Constructionism in the Oilfield

Michael Tempel, *michaelt@media.mit.edu*
Logo Foundation
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Abstract

Is it possible to create a constructionist educational program within a large multinational corporation? An example was Schlumberger Excellence in Educational Development (SEED), an international program that included science and technology workshops for students and teachers. The structure and educational approach of these workshops was based on a long tradition of constructionist educational programs, but there were unique aspects to SEED Educational Programs.

The SEED experience provides and "Object to Think With" for other corporations wishing to design an educational program built upon the expertise, organization, and culture of the company.

Keywords

science, technology, workshops, students, teachers, corporations, constructionism, international

Context

SEED was established in 1998 as an educational project within Schlumberger[1], a global oilfield services company. The guiding principle was to build educational programs, activities, and content on the expertise found within the company. Based on this idea, two programs emerged:

- The Connectivity Grant Program[2] provided financing for Internet connectivity and computers to schools in developing countries where Schlumberger was active. This leveraged the computer networking expertise within the company.
- A Science Education Web Site[3] contained content based on the expertise of the many scientists and engineers in the company. The Web site included informational articles and activities on topics related to the science and engineering of the industry, and an Ask the Experts feature[4] where scientists and engineers responded to questions submitted by visitors.

There was a small SEED Core Team, based in Schlumberger's New York City headquarters, which initially consisted of a manager for the Connectivity Grant Program, a web developer and an educator responsible for developing Web site content, and support personnel.

Responsibility for implementing the Connectivity Grant Program, and funding for it, rested with Schlumberger personnel in "The Field" – the locations around the world where gas and oil exploration and production were carried out. The level of support for the program varied greatly from one location to another, depending upon local management enthusiasm.

In 2003 we sought to increase the level of service to the schools in the Connectivity Grant Program by initiating SEED Educational Programs featuring constructionist, theme- and project-based workshops. Technology skills would be learned as needed in the context of projects that the participants would design and build.

Educational Roots

We had a number of good program models to build on: The St. Paul Logo Project[5], the Programa Informática Educativa in Costa Rica[6], and the Logo Summer Institutes[7]. But these projects tended to concentrate on introducing new technologies and then applying them to various content areas. The Workshop Center for Open Education at City College of New York[8] offered a model of a program that focused on content areas and pedagogical approach. It included intensive summer workshops and extensive school-year support.

For SEED we developed workshops around broad themes in science and brought in technologies that were needed to support learning and project development in those areas.

Inspired by Seymour Papert's vision of a learning society[9], we designed the workshops to be intergenerational learning communities with equal numbers of students and teachers. All participants were to be both teachers and learners. Most students were from secondary schools, but there were sometimes primary school students as well. We used the term Collaborative Workshops to emphasize collaboration among participants from several schools[10].

Workshop Design

The first theme was Water[11]. A second theme on Climate Change and Energy was introduced in 2006[12]. Project materials were developed and posted on the SEED Web site to be used in the workshops.

We provided tools and materials for creating virtual and physical models: MicroWorlds[13] and later Scratch[14], wood, plastic tubing and bottles, corrugated cardboard and plastic, and a variety of arts and crafts materials. GoGo Boards[15], along with sensors, motors, pumps and lights enabled the creation of active models. A water quality test kit was included when appropriate.

As participants imagined and designed their projects they often required materials that we had not anticipated. It was not uncommon to take some participants to a local hardware store or electronics street during the workshop to pick up additional materials.

This is an overview of a typical five-day Collaborative Workshop schedule:

<table>
<tr><th>Day 1</th><th>Day 2</th><th>Day 3</th><th>Day 4</th><th>Day 5</th></tr>
<tr><td>Introduce theme</td><td></td><td>Brainstorming</td><td rowspan="3">Project development</td><td rowspan="2">Project development</td></tr>
<tr><td colspan="2">Introduce tools and materials</td><td>Project Planning</td></tr>
<tr><td colspan="2">Gather information and expert input; field trip</td><td>Project development</td><td>Sharing</td></tr>
</table>

The workshop leader would introduce the theme and point to relevant documents that had been placed on the computers, and links to relevant Web sites. Frequently there was a talk by a local expert on a topic related to the theme. Whenever possible there was a field trip. For example, we visited water treatment plants in Mexico City, Cairo and Alexandria, and a water purification and bottling plant in Villahermosa, Mexico. We went to lakes, rivers, and the ocean for water quality testing. In Malaysia we went to a hydroelectric dam and had a tour of the control center that overlooked the turbine room, and visited a university center studying alternative energy sources. We introduced MicroWorlds, Scratch and, the GoGo Board, giving participants enough familiarity with these tools to begin working with them in the context of their projects.

