The CREATIVE LEARNING Exchange
VOLUME 23 • NUMBER 3 • FALL 2014

Innovation Academy Charter School Reaffirms a Systems Approach to Education

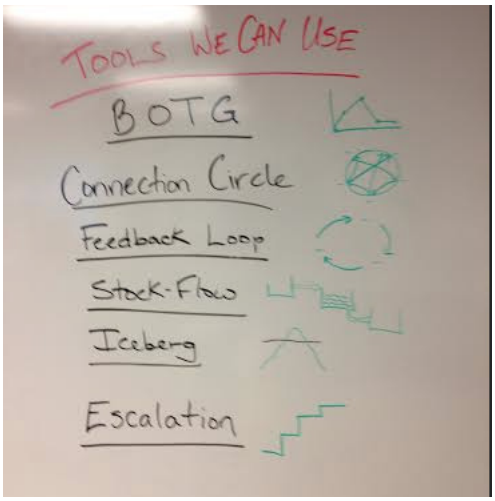
Megan Lovely

It is 7:55 a.m., and Greg Orpen takes his usual post outside the auditorium, greeting students and faculty and ushering students off to their first-period classes. Orpen, who has been part of the IACS faculty for fourteen years, has always been a positive, familiar face in the community. With his promotion to Head of School in November 2013, Orpen is able to shine in a new light. Throughout the Head of School search process, a repeated theme discussed by the Search Committee was the desire to return to the school's original charter, and within that, systems thinking and system dynamics.

When IACS was first proposed to the state of Massachusetts by the Chelmsford Alliance for Education—a coalition of educators and parents who were actively involved in the Chelmsford public school system and worked to promote excellence in Chelmsford schools—the school was located in Chelmsford on Hunt Road in a rented facility and called the Chelmsford Public Charter School (CPCS). The coalition founded the school to present a different approach to learning. The charter explains that CPCS was developed to promote experimentation and hands-on learning versus the traditional textbook curriculum. The charter reads, "The mission of the Chelmsford Charter School is to provide students with a challenging, interdisciplinary education that will prepare them for the 21st century through an emphasis on holistic learning, higher order and critical thinking skills, and practical application and integration of curriculum areas." (The mission statement is now revised to read "The mission of the Innovation Academy Charter School…")

Throughout the charter, various words that support this mission are repeated, including "change," "risk-taking," and "interrelatedness." All these words are connected to two grander and closely related topics called systems thinking and system dynamics.

Although system dynamics, founded by Jay Forrester in the mid-1950s, began in the corporate field, it has since expanded to apply to academics. A systems education combines both the philosophical ideas of systems thinking and the concrete models of system dynamics. As Greg Orpen observed, "Systems thinking is a broader umbrella that speaks about the philosophical outcomes. System dynamics is a more narrowly defined field of people who are building computer models and simulations." Specific to the K-12 world, Orpen defined systems thinking as "a methodology that gives students concrete tools to help them analyze texts, concepts, social systems, natural/environmental systems, political systems and economic systems." He said, "I think of it like a toolbox, a toolbox that helps kids engage in deeper learning."



Fifth grade students in Mairead Orpen's Critical Reading class refer to this list of systems tools.

THIS ISSUE AT A GLANCE

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EDITORIAL

Ah, fall in New England! The days are crisp and the nights cool; the leaves are starting to change color. Will it be a brilliant fall this year? Who knows? (Check the Farmer's Almanac!) What we do know is that there is lots of activity across the country utilizing systems thinking and system dynamics in schools. The recent ST/DM conference and Camp Snowball, as well as training workshops, have given educators a shot in the arm to utilize systems concepts and tools in the classroom and organization. We are struck with the attraction ST/SD concepts have for many educators, and the effort needed to get those concepts to our most important audience—our students. I encourage everyone who is engaged in this work to consider how to increase the reach of these critical thinking tools to the thinkers of the next generation. They are going to be the ones to solve the important global problems. They need to know about the interconnectedness of complex problems and the tools to understand that complexity.

We have added a new simulation and lesson to the CLE website this fall. It deals with one of the most basic of human issues: what happens when one group of people has control over another. Real-life examples abound, and the fiction based on this premise is widespread. Please tell us when you use the simulation to augment your curriculum. We appreciate all your feedback and would welcome the opportunity to discuss your needs for this kind of simulation.

