together.

The kids, on the other hand, were going to start from scratch. Each had collected a sheaf of newspaper articles about various environmental topics over the summer (those who had done their summer homework, anyway), and early in the school year they scanned the articles for hints about causality and feedback. From the meager bits of information they found, they cobbled together loop sets.

The topic—how to make loops, specifically—had fallen into that pedagogical netherworld in which a class can simultaneously say, “I don’t know how to do this,” and “We already did these.” Determining the veracity of statements such as these is always a slippery matter, but hearing them in a classroom is a pretty good sign that you have not taught something effectively, and that students are about to put forth a halfhearted effort.

Disappointed with the entire project, the teaching team set causal loops aside for a while. Sure, they thought, we can get kids to draw loops, but how do we get them to draw loops well, to understand them well enough that they care about the quality of the product? Perhaps, they said, when we have more time. When we understand it better, so will they. We wish, they said, we had someone who could work on preparing materials and training us to teach this stuff. And wouldn’t you know it? Their wish came true.

The following year, the Waters Foundation provided funding for one teacher at the school to spend one day each week working on system dynamics-related curriculum. By now, Sue Jamback had been able to sense that her staff was being run a bit ragged by creating everything themselves. She advised that teacher—me—to stay away from the school on my “Waters Days.” Instead, the best idea, we decided, was to carefully pick through the materials that existed on the Creative Learning Exchange’s web site and select some to bring into the school.

It wasn’t long before the strategy paid off. Early in the school’s fourth year, during a project on cartography that included a few days studying early civilizations, I brought in a model, downloaded from the CLE web site, of the last days of Mohenjo-Daro. After locating it, which was relatively easy, I spent the better part of two days—two weeks, that is, using one day per week—understanding its dynamics and preparing materials to go with it. It worked very well. The class—and another studying

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1 www.watersfoundation.org
2 Available on the CLE website—clexchange.org—catalogued as CC1994-08MohenjoDaroSim
Mohenjo-Daro—enjoyed using the model, even though they didn’t get to each play with it as they had with the newspaper model the year before, and they recognized the dynamics at work.

Two classrooms, though, was not enough. Slowly, as I found more useful products to bring in and share via mailbox, e-mail, or team meeting, the use of the tools spread out into nearly every classroom. A project in which students followed different equities to learn about financial markets and macroeconomics had gone very well two years earlier, but the teachers improved it by adding a week in which students modeled the compound growth that convinces us all to sock away our money in mutual funds. The resulting graphs made nearly every seventh and eighth grade student a billionaire, since no one was able to build the balancing process that bursts stock bubbles. But it was the winter of 1999, so perhaps that didn’t seem so important. After we recovered from being blindsided by the confusion that ensued when there were two completely different things called “stocks” in the same unit, the kids got the idea.

During the same project, kids participated in something we called “TulipMania,” a sort of trading pit for tulips, designed to simulate the speculative craze surrounding blighted tulip bulbs that gripped Holland in 1637. After yelling and screaming and buying and selling in a frenzy for about forty-five minutes (the teachers played the part of “demand” and bought tulips of various colors according to demand graphs that roughly mimicked the real mania), the class was able to talk through the loop sets that represented ever-growing demand followed by a crash.

A different unit, in which students studied Westward Expansion in the United States during the nineteenth century, was built entirely around a wall-sized behavior-over-time graph which showed, on its Y-axis, the percentage of U.S. land controlled by Native Americans (admittedly, a poor translation of history, since different tribes had very different beliefs about whether land could be “controlled” at all) and the percentage controlled by white settlers. Of course, the two numbers changed drastically over the hundred years in question—one line kept going down, and the other kept going up. Students then placed events along the timeline of the X-axis as they decided that those events had had some effect on who had controlled the land. While they spent a good deal more time researching the different events than doing any dynamic modeling (we had learned something from Earth Force), they were able to see how a series of relatively small—if routinely horrific—events led to an enormous change. Many teachers used behavior-over-time graphs in a variety of ways in their history classes.

And seventh and eighth-grade students studying physics spent a day working with a series of small models that demonstrated position, velocity, and acceleration\(^3\). Using these models—no larger than one or two stocks—they solved simple physics problems about when one car would pass another, when a rolling ball would reach the bottom of a ramp, or when a truck would reach a certain speed. In a fifth-sixth grade classroom, students used a flight simulator to better understand the novel *The Giver*.

With nearly every student enjoying some exposure to systems thinking and system dynamics, the school was able to find ten kids, representing all grade levels, to

\(^3\) Also available at the clexchange.org website, catalogued as CC1997-01LettlRollRampModel
send to the first annual DynamiQueST, held that year at Trinity College. That small
cross-section of students—certainly not all would have been able to manage
it—demonstrated expertise in constructing models or stock-and-flow diagrams, drawing
loop sets, and facilitating systems thinking-based games.

