

US-China Project Focuses International Student Teams on Real World Problems

They speak different languages and live 7,102 miles apart in time zones that differ by 12 hours. Yet students at the Vermont Commons School in Burlington, Vermont and their peers in Nanjing, China make it look easy to collaborate on complex models of real world issues.

“People under 20 years old have a lot more in common than those of us who are over 20,” reasons Rob Skiff, Co-Founder of the Vermont Commons School. “They play similar on-line games and use similar technology. There’s a new kind of globalized network that makes it easy for kids to connect if their teachers can work in that world.”

Teachers at Vermont Commons and their counterparts at Nanjing Education Technology Center do function in that world. In 2003, Rob Skiff met Chen Yi Bai, the Center’s Vice Director, at the International System Dynamics Conference in New York. Both educators were already using Systems Thinking and STELLA, Systems Thinking software from isee systems, in very different educational settings. Students in Nanjing were modeling chemical properties and reactions while their peers in Vermont were applying Systems Thinking to biological processes and social science topics like population growth, natural resource conservation, and economic change.

Their shared belief that Systems Thinking provides a critical teaching environment and conceptual toolkit has enabled Vermont Commons and Nanjing Education Technology Center to form an ambitious partnership. Through the US-China Systems Science Learning Project, students in Nanjing and Vermont team-up to create, design, and test solutions to real-world problems. Students meet weekly via video-conference and more regularly using email and Skype. Their Systems Thinking work, which includes models and simulations, is powered by STELLA.

Starting with Systems Thinking

The Vermont Commons School was founded in 1997. It’s a small school with a big mission. The Founders’ message on the school’s website reads, “As we stand on the brink of a new century, we find ourselves immersed in a time of rapid change and growing complexity. While planning our future, we must reexamine our relationships — between the individual and local community, local community and global community, and humans and the natural environment. Most importantly, we must prepare our children to understand and shape their roles within these relationships.”

At Vermont Commons, examining relationships and dealing with complexity is accomplished through Systems Thinking. Skiff explains, “The whole school revolves around Systems Thinking and problem solving.” System Dynamics and Systems Thinking have been

in place at Vermont Commons for the last ten years making it the only school in the country that is both on the cutting edge and very experienced in immersing young students in complex problem solving.

Of course the real education is in the journey; getting from a defined problem to a tested solution. Along the way, students are encouraged to think “outside the box,” to take risks with their ideas, to build on one another’s thoughts, to question and be prepared to change direction. Getting students through that complicated process requires the careful guidance of experienced instructors, a shared methodology (Systems Thinking), and the right toolkit for documenting, modeling, testing, and sharing (STELLA).

Peter Goff, a biology teacher at Vermont Commons and Chair of the Science Department, starts his seventh graders off with eco-machine creation. “We go out into local streams and ponds and grab real mucky stuff and dump it into a physical cell. Kids quickly see their eco-machine as a self-organizing system in which organisms move to where they can thrive. We connect the first cell to others and see how water flows in the system. There’s a nice, intuitive connection between these real models and mental models. Kids get the idea of stocks and flows. At that point, we can start introducing Systems Thinking concepts and talk about the relationship of models to the real world.” STELLA enters the classroom at that point. Students use STELLA to build models based on their eco-machines and begin to run experiments back and forth in order to note differences between physical models, software-based Systems Thinking models, and the real world.

Success in the Vermont Commons classrooms using STELLA requires that teachers have both a deep understanding of their discipline and an ability to facilitate Systems Thinking principles. Goff’s professional experience simulating complex biological and financial systems energizes his students and challenges them to create even more sophisticated work because they understand that modeling has ‘real world’ value.

Systems Thinking also provides a foundation for Skiff’s social sciences classes. Students create simple STELLA models to project population growth or decline for selected countries. In the process they learn how population affects social policy and prospects for economic development. By sharing their models and findings, students brush up on their presentation skills and practice math concepts used in Systems Thinking including linear and non-linear equations, differential equations, and basic calculus.

Vermont Commons also requires students to take Research and Service, a course that focuses students on studying and solving real community problems. The multi-age course (students in grades 7 through 12 work together in problem teams) asks students to choose a problem that has defined stakeholders (real people have to really care about the work) and boundaries.

Providing constant and consistent interdisciplinary practice in Systems Thinking and model creation was ensuring that students left Vermont Commons as confident, creative problem solvers. But for Skiff, Goff, and others at Vermont Commons, something was still missing.

Adding the International Component

Vermont Commons is serious about its responsibility to prepare students for leadership positions in the world. Citing worldwide problems like global warming and disease, Skiff emphasizes the probability that his students will be called upon to collaborate with peers in other countries. “We need to create a cadre of people who can apply Systems Thinking on a wider scale.”

Meanwhile, Nanjing educators, directed by the Jiangsu Province branch of the China Academy of Science and Technology Development, (JSCASTD) have also realized that a changing world calls for changes to educational approaches. In a speech given by Vice Director Chen Yi Bai at Middlebury College, he stated the importance of “encouraging students to find the problems by themselves, discuss them, do the experiments, find the way to solve them and find the results....This not only brings up good methods and attitudes, but the right way and attitude to their life, so that they have greater bravery and self-confidence to deal with the problems they will meet.” Nanjing asserts that students who can learn to use Systems Thinking and STELLA modeling to simulate and solve complex problems will have an advantage over others.

Their mutual commitment to Systems Thinking and experience using STELLA gave the schools the links they needed to create the US-China System Science Learning Project, directed by Piper Lounsbury Stover. “Stover’s business experience with multinational firms utilizing Systems Thinking and systems engineering talent, as well as her Chinese language skills and work experience in China are critical to helping Vermont Commons establish and grow a successful partnership with Nanjing,” Skiff adds.