Stay tuned for upcoming simulations: a multi-player game about the management of forests, and a social studies supplemental curriculum incorporating the study of population demographics.

Happy school year to all!

Take care,
Lees
(stuntzln@clexchange.org)

UPDATES

2014 ST&DM Conference

The 11th biennial Systems Thinking and Dynamics Modeling Conference was held near Boston, Massachusetts, at the end of June. We had a good turnout, with active involvement. This year we offered an innovative introductory session on Friday, preceding the conference and continuing into Saturday. Anne LaVigne and Alan Ticotsky did an excellent job of bringing the group up to speed so that they could appreciate and participate in the rest of the conference more fully.

For those of you who missed the conference, the handouts and descriptions are up on the website. (http://www.clexchange.org/news/conference/2014conference.asp) Take the time to peruse the presentations and the topics. There's a lot of good stuff on that webpage!

Coming this Spring... DynamiQueST returns!

Educators in the Boston, Massachusetts area have been getting together for a couple of years to share stories and best practices, and hone their skills as teachers and advocates for the critical thinking and learner-centered learning that comes out of the use of ST/SD in the classroom/organization. In the initial gathering this fall, the idea of a project fair centered on coaching student work that showcases the use of ST/SD tools and concepts reemerged.

The Northeast Project Fair, DynamiQueST, ran successfully for eight years (2000-2007). The model was one where students, experienced teachers, and professional system dynamicists spent a day coaching student work and learning together.

The Boston Area Gathering has decided to host DynamiQueST again this school year. We invite schools, teachers, administrators and anyone from other parts of the country (or world!) who wish to join us. Stay tuned for the date and place! We are excited about this venture and feel it is a leverage point in raising the visibility of systems-based education in the Northeast.

IACS Returns to a Systems Approach to Education

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In describing systems thinking and system dynamics, the charter makes numerous references to the articulations of Forrester and Peter Senge, another leader in the systems field. Forrester described the five main goals of a systems education in his essay, *Learning Through System Dynamics in Preparation for the 21st Century*. He believes a systems education should do the following: clarify the thinking process, improve communication, build confidence, develop unique philosophies, and unify knowledge.

Clarify the Thinking Process

According to Forrester, a systems education should first and foremost ***clarify the thinking process***. It is easy to make subtle and contradictory statements that beat around the bush and ignore gaps in logic when ideas are kept solely in the head. Systems thinking does not allow this. A common application of system dynamics is computer programming, where an equation or series of equations describing the system is plugged into a computer programming system. The equations take into account the variables that can impact a system. For example, if you wanted to figure out why a pond was polluted, you could not just say, "Well, that depends on the situation." You would have to tell the system who was involved in the situation, what the possible responses were, and identify the different branches leading off of those different responses. You would have to consider variables like the location of the pond, public access to the pond, and how the town disposes of its sewage.

Improve Communication

Closely connected with the thinking process is the goal of ***improving communication***. A system dynamics model requires explicit directions. When creating a model, it is necessary to describe the system as one would to an alien. Forrester writes, "The ordinary spoken and written language allows a person to hide behind ambiguous, incomplete, and even illogical statements. Language, within itself, does not impose a discipline for clarity and consistency. By contrast, computer modeling requires clear, rigorous statements." If ideas are not laid out in the preliminary steps of the thinking process, it makes the process less consistent and more frustrating later on. Forrester compared this concept to making a detailed outline instead of immediately beginning to write. He wrote, "Your final product is often much cleaner and more efficient. You don't have as many tangents. You get to your point clearer. You and your reader know what you are trying to say."

Build Confidence

A third goal of a systems education is to help students ***build the confidence*** they need to share unconventional ideas. This is the "risk-taking" concept that appears so frequently in the IACS charter. A systems education should breed what Everett Hagan, author of the book *On the Theory of Social Change*, distinguishes as an innovative personality versus an authoritarian personality. The authoritarian does not expect reasons behind things, nor does he seek them out. The innovator always believes things happen for a reason, and he seeks out that reason. Students should be more like the child and keep asking questions. They should never settle for a simple explanation, and should not be afraid to take leaps with their hypotheses.

