THE AGENTS OF CHANGE PROJECT: CHANGING PERCEPTIONS OF BUILDING PERFORMANCE

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ABSTRACT

This paper describes the Agents of Change Project, a 3-year effort to disseminate a unique and successful approach of embedding investigations of actual buildings within architectural curricula. The project builds upon the foundations of the Vital Signs Curriculum Project conducted from the University of California Berkeley (1992-1998). With funding from the U.S. Department of Education Fund for the Improvement of Post Secondary Education (FIPSE) and support from the Society of Building Science Educators, the project will transform learning by engaging students in hands-on exercises, expanding the architectural knowledge base, training successive waves of teaching assistant-faculty teams, and integrating environmental technology/design issues into architecture curricula nationwide. During the 3-year project, five regional workshops will train approximately 180 teaching assistants (TAs) and faculty and over 2,400 students from accredited architecture programs nationwide.

This paper describes activities and experiences related to the intensive 3-day workshop held January 2-4, 2003 in Portland, Oregon. This training session involved teams conducting case studies on the Water Pollution Control Laboratory building (which won 17 awards for excellence in architecture and energy-conscious design, see Figure 1). Teams proposed inquiry questions, framed hypotheses or hunches about the probable outcomes, formulated research methodologies for gathering data, used field protocols to physically collect data, analyzed results, and cogently reported findings.

1. INTRODUCTION

"In their nature - innovations cannot always be "right first time". However careful you are in planning and testing, there will always be surprises, as is well known in R&D with its all-pervasive "Murphy's Laws". That is why scientific method is based on hypothesis, followed by experimental testing. Except for the most repetitive projects, every new building is a hypothesis and its performance in practice is the experiment. But where are the designer/experimenters? In the distant past, when technology and user requirements changed slowly, one could perhaps rely on evolutionary feedback. More recently, one could perhaps rely on academic study and the test of time. But today, when things are changing so fast, there is no alternative to learning on the job."

-Bill Bordass (1)

Agents of Change provides a comprehensive strategy to continuously supply generations of experienced faculty and TAs, expand and improve the architectural education knowledge base through case studies, and cultivate a new generation of skilled architects versed in building performance evaluation. The primary goals of this self-sustaining model are to assist participants to:

- use state-of-the-art data acquisition systems and handheld equipment;
- conduct case-study investigations of buildings;
- practice acquired teaching skills through the teaching of peers;
- develop case-study exercises tailored for their home institution’s curriculum;
- train successive generations of TAs to use and teach the case-study approach.
Our previous experiences with a one-year FIPSE planning grant and with the Vital Signs Curriculum Project show that faculty and students are fascinated by the lessons they learn from buildings. Measurements made with relatively low-cost instrumentation, combined with first-hand explorations of a building, have extracted exciting stories about building performance and design intent/fulfillment. These experiences and stories tend to focus on the performance of comfort, solar, daylighting, alternative energy, energy efficiency, and green building systems.

1.1 Building on the Foundations of Prior Efforts

To better prepare future faculty and architects as stewards of the built environment, Agents of Change builds upon prior curricular reform efforts—the Vital Signs (VS) Curriculum Project; the Society of Building Science Educators (SBSE) international network of technology educators; Tool Days; FIPSE-sponsored Agents of Change regional workshops conducted in 2000–2001; and TA-training courses at the University of California Berkeley and the University of Oregon.

The Vital Signs Project. The Vital Signs Curriculum Project (1992–1999) began to fundamentally change the way environmental technology is taught in architecture schools and provides a modular, flexible means to improve the curriculum. With its focus on energy efficiency, occupant comfort, and building system performance, the Vital Signs Project provided a new paradigm for understanding the multiple experiential layers that make building design so intriguing and so complex. Many of the Vital Signs trainers and trainees are members of SBSE.

Vital Signs developed a variety of curriculum resource materials and events. Of particular importance to Agents of Change were four summer workshops (1995–1998) where 200 technology and design faculty were trained to use the VS equipment, materials, and case-study approach. Through an associated toolkit loan program, which is still active, eight $25,000 toolkits are provided each year to schools that are without ready resources to acquire building measurement equipment to generate case studies. As of October 2000, 72 of the 119 (85%) schools of architecture in the U.S. and Canada had participated in the Vital Signs programs (2).