The program enables students in grades 7-12 to work together to model, test ideas, and solve real global problems from a local community perspective. If that sounds challenging, it is. But with the support of faculty and targeted technologies, students found ways to achieve results from their locations on opposite sides of the globe. While videoconferencing, email and Skype kept communication between students and teachers flowing, actual problem solving was aided by STELLA.

Pictures are worth a thousand words, especially when you don’t share a language. STELLA gave the students the ability to visually model systems, share ideas, ask questions, and test theories. And because Systems Thinking and STELLA quickly demonstrate that logic, reasoning, math, literacy, and presentation skills are all needed to analyze problems and offer solutions, all students were able to tap into strengths and exercise weaknesses. STELLA became the universal language that permitted problem solving while highlighting cross-cultural perspectives.

This Year’s Experience

In September 2006, 12 students from Vermont Commons School and 14 students from Nanjing Education Technology Center were divided into four teams. Each team included both American and Chinese students and leadership roles were given to Vermont Commons and Nanjing seniors.

The first challenge was to agree upon the problem each group would tackle. “Students needed to be responsible for the ideas,” explains Stover. “Students in Vermont made five proposals and the Chinese group offered three.” In the end, four problems defined the work to be done.

- The Effect of Climate Change, Keystone Species, and Economics on Vermont’s Maple Sugar Production
- Urban Development in Williston, Vermont and its Impact on Local Vermont Indicator Species
- Chemical and Physical Systemics of Rocketry: Determining the Right Fuel and Number of Stages to Successfully Launch a Satellite into Orbit
- Improving Water Quality of a Campus Pond in Nanjing

Throughout the academic year, students met weekly via videoconference requiring the Vermont students to get to school by 7:00 am and their peers in Nanjing to stay at school until 8:00 pm. Students shared data gathering duties and split model building tasks and kept one another informed of progress, reported problems, and asked for help via email and Skype. Access to faculty, Chris Soderquist of Pontifex Consulting based in Hanover, New Hampshire, and advisors of JSCASTD ensured that student’s model creations and STELLA expertise kept pace with their ideas and experiments.

The year’s work culminated in a visit to Vermont by the Chinese students and their faculty advisors. From May 7 through May 11, 2007, workgroups met to finalize and present their models, first in a practice session held at Vermont Commons School, next at a public presentation held at Champlain College, and then again at DynamiQUEST held at Worcester Polytechnic Institute in Worcester, Massachusetts.

For the Chinese students, it was the first visit to the United States. For all of the students, it was a chance to finish their work, get to know one another, and celebrate their time together. And for the faculty, it was an opportunity to see just how far their students had come. Stover remembers, “At DynamiQUEST, Professor George Richardson (Professor of public administration, public policy, and information science, Nelson A. Rockefeller College of Public Affairs and Policy, State University of New York at Albany) noted an issue with a conveyor in one of the models. He explained it to the students and they got it immediately. They understood his point and were excited to make the change and see the results. He pointed out that he usually has that kind of interaction and response from graduate students.”

What Comes Next

Vermont Commons and Nanjing Education Technology Center have agreed to a three year partnership. Stover anticipates that two sections of the course will be needed to accommodate interested students during the 2007-2008 academic year and the two sides hope to grow the program to at least ten more schools with funding.

Meanwhile, math and physics teachers at Vermont Commons are coming up to speed on Systems Thinking and STELLA. More teachers in China are also getting involved in order to speed their student’s learning curve in using this project-based learning approach.

Nanjing aims to extend the STELLA training program to all schools in Nanjing and Jiangsu Province within two years, focusing on complex problems involving energy resources, climate change, and disease prevention.

With just one year of the China exchange under their belts, Skiff, Goff, and Stover are more committed than ever to education based on Systems Thinking. The group knows that they have set off on a unique course but believe it's one that should be adopted by public and private schools "We want to make a difference," says Goff. "Vermont Commons is happy to help any schools that are interested."

Skiff puts it more bluntly. "Systems Thinking gives kids such an advantage. When I think of how the world will change in the next 50 years, how people will work with peers around the world to solve complex problems — I don't know how you *can't* teach Systems Thinking and problem solving."

About Vermont Commons School (www.vermontcommons.org) — Founded in 1997, the Vermont Commons School is an independent college preparatory school for grades 7-12. The school's Research and Service program is a hallmark course known for encouraging students to apply scientific research methodologies to selected community issues or problems in an effort to create positive change. The Vermont Commons School is located in South Burlington, Vermont.

About Nanjing Educational Technology Center — The Nanjing Educational Technology Center is the information technology hub serving all high schools in the capital city of Jiangsu Province, China. The Center represents the efforts of the Jiangsu Government, Nanjing Education Bureau and the Jiangsu Branch of China Academy of Science & Technology Development (JSCASTD) in exploring the use of Systems Thinking and System Dynamics in education reform. The two Nanjing high schools currently involved in the US-China Systems Science Learning Project include the Affiliated High School to Nanjing Normal University and the Jinling High School.

About isee systems (www.iseesystems.com) — isee (formerly High Performance Systems) is the world leader and innovator in Systems Thinking software. Founded in 1985, isee released STELLA®, the first software application to bring Systems Thinking to the desktop. In addition to STELLA which is primarily used by educators, isee offers *iThink*® for business simulation. Thousands of individuals and organizations in over 80 countries use isee software to gain insight and shared understanding of environmental, financial, organizational, biological, chemical, mathematical, humanistic, and other systems.