Develop Unique Philosophies

Similarly, a systems education encourages students to ***develop their own philosophies***. Students should form opinions and fight for them. They should not just spit back information. Systems thinking allows students to process all the variables and find connections between them. They may find connections between two themes that no one else has thought about before. System dynamics allows students to support those connections through visuals, thus allowing them to provide a compelling argument.

Unify Knowledge

Lastly, a systems education should ***unify knowledge***. This relates back to the IACS charter's frequent use of the words "interrelatedness" and "interdisciplinary." Debra Lyneis described the compartmentalization of education curriculums in her essay, *Systems Thinking in 25 Words or Less*. This idea stems from the early days of modern science and the concept of reductionism: the idea that something is better understood if the components are learned separately. Specialization and compartmentalization rarely happen in the real world, yet our elementary, middle, and high school curricula leave it up to the students to figure this out for themselves. This is the importance of a systems education. A systems education is similar to the concept of a liberal arts education, in that it connects the subjects. We can only understand the whole picture after we have examined the smaller parts.

So, what is the "model" for actually implementing systems thinking and system dynamics into a school system?

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Alan Ticotsky has been the Systems Thinking Coordinator of IACS since the fall of 2011, and is an active member in the field of systems thinking. During his time at IACS, Ticotsky has had the opportunity to work closely with the faculty to help them incorporate systems into their curriculum. "There's a wonderful synergy between the other parts of IACS, between the outcomes and project-based learning that goes on here. They both are important parts of systems thinking and experiential learning, which are the center of the IACS curriculum," said Ticotsky.

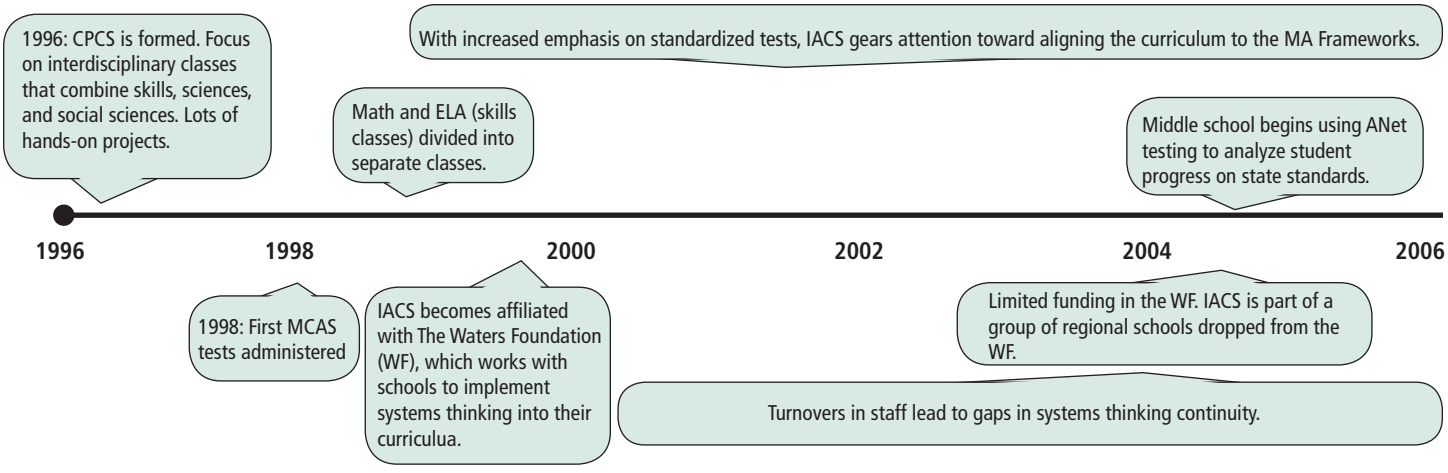
Orpen links the four outcomes of IACS—effective communication, problem solving, self-direction, and community membership—to systems thinking. "All systems thinking tools are communication tools. They can also be helpful problem-solving tools. Usually systems diagrams and computer models are designed to help you understand how things are connected. They help you understand the problem. Self-direction: usually when you're having to use these tools, you're required to think more independently or collaboratively with your peers. It's usually not an, 'Okay, everyone should do this' or 'Everyone should have the same answer.' I think it promotes the need to pummel through things."