The next stage of the workshop was to design and develop group projects. This process began

with brainstorming sessions. Each group of eight to ten people would come up with ideas for what they might do. These were written on large sheets of chart paper and shared with all participants.

Then the groups would narrow down ideas that emerged from the open-ended brainstorming sessions and focus on one or a few projects to develop. Plans were drawn and written on chart paper, shared with the larger group and then posted on the wall for ongoing reference during the development phase of the workshop that followed.

Groups generally divided up tasks according to individual interests and talents. Some built the models. Others programmed the GoGo Board, created a virtual model in MicroWorlds or Scratch, or wrote reports or made PowerPoint presentations. The final afternoon of a Collaborative Workshop was devoted to sharing. Each group reported on their work to the audience, which consisted of all the participants and frequently included visiting dignitaries and Schlumberger managers.

Project examples

Here are some of the projects that were built during Collaborative Workshops:[16]

- Water filtration systems, often based on what had been learned on a trip to a water treatment facility. These often involved passing water through successive layers of sand, cotton, charcoal and other materials[17]. One project, called Agua Viva[18], pumped muddy water into a holding tank where the sediment was allowed to settle. A turbidity sensor made with a light and light sensor was attached to a GoGo Board. When it sensed that the water had cleared, a pump was activated to send the clear water on its way.
- Automatic irrigation systems[19] used a GoGo Board with a moisture sensor buried in the ground to detect when water was needed and then turned a pump on. The pump would turn off when the ground became sufficiently damp.
- Energy-efficient buildings[20] combined traditional and modern means to regulate inside temperature and lighting. A clay tile roof in a wet, rainy climate reduces heat in a house through evaporative cooling. GoGo Boards were programmed to turn fans on and off depending on the values of temperature sensors. Light bulbs would turn off when a light sensor detected daytime and on at night. Solar cells produced electricity to charge batteries or capacitors.
- An energy playground[21] used the motion of a bicycle or merry-go-round to turn a generator and charge a capacitor. At night, as indicated by a light sensor, a GoGo Board controlled relay would switch the capacitor from the generator to a light bulb.
- Solar cookers were popular projects, especially in Malaysia, where a wide variety of designs were built and tested[22].

Growth

The first SEED Collaborative Workshop[23] was held in Villahermosa, Mexico in September 2003, attended by 70 students and teachers. The staff consisted of members of the SEED Core team along with graduate students and faculty from the Future of Learning group at the MIT Media Lab.

As Educational Programs continued in Mexico with two to five workshops each year, it expanded into other countries: Egypt and India in 2004, Malaysia, Russia and Venezuela in 2005, Saudi Arabia in 2006, and China and Brazil in 2007.

Over time the program became more efficient in several ways. As students, teachers and local Schlumberger employees became familiar with the content, tools, and methodology of the workshops, they were able to serve as facilitators. It was no longer necessary to have large numbers of facilitators from the SEED Core Team or the Media Lab at each workshop. We formalized the empowerment of local facilitators by establishing Facilitator Workshops. These were one or two days long, held immediately prior to a Collaborative Workshop, to prepare facilitators to be leaders in the Collaborative Workshops. Some students and teachers participated in workshops over a period of years and became effective workshop leaders. In some cases, notably in Russia, SEED schools hosted workshops attended by participants from other local schools.

The key people in the success of Educational Programs were the SEED Country Coordinators. In some cases this was a part-time position, often shared with a Personnel function, but was most effective when it was full time. Country Coordinators mentored each other. As the program expanded, a newly appointed Coordinator might attend a workshop in a country where the program was established so as to learn the ropes.

International mentorship extended to facilitators as well. When the first Collaborative Workshop was held in Venezuela in 2005, three teachers and a student from Mexico were part of the facilitator team[24].

Lessons Learned

There is anecdotal evidence that SEED Educational Programs had significant impact on participants: A teacher in Mexico initiated a robotics club following the first SEED workshop and has continued it to this day. Former SEED students who are now at university report that their experience in the workshops influenced their academic and career choices in the direction of science and engineering.