Students using the case-study approach seem to make more meaningful and intuitive connections between theory and design, between initial intent and final outcome. SBSE Past-President Walter Grondzik wrote, “… the Vital Signs project provides an excellent vehicle for expanding student views of the built environment. In addition, it provides a structure that can enhance student communication and team planning capabilities. As establishing a methodology for a site investigation is essentially a design problem, it could also be argued that the Vital Signs project can broaden students’ design thinking.” (2)

The Society of Building Science Educators (SBSE). SBSE members have developed a vast network of architectural technology teachers who not only willingly and graciously share their ideas, teaching materials, and experiences, but also serve as mentors to each other. This unique group has identified the need for a revised pedagogic approach during their annual summer retreats (which began in 1985). Discussions repeatedly return to the lack of building case studies, curricular changes, design studios that bridge the technology gap, and strategies to implement active learning approaches. SBSE provides a supportive arena for TAs (future faculty) to learn about successful teaching and to discuss a wide range of issues confronting architectural technology educators.

FIPSE Planning Grant-Sponsored Regional Training. Two training sessions (in Berkeley, CA, and Milwaukee, WI) tested the mechanism of TAs teaching TAs and the viability of using regional training sites as a means to reduce participation costs while reaching as many architecture schools as possible. These experiences were evaluated and designed into the current Agents of Change model.

One of the goals of the planning grant was to evaluate the Vital Signs (VS) Project and its influence on teaching and learning. Through web surveys conducted by external evaluators during the one-year grant period, 120 VS-trained faculty and 257 students in Environmental Control System (ECS) courses were asked to respond to questions about their attitudes and perceptions. The response rates from those two groups were 56% and 45%, respectively. The following is a brief summary of some of the responses as compiled by the evaluators.

Over 80% of the respondents (both faculty and students) agreed that post-occupancy evaluation (POE) is essential for effective architectural practice and design and that architects have a responsibility to ensure occupant health and well-being. Over 70% of the faculty reported they made changes in the way they taught and agreed that their teaching improved—all as a result of Vital Signs training. 67% relied on VS as an important source of ideas for teaching. Faculty “incorporate[d] case study analysis as an essential learning exercise … and became more confident in [their] teaching as a result of [their] VS training … placed more emphasis on the case study method and field work in both studio and tech courses ….” (3)

Over 75% of the faculty respondents agreed that student learning had increased, that case studies increased students’ understanding and retention of architectural concepts and improved the scope and depth of their students’ design
work, and that the VS approach affected students in a positive manner. Critical thinking improved, students had a more ‘real-world’ sense of design and technology, were engaged more deeply by sophisticated architectural design issues, and experienced more effective and more active problem solving. There was even evidence that student learning infiltrated design studies: “Studio professors tell me students are more interested and knowledgeable about building systems and energy use and incorporate strategies without prompting from the studio professor.” (4)

Student respondents corroborated faculty impressions of increased learning. Students agreed they had a better understanding of how buildings worked as a result of their ECS course (82%); used the knowledge gained from VS case studies in their design studio projects (72%); developed a deeper understanding of key architectural technology concepts due to the tools, technologies, and techniques introduced in ECS (79%) and because of the case study exercise (60%); and had a greater appreciation for the links among occupant well-being, the environment, and architecture (79%). In assessing their gains in learning before and after taking ECS, students said their abilities to use tools to evaluate buildings increased in developing methodologies for investigating building performance and in evaluating the outcomes of building design.

Student respondents (92%) said they intended to use course concepts and tools to design more sustainable buildings and to improve buildings through post-occupancy evaluation. Typical comments included:
- “learning to use the tools for assessing a building’s performance was critical.”
- “I am now more able to understand and foresee design problems and [have] the knowledge to fix them.”
- “… there is more to architecture than two-by-fours and I-beams. There is a human element, too.”
- “Sustainability and environmental factors are now driving forces in my designs.”