The kids involved were not those who always performed at the highest levels
back at school. Reflecting on this fact after the weekend had passed, and wondering
about what it was that led a student to show a talent for systems thinking and modeling,
the teachers began to wonder about why they had not achieved any of the goals the
school had set for itself. Think about that for a moment: the school had listed specific
goals regarding the mastery of different systems thinking and system dynamics tools for
the grant application, and after a year of good faith effort, wasn’t close to meeting any of
them. Certainly, they were moving towards many of them. But the levels they had set for
themselves—ninety percent of the student body being competent at looping, or finding
leverage, or drawing operational diagrams—seemed ridiculous when compared to where
the school actually was.

But where, exactly, were they? No one knew. Sure, teachers knew, watching one
fourteen year-old say to another at the Trinity College event, “There’s got to be a better
way to solve this…” that some of them had “arrived.” But they had spent hundreds of
hours over the past few years creating and modifying tools to assess, for example,
writing—something all of them were able to do competently. How exactly would they
create analogous tools for dynamic modeling?

On one occasion, teachers created a rubric to assess causal loop diagrams. Taking
the notes from different training sessions, they tried to determine what characteristics
made a loop correct. When two advanced students created a wild page full of circles and
arrows to explain the systems at work in the book Native Son, their teacher happily
handed them the rubric. “OK,” he said. “Nice start. Now, get revising.” They revised.
Weeks later, at DynamiQueST, a nationally recognized system dynamics expert
wondered aloud who in their right mind had asked those two girls to change their original
loop set. It was probably the best feedback the faculty ever received about an assessment
tool, but it pointed to a major gap in what they were trying to do.

Without the ability to accurately determine what success even looked like, they
were not going to be able to measure success, and, more importantly, they were not going
to be able to help students achieve it on any sort of regular basis. What they could have
measured, though, was teacher behavior. It would have been easy to see if each faculty
member had, say, used a working model in at least one lesson, or if everyone had
assigned students to create at least one loop set. But it never became an explicit goal.

In fact, the staff didn’t do any of the normal things they did with other sorts of
school work they assigned. They didn’t observe each other teaching systems concepts, or
create models that students could try to copy or emulate, or even talk about what would
have made one model better than another. They didn’t require a piece of systems thinking
or system dynamics work to go in the portfolios.

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4 See an article on this topic (“System Dynamics and Student Leadership,” Barcan) on the website, in the
Fall 2001 Newsletter (volume 10, Number 4).
How did they miss these things? For one, they tended to see systems thinking and system dynamics as something separate from the rest of the curriculum. While students received careful feedback on, and moved towards mastery of, basic physics, the history of Mohenjo-Daro, or the symbolism in *Native Son*, they hadn’t made much progress at systems-related skills. When teachers encountered situations in which students understood a concept—say, how bills become laws—but not the systems tools—say, causal loop diagrams—that they had used to understand the concept, they moved on.

But systems education was in the school’s charter, right? The school was bound by law to teach it. The state would be checking for it. All true, but there wasn’t anyone at the state’s charter school office—staffed by three people, who had the responsibility to monitor roughly twenty-five schools—who really knew what they ought to look for to know they were seeing “systems thinking and system dynamics” in a school.

And with no one looking carefully over their shoulder as they attempted to move from a situation—the first few years—in which every failure was chalked up to the novelty of the entire enterprise, and every success celebrated as one might the discovery of a new element, to one in which they would be measured against their own past performance, the teachers balked. “Honestly,” says Leah Zuckerman, “we never really brought any pieces of student work [in the area of systems thinking/system dynamics] to meetings. Since this was the area where we were weakest, it would have made sense to help each other more.”

What that seems to tell us, then, is that despite their lofty student goals, the staff had created a system that would spread systems education, even integrate it, but would not ensure its quality. The goals, in fact, were the only things that spoke to the actual quality of the outcomes. The other parts—my focus on locating and disseminating materials, the exclusion of systems education from the normal support and feedback channels the staff had already built for the rest of the teaching—all made for a place where everybody would get systems, but no one could vouch for exactly how well they would get it.

Maybe such quality can come only from more experienced school mentors training new ones about how to lead others to learn about systems thinking and system dynamics, and maybe organizations such as the Waters Foundation or schools that have already learned to teach systems well can lead the way here. Either way, learning to measure how well we are teaching, and how well students are doing what we ask is as important when we teach systems thinking and system dynamics as when we teach anything else, and maybe more so.

Dan Barcan <djb221@yahoo.com>