Greg's elaboration on community membership captures the heart of systems thinking. He said, "In terms of community membership, one of the outcomes that I've come to appreciate around systems thinking is that when you realize you are part of a system, you start to understand 'Actions I take affect other people, and how they affect other people is going to come back and affect me.' That can apply to bickering with a sibling. It can apply to how we dispose of hazardous waste. I think this idea that actions rarely ever occur in isolation is actually an important idea that can help promote community membership. When you realize we're all connected, it doesn't make sense to go do something that's violent or reckless."

The faculty at IACS works hard to implement the four outcomes and systems into their classes. Charlene LaRoche has been a part of the school since it first opened in 1996. She was a parent volunteer, a long-term substitute, a para-professional, a math and science teacher, and is currently Middle School Assistant Principal. In the early years of IACS, there were many interdisciplinary classes that combined skills, sciences, and social sciences. The idea was that through one project, students could learn their math, science, and social studies concepts, as well as acquire the skills they needed. LaRoche explained, "The charter itself was about doing hands-on projects. The feeling was that students could learn and see those interconnections between disciplines. So your writing skills shouldn't only be thought of as a language arts skill. The initial feeling in the early days was, through these projects, [the skills] are more engaging for students, and you could kind of slip in those other disciplines."

Middle School Inclusion Aide Peggy Stephens-North is another staff member with a long history at the school. Her eldest daughters, Caitlin and Erin, attended CPCS as eighth graders for the 1999-2000 school year. Her daughter Zoe entered the school as a sixth grader in 2003. "It was a very different atmosphere," said Stephens-North about her first years at the school. "One of the staff member's dogs used to walk around. Everybody went by first names." Students of Stephens-North still call her by her first name.

Timeline of Systems Thinking at IACS



"When I first started volunteering here and working in classrooms, several teachers, including Greg Orpen, used systems thinking a lot. When Caitlin and Erin came here in 2000, they were using systems thinking all the time. They were using stocks and flows before I even knew what they were," she said.

Orpen said that when the school was first founded, "the school was in an easier position to say, 'We're just going to do systems thinking as much as we can.'"

As the emphasis on standardized testing increased, the flexibility to use systems thinking decreased.

"MCAS is a big part of it, because that's one of the ways the school is assessed, as well as individual students. That means the Department of Education is determining our curriculum and standards, and we have to follow that. That puts teachers under a different kind of pressure," said Stephens-North.

"Landscapes have changed, we've grown as a school, and there are more obligations and criteria that we need to follow," said Orpen.

Ticotsky explained that, unfortunately, systems thinking provides a lot of "anecdotal data," but not enough "hard data." "In the last 20 years, there has been a very big return to a reliance on testing. If it's not a return, the metrics are getting more precise. We can't really prove that teaching students systems thinking will help with test scores," said Ticotsky.

Experimentally, though, he said, "We've proved that it helps with problem-solving."

An increase in the number of students and staff in recent years, as well as larger facilities, also contributed to the strain on systems thinking.

LaRoche said, that in the early years, teachers used to attend multiple day-long systems thinking conferences in Burlington, Vermont. Even students attended conferences. Caitlin Daphtary, who attended the school as an eighth grader for the 1999-2000 school year, referenced a youth conference on systems thinking as one of her most memorable systems experiences at IACS. "At the time, my skill set was certainly not as developed as those of other students who had more intensive systems thinking programs. Therefore, I appreciated the projects I saw for their complexity, but could not tell you the nuances of what they entailed. I was impressed, inspired, and desired to know more about systems thinking," she said.

LaRoche commented, "I think that as we had some changes and turnovers in staff, there were people leaving who had experience with systems thinking. It became hard at times to maintain a certain comfort level amongst the staff for using systems principles because those trainings did not continue. I think it is something that having a staff continually revisit and have additional training on is helpful."