Teaching Assistant Training. With the exception of the University of Oregon (UO) and the University of California Berkeley (UCB), most institutions provide no training in pedagogy for TAs. Graduate Teaching Fellows (GTFs) for the required environmental technology courses at the UO receive specific training through case study courses and a 1-credit, 10-week course taught by the instructor prior to their tenure as GTFs. Undergraduate assistants who volunteer to assist GTFs with section activities have completed case studies and performed well in the course. At UCB prospective Graduate Student Instructors (GSIs) take a 1-credit course to ensure their readiness to teach the environmental technology course the following semester. They prepare materials, give presentations on concepts and principles, and receive peer and instructor critiques on their teaching performance.

Teaching Assistants as Peer Teachers. TAs have unique roles as both teacher and student. Given that capacity, they are powerful instruments to transfer information to student peers. They have previously taken a course, know the experience others are going through, have one-to-one contact with students in lab sections, often are more accessible than professors, and influence student learning through their enthusiasm.

2. TRAINING SESSION MODEL

Agents of Change trainee teams will conduct case studies during several training sessions scheduled for the next two years. The format and structure of these sessions is as follows.

2.1 Format and Activities

The framework for the training sessions provides concrete experiences for participants to learn how to teach by being taught, beginning with the basics of data acquisition and gaining hands-on experience measuring buildings and their environments. Led by TA and faculty trainers (graduate teaching fellows and faculty with Vital Signs experience), each day of a training session will incorporate peer-to-peer teaching combined with critique and evaluation. These activities are outlined in the sample program schedule shown in Figure 2.

Days 1, 2: Investigating and Measuring. The Principal Investigator (PI) welcomes participants and introduces the training session objectives and schedule. TA and faculty trainers introduce themselves and describe their Agents of Change and Vital Signs experience. Trainees introduce themselves, and discuss their reasons for participation and what they hope to learn.

Participants will learn first-hand about the case-study process by conducting a mini field investigation of a building that has been selected by the PI. They will go through the following steps of the case study process:
- study building background material and discuss design issues with the architect,
- assemble a list of inquiry questions and topical areas of study,
- develop questions into testable hypotheses,
- discuss appropriate methodology and equipment,
- collect and analyze data, and
- present summaries and design lessons learned.

The TA and faculty trainers will facilitate all steps and provide feedback to the TA–faculty trainee teams.
Day 1: Investigating

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Welcome &amp; Introductions</td>
</tr>
<tr>
<td>10:30</td>
<td>Tools Training &amp; Treasure Hunt &lt;br&gt;Contents of loaner toolkit &lt;br&gt;Exploratory exercises with equipment</td>
</tr>
<tr>
<td>12:15</td>
<td>Take a Tool to Lunch (no-host)</td>
</tr>
<tr>
<td>1:30</td>
<td>Building Introduction Background Information &lt;br&gt;Review drawings &lt;br&gt;Develop questions &lt;br&gt;Team Meetings &lt;br&gt;Select topic</td>
</tr>
<tr>
<td>3:45</td>
<td>Team Meetings &lt;br&gt;Hypothesis generation &lt;br&gt;Develop methodology &lt;br&gt;Assemble equipment</td>
</tr>
<tr>
<td>6:30</td>
<td>Team Dinners</td>
</tr>
</tbody>
</table>

Day 2: Measuring

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Measurements in Building &lt;br&gt;Teams conduct field evaluations &lt;br&gt;Hypotheses re-visited &lt;br&gt;Methodologies revised</td>
</tr>
<tr>
<td>10:30</td>
<td>Information collected, documented</td>
</tr>
<tr>
<td>12:15</td>
<td>Take a Tool to Lunch (no-host)</td>
</tr>
<tr>
<td>1:30</td>
<td>Data Analysis &lt;br&gt;Group Photo</td>
</tr>
<tr>
<td>3:45</td>
<td>Team Presentations</td>
</tr>
<tr>
<td>6:30</td>
<td>Group Dinner</td>
</tr>
</tbody>
</table>