The experience with SEED shows that it is possible for a large multinational company to create and maintain an extensive program of constructionist educational activity. The logistics of supporting such a program can be built upon the structure of the company. Educational content can be based on its expertise. But it is also necessary to have professional educators in the program to structure and guide it so as to be educationally sound, and to make the most effective use of corporate expertise.

How can the SEED experience be generalized to other companies? Since each corporation is unique it should not be taken as a prescription, but rather as an “Object to Think With” that can guide the design of a comprehensive educational program. A company wishing to do so should consider these factors:

- What is the expertise of the company? What educational value can be derived from that expertise?
- How is the company structured? How can an educational program be coordinated with, and supported by that organization
- What factors in the company culture can support an educational program? How are education and training done internally? Are there any existing social or educational programs that can be built on? Are there informal grass-roots educational activities conducted by employees that can be consolidated and coordinated into a comprehensive program?

This approach is different from what most companies do as part of their corporate social responsibility programs. Rather than contribute to outside educational programs, SEED was an example of building such a program into the company itself. This is more challenging, but can also be very rewarding for employees and offer unique educational advantages for students and teachers.

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[1] www.slb.com
[2] The Connectivity Grant Program was renamed to be the School Network Program in 2006 See http://www.planetseed.com/location
[3] http://www.planetseed.com/science
[4] http://www.planetseed.com/faq_ask
[5] Kozberg, Geraldine and Tempel, Michael, "The St. Paul Logo Project: An American Experience" in *Logo Philosophy and Implementation*, 1999, LCSI, pp. 22-47, available for download at http://www.microworlds.com/company/philosophy.pdf
[6] Fonseca, Clotilde, "The Computer in Costa Rica: A New Door to Educational and Social Opportunities" in *Logo Philosophy and Implementation*, 1999, LCSI, pp. 2-21, available for download at http://www.microworlds.com/company/philosophy.pdf Also see the Omar Dengo Foundation Web site at http://www.fod.ac.cr/,
[7] Tempel, Michael, *Logo Summer Institutes*, 1993, Logo Foundation, http://el.media.mit.edu/logo-foundation/pubs/papers/institutes.html. Also see http://el.media.mit.edu/logo-foundation/workshops/summer.html
[8] An overview of the Workshop Center for Open Education is at http://www.eric.ed.gov/PDFS/ED120179.pdf. Additional descriptive information and a teacher case study is at http://www.eric.ed.gov/PDFS/ED088862.pdf
[9] Papert, Seymour, *Mindstorms*, 1980, Basic Books, chapter 8
[10] There were also School Workshops – those held in a single school. Some of these were comprehensive week-long events similar to the Collaborative Workshops, but most were a half day or less and focused on a narrow topic.
[11] The Water Project is described at http://www.planetseed.com/science/articles/water-project
[12] The Energy theme was launched in a Collaborative Workshop in Malaysia http://www.planetseed.com/node/22686
[13] www.lcsi.ca
[14] http://scratch.mit.edu
[15] www.gogoboard.org
[16] Reports and documents related to some of the projects were posted on the SEED Web site: http://www.planetseed.com/science/student-science-journal/health-safety. From 2003 to 2005 an online publication program called HDL, developed at the MIT Media Lab, was used to publish project results. The program is no longer active, but the archive of SEED projects is available at http://www.planetseed.com/files/uploadedfiles/voices/workshops/hdl/index.htm.
[17] See examples at http://www.planetseed.com/files/uploadedfiles/voices/workshops/hdl/alexandria/static/html/145.html and http://www.planetseed.com/files/uploadedfiles/voices/workshops/hdl/alexandria/static/html/131.html.
[18] http://www.planetseed.com/node/99116
[19] See http://www.planetseed.com/node/99118 and http://www.planetseed.com/files/uploadedfiles/Science/Student_Science_Journal/project_reports/tanchuk/index.htm for examples.
[20] See http://www.planetseed.com/node/20637 for a description of the Energy-Efficient Building project. Examples are at http://www.planetseed.com/files/uploadedfiles/SMK_Ismail2_SI2Heavan%282%29.pdf and http://www.planetseed.com/files/uploadedfiles/malaysia_smk_binjai%282%29.pdf
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[22] http://www.planetseed.com/node/20644
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[24] http://www.planetseed.com/node/22722