There are many teachers at IACS who have been successful incorporating systems into their curricula. One such teacher is Christopher DiCarlo, who teaches an eleventh and twelfth grade science elective called Environmental Systems. Students study three systems over the course of the semester: land, sea and air. They use connection circles, feedback loops, STELLA Modeling & Simulation Software and behavior-over-time graphs (BOTGs) to examine the impact of human activities on those systems. The goal is to teach students how to identify and manipulate the leverage points—the factors in a system that have an influence on the rest of the system—within a system. (See *Systems Tools in High School: Interdisciplinary Learning in a Science Classroom at* clexchange.org.)

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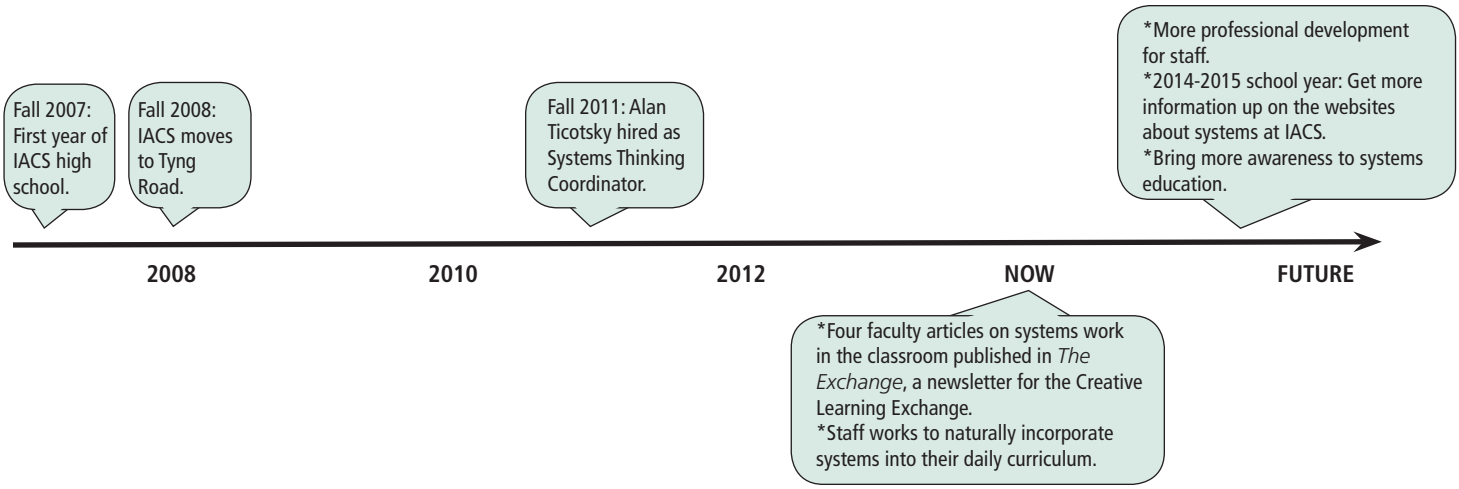

IACS Returns to a Systems Approach to Education

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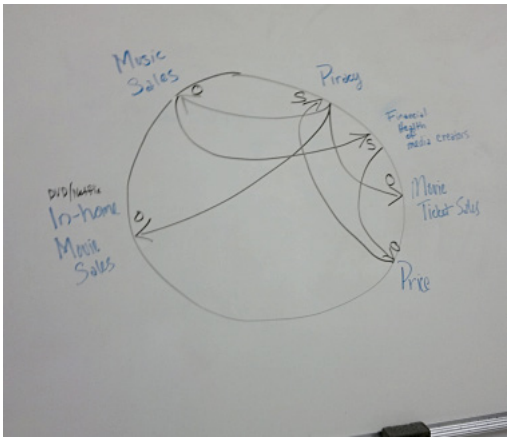
DiCarlo used a class project about carbon dioxide in the atmosphere as an example. "When humans burn fossil fuels, carbon dioxide is released in the atmosphere. Not only is that a problem in and of itself, but it causes problems all around in different systems. We have issues with that carbon going into the ocean, which causes the pH to change in the seas. That carbon causes changes in the biosphere. If there's more pollution, that can affect life on land. It's looking for one particular source that tends to drive the rest of the problem."