Day 3: Teaching

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Design Lessons Learned &lt;br&gt;Team presentations</td>
</tr>
<tr>
<td>10:30</td>
<td>Exercise Development &lt;br&gt;Exercises and approaches to be implemented</td>
</tr>
<tr>
<td>12:15</td>
<td>Toolkit Loans</td>
</tr>
<tr>
<td>1:30</td>
<td>Evaluation Roundtable &lt;br&gt;Feedback from TAs, networking</td>
</tr>
<tr>
<td>3:45</td>
<td>AOC Workshop Evaluation</td>
</tr>
<tr>
<td>6:30</td>
<td>Special Building Tour (optional)</td>
</tr>
</tbody>
</table>

Fig. 2: Agents of Change Training Session Schedule

Day 3: Teaching. Using the curriculum materials in the Teaching Toolkit, teams will outline a strategy to implement and integrate case-study exercises into their courses in the upcoming semesters/terms. After the strategies are outlined, participants will develop case-study assignments such as a two-day exercise, term project, five-week study, or even a one-hour exercise on observation and hypothesis development. Case-study investigations spanning a term would, of course, allow full development of ideas and data. Strategies will be presented to the group for critique and suggestions.

As a group, participants will discuss the pros and cons of the training session. Participants will be asked to complete a survey at the end of the training session.

3. FIRST YEAR DEVELOPMENTS

3.1 Portland Training Workshop, January 2003

Thirty seven participants from 13 schools of architecture attended the Training Workshop in Portland, Oregon. Six teams each led by UO GTFs and faculty trainers learned about the Water Pollution Control Laboratory (WPCL) building through an introduction by the interior designer, daylighting consultant, and the local architect. Teams developed hypotheses supported by methodologies and equipment from the Agents of Change equipment toolkit.

Designed by Miller/Hull (in association with SERA Architects of Portland), the WPCL sits on a 7.6 acre site, bound by the Willamette River and includes a park under a suspension bridge. The 40,000 s.f. design is a combination of 15,000 s.f. of laboratories with 25,000 s.f. of administrative and support spaces. The laboratories use state-of-the-art environmental procedures for identifying pollutants, including general chemistry, microbiology, nutrients, organic analysis, metals, and organic preparation. The labs are clustered under one large sloping roof punctuated by an array of skylights that are visible when driving across the bridge. (Fig. 1)

Figure 1. Water Pollution Control Laboratory -selected as a case study building site for the Portland Training Workshop, January 2003 (photo: S. Stannard).
By observations, surveys of lab workers, fish-eye photographs of the skylights, and measurements with luminance meters the team concluded that the daylight contribution from the skylights was not significant. Team presentations of all case studies prepared at the training session can be viewed on the Agents of Change web site: http://aoc.uoregon.edu/workshop/

3.2 Participant Responses

The comments from the participants to the training session reinforced the mission of the Agents of Change Project. Many positive statements and impressions were made regarding the ease-of-use of state-of-the-art equipment, the excitement of conducting a case study of a building in one day, the enthusiasm (and confidence) about the prospect of bringing these newly learned skills learned at the training session back to their home institution, and value of working with a team to share ideas in developing a strong foundation on concepts and methodology. Most went away from the workshop wanting to learn more.

3.3 Teaching Toolkit (exercises)

The Teaching Toolkits, in conjunction with the TA trainees, become invaluable resources for maintaining the case-study approach and sustaining effective training of the next generation of TAs.

Available as hard copies and electronic files on the AOC website, the teaching toolkit includes the following materials:
- sample equipment lists,
- vendor contact information,
- sample grant proposal for equipment,
- links to exemplary case studies,
- term, half-term, two-week, and one-day exercises that can be adapted to suit each institution’s curriculum,
- three-day field investigation exercises, and
- case study evaluation forms and grading criteria.

Teaching Toolkit exercises are expected to be passed from one generation of TAs to another. Instructional materials are available online for those who cannot attend the training session but are interested in obtaining the teaching notes, sample exercises, and teaching strategies. These “agents of change” (faculty and TA) may modify the materials for use at their institution and share these adapted materials via the AOC website.