Other classes at IACS incorporate systems in a more subtle way. Andrew Frankhouse, Music Department Head, has introduced systems thinking in his music classes in ways that Ticotsky says he has never seen before. Ticotsky published an essay with Frankhouse in 2012 about Frankhouse's work in the classroom. The essay describes a tool Frankhouse developed called Sound Energy Analysis (S.E.A.), which helps students objectively analyze a song. He asks students to listen to different songs and score them based on their energy level in categories such as "Loud/Soft" and "Bright/Dark." Students then graph their ratings to compare the energy levels of different songs. (See *Using Systems Tools In Music Class* at clexchange.org.)

Frankhouse explained that systems helps his students objectively approach music from various time periods. He said, "When students come into [music] class, being that many of [the classes] are not elective classes, I don't want to put students with little musical experience or no musical experience in a position where they're at a disadvantage to students with a lot of musical experience. [I want to make] music which is inherently abstract and inherently difficult to talk about, [able to be written about] in a way that is articulate and objective. By approaching something in that way, I think you can kind of overcome the sort of natural resistance from students to classical music."

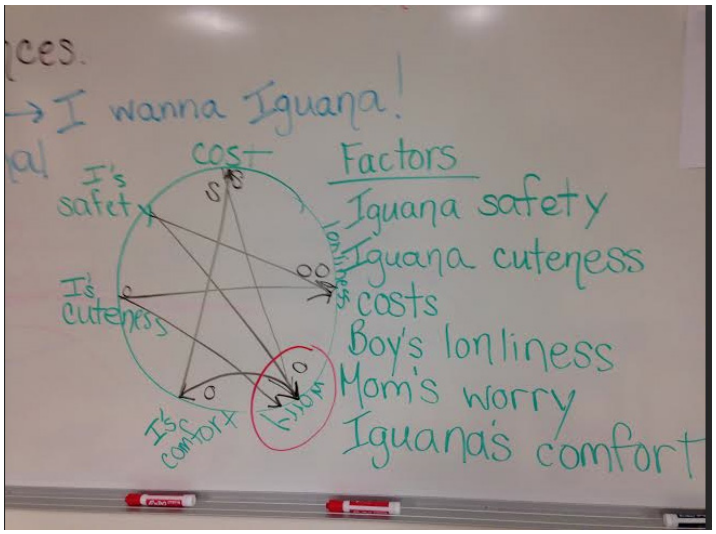


Andrew Frankhouse draws a piracy feedback loop on the board in one of his music classes.

Students at IACS are using systems as early as fifth grade. When asked whether he had heard of systems thinking or system dynamics, seventh grader Spenser Worthington-Berry enthusiastically said, "We just did that in social studies!" Seventh and eighth grade history teachers Jason O'Neil-Willoughby and Martha McClure use systems tools to help students examine how events in history relate to each other. Worthington-Berry explained that they talk about systems thinking in terms of collective learning. "You're passing [knowledge] down from generation to generation. So basically it's passing things down from generation, learning new things, and it's all basically a big cycle. I would say it kind of [explains] how human history's course went. If we hadn't learned about [one thing], we wouldn't have learned about agriculture, tools, etc," he said.

"[Systems thinking] is very visual. For some students who writing is a challenge for, or reading, this is a way to present their ideas in ways that are better suited for them," said O'Neil-Willoughby.

Mairead Orpen is a systems leader in the middle school with her Critical Thinking and Reading class. She explained the importance of introducing students to systems at an early age. "I think these tools offer the ability to explore what different changes are, and express what they are, and I'm guessing part of the reason this was included in our charter was to create thinkers in the world, people who weren't just going to read a book and regurgitate what was going on. It's just a fun way for kids to express themselves. So why start in fifth grade? This is who we are. If kids are comfortable using these tools now, they're going to be able to go so much deeper as they get older and older. I think it



Fifth grade students make a connection circle to connect various factors in a story.

makes their ability to make these interdisciplinary connections so much stronger if they're exposed to it early on," she said.

In looking toward the future of IACS, Ticotsky said, "I would like to flesh out and help the faculty publish some of the wonderful work they're doing. I think some of the people here don't realize the unique work they do. This year, we're going to have a series of three professional development meetings after school. My goal there is to create an internal network of teachers who are more 'seasoned practitioners' so that other teachers know they can go to them."