3.4 Toolkit Loan

Equipment kits valued at $2000 are available for loan to participating teams use at their home institutions to implement case study exercises. Tools included in the kit:
TABLE 1: Agents of Change Loaner Toolkit

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hobo Temperature/Relative Humidity/External Loggers (5 @ $85)</td>
<td>$425</td>
</tr>
<tr>
<td>Hobo Temperature/Relative Humidity Loggers (5 @ $95)</td>
<td>$475</td>
</tr>
<tr>
<td><strong>Wide-range temperature Sensor – 6ft</strong></td>
<td>$125</td>
</tr>
<tr>
<td>Onset BoxCarPro software Starter Kit (1 @ $95)</td>
<td>$95</td>
</tr>
<tr>
<td>Suunto Compass DP-65 Global (1 @ $45)</td>
<td>$45</td>
</tr>
<tr>
<td>Kestrel 3000 Pocket Weather Meter (1 @ $145)</td>
<td>$145</td>
</tr>
<tr>
<td>Sylvania Light Meter DS2000 (2 @ $175)</td>
<td>$350</td>
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<tr>
<td>Raytek Hand-held Infrared Thermometers MT-4 (1 @ $105)</td>
<td>$105</td>
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<tr>
<td>Testo Velocity Stick – 405 V2 (2 @ $129)</td>
<td>$258</td>
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<tr>
<td>Solar Transit Template (1)</td>
<td>$0</td>
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<tr>
<td>Pilkington Sun Angle Calculator (1 @ $15)</td>
<td>$15</td>
</tr>
<tr>
<td>Pocket Balometer (1)</td>
<td>$0</td>
</tr>
<tr>
<td>Motorola Flicker Checker (1)</td>
<td>$0</td>
</tr>
<tr>
<td><strong>Agents of Change Toolbox (1)</strong></td>
<td><strong>$ 27</strong></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$2080</strong></td>
</tr>
</tbody>
</table>

4.0 UPCOMING EVENTS

4.1 Regional Training Workshop

A Regional Training Workshop in Oberlin, Ohio workshop will take place August 8-10, 2003 at the Lewis Center for Environmental Studies, which will serve as the case study building and venue.

4.2 RFP for Future Regional Training Workshops

Agents of Change will offer two $15,000 grants for faculty to administer regional training sessions in January 2004 and in August 2004. Proposals were received March 1 and awards announced March 15. We are hoping for geographic diversity in hospitable climates!

4.3 Tool Days

Tool Day was devised to spread VS/AoC methods to practicing architects and engineers. In a compressed one-day training session, practitioners, faculty, and TAs from across the nation have come together at notable buildings to learn about the use of hand-held equipment to assess occupant satisfaction and building system performance. SBSE and AOC have sponsored Tool Days at the National Building Museum in Washington, DC; the Boise (ID) Art Museum; and the Patagonia Headquarters in Reno, NV. Another Tool Day is planned for June 2003 the UTexas Solar Decathlon building at MaxPot in Austin, TX.

3.5 Evaluation

An independent evaluator will use several protocols to engage the following questions:

1. To what extent has the *Agents of Change* project pedagogy been disseminated and adopted in architectural curricula?

2. How effective are the training sessions at teaching the case-study approach, training on effective equipment use, and discussing pedagogical issues?

3. How many case studies will be developed and as the knowledge base grows, how will the quality of the case studies be judged?

4. To what extent are design skills and attitudes in design studio different as a result of the use of in-depth building investigations?

5. To what extent has *Agents of Change* motivated and inspired TAs to pursue teaching careers?

5. SUMMARY

Agents of Change, and its Vital Signs predecessor, have demonstrated a viable means of introducing design students (and professionals) to the joys of understanding real buildings. Exposure to the scientific method (hypothesis, method, analysis, results) helps to reinforce the fact that many aspects of building performance follow the laws of nature. Likewise, dealing with users and operators of real buildings reinforces the fact that buildings are for people and their perceptions.

The three Agents of Change training sessions held to date were deemed successful by participants and considered successful by the organizers. The long-term consequences and implications of the peer-to-peer teaching model embodied in Agents of Change will be the subject of independent evaluation over the next several years.

6. REFERENCES


4., 5. Agents of Change Final Report to FIPSE, 2002