He continued, "One thing that we don't have now that I would love to implement is sort of a pipeline for students—a set of competencies that we know students will have."

"I think a first step related to systems thinking is to try to invite more students and families to go back and read the charter and get a better sense for who we were intended to be as a school," Orpen said. He also talked about more professional development for the staff, and about spending time before the beginning of the 2014-2015 school year getting more information up on the website, with simpler explanations of how and why systems are used at IACS.

"I see it as a multi-facet educational push to help bring awareness [to systems education]," he said.

LaRoche said, "It is important to get the staff used to saying, 'Let me try some of the [systems] tools.' I think that's where we're at now. Let's try some tools in the classroom, and not be too concerned about, 'Am I doing it right?'"

Mairead Orpen had a similar view. "It seems like there [used to be] a goal that teachers would try to use a tool a year, and then you did your job. But that's not what it is. It's a way of thinking. You're not just supposed to cross it off. The goal is that it is just naturally part of the way we think and how we express ourselves. That seems newer—that we're getting to that point now as a school. I think it's a compliment to the school that we're able to get there now, because it means that other systems are in check."

✦

An Old Idea Comes Back to Life as a New Resource/Simulation

Behind Closed Gates: Potential dynamics when one individual or group is given complete authority over another

Article written by Anne LaVigne

Approximately twenty years ago, a few middle school teachers[1] saw a connection between a model that Barry Richmond[2] had created to represent the dynamics of Phillip Zimbardo's Stanford Prison Experiment[3] and a book they were studying with their classes, *Animal Farm*. The relationships of power found within a prison structure seemed very similar to those that played out within the book.

The teachers ran with that idea and created a simulation interface for an adaptation of Barry's model that connected relationships among the characters to relationships between prisoners and guards. For a number of years, these middle school students read the book and used the simulation to explore those relationships and connect them to similar, real-world situations. The teachers have since retired and the students are now all grown. The simulation went out of use and sat dormant for many years.

In 2009, James K. Doyle, Khalid Saeed, and Jeanine Skorinko presented a plenary session at the International Conference of the System Dynamics Society to explore the implications of Barry's model[4]. Attending this session at the conference provided inspiration for finding some way to bring Barry's important work back into the hands of middle and high school students.

With consent from Catalina Foothills School District, isee systems, inc., and the Waters Foundation, and support from the Gordon Brown Fund, a new development project[5] began. The main development goals were to:

- use Barry's original model and adapt it such that students could explore a range of decisions using slidebars. The main structure is extended and includes Barry's original stocks of Prisoner resistance, Prisoner fear, and Guard repression, as well as Guard distrust and Prisoner solidarity. A slider for each variable allows students to adjust a tendency or willingness factor, *e.g.*, Prisoners' tendency to fear, Guards' willingness to repress.
- broaden the context of the simulation beyond one book. The new interface connects prison dynamics to a variety of contexts including literature (e.g., *Animal Farm, Hunger Games, Lord of the Flies*), to history, (e.g., The Holocaust), and to current or historical revolutions.

Behind Closed Gates *continued on page 8*

Behind Closed Gates: A New Resource/Sim

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After adapting the model, building a new interface, testing within classrooms in both middle and high school, and developing a teacher guide with optional handouts, this new resource is now available for widespread use. You can access the simulation and download the free guide from the CLE website.

http://www.clexchange.org/curriculum/simulations/prison_simulation.asp

Feedback is always appreciated. Please let us know how you've used the simulation and materials, and what challenges you discovered along the way.

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[1]Orange Grove Middle School Literature teachers

[2]Developer of STELLA® software

[3]For additional information, see http://www.zimbardo.com/resources/stanford-prison-experiment

[4]James K. Doyle, Khalid Saeed, Jeanine Skorinko. "Personal versus Situational Dynamics: Implications of Barry Richmond's Models of Classic Experiments in Social Psychology," Department of Social Science and Policy Studies, Worcester Polytechnic Institute.

[5]Project team consisted of Jen Andersen, Anne LaVigne, and Lees Stuntz, with input from Jeff Potash and middle/high school teachers who tested the new simulation, and editing by Marcy Kenah and Bunny Lawton.

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