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A testing experience

Interdisciplinary research is the new buzzword, but does a grounding in different disciplines really make you better at solving problems? **Amanda Haag** joins an experiment to find out.

Even the bastions of academia are no longer immune to reality television. In late August, 48 doctoral students arrived in the resort village of Snowbird, Utah, for a collaborative weekend of solving environmental problems — and found themselves the subject of a social-science experiment uncannily like MTV's *Real World*. First gasps and uneasy silence, then nervous laughter spread through the Cliff Lodge conference room when students learned that their hotel-suite working areas were equipped not only with laptops, Post-its, and flip charts, but also with microphones, a video camera, a voice recorder and a silent observer.

Within hours, the students were ensconced in groups of six, setting out to define a pressing environmental question, design a study and write a grant-worthy proposal to solve it — all in two and a half days. Giant sheets of scribbled notes, flow charts and diagrams soon plastered every available surface, from mini-bars to bathroom doors. Science, it seemed, could progress even with a video camera watching.

"It was a little Big Brother with the cameras and everything, but you get used to all that," says Nicole Czarnomski, a PhD student in water resources engineering at Oregon State University in Corvallis. Others initially felt a bit like lab animals. "I kept thinking, 'Don't cross your arms, that means you're not open to an idea!'" says marine ecologist Suzanne Olyarnik of the University of California, Davis.

Being open to ideas was, after all, part of the point of spending a weekend brainstorming different approaches to environmental problem-solving. But the students were also an experiment in themselves — part of a social-science study to investigate interdisciplinary education. By sorting students according to whether they came from traditional, single-discipline graduate programmes or the new wave of interdisciplinary research, the organizers aim to learn what creative processes drive scientific thought today.

The National Science Foundation (NSF), which funds a graduate interdisciplinary programme, is not interested just in producing scientific knowledge, says Ed Hackett, a sociologist at Arizona State University in Tempe: "They're increasingly interested in understanding how it's produced."

The impact of Hurricane Katrina on the US Gulf Coast — the first anniversary of which occurred as the students set to work — is a classic example of the problems that occur when human social dynamics, natural processes and complex environmental systems collide, says Diana Rhoten of the Social Science Research Council in New York City. As a final stage of their four-year project on the nature of scientific collaboration, she and Hackett designed the weekend as a 'charrette', a nineteenth-century concept now used to describe a short burst of intense problem-solving.

Mission: flexible

The charrette began more like a movie than a television show — with students finding packets in their working suites, "a bit like *Mission: Impossible*", says Hackett. Each packet contained not a scientific challenge, but an open-ended research design with a few defined parameters. For instance, the students might have to propose a research question that would cost roughly $10 million over five years and support a full team of scientists. How the students defined the question would be as closely scrutinized as the way in which they went about solving it.

The questions had to deal with the intersection between human activities and ecosystem services, as defined by the 2005 Millennium Ecosystem Assessment. Each question hinged on comparing two places with different levels of human activity, such as urban New Orleans and the less developed Euphrates River in the Middle East. A suitable subject might be a region where economic growth and human health depend on fishing and a clean water supply, yet

where overpopulation threatens the aquatic ecosystem. Once the problem was defined, students worked as a group to develop the seed of a written grant proposal and give a 15-minute PowerPoint presentation to a panel of experts.

The model for the charrette dates back to the nineteenth century, when students at the architecture school of the École des Beaux-Arts in Paris were asked to draft a solution to a design problem under a strict deadline. Faculty members would often hand out problems so ambitious that few students could crack them before the cart — *charrette* — rolled by the drafting tables to retrieve the work, finished or not. Today, professions ranging from urban planning to graphic design use charrettes to inspire fresh approaches to problems.

No survivors

For this experiment, Rhoten and Hackett divided the group into eight teams of six students. Each was composed as nearly as possible of three ecologists plus one other natural scientist (such as an agronomist or a biologist), a physical scientist (such as a hydrologist or an atmospheric chemist) and a social scientist or policy analyst. There were four groups each of early- and late-stage students, divided further into students from disciplinary and interdisciplinary programmes.

That last distinction was key. One of the charrette's goals was to determine whether students trained in traditional graduate programmes work together to solve problems differently from their interdisciplinary peers. "We wanted

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to create an environment in which we could say, 'if we put these guys in teams, do they interact with individuals differently from their colleagues who haven't had this intervention?'" Rhoten explains. She and Hackett also wanted to see whether interdisciplinary programmes are training students to produce science that informs science policy. In 2005, 75 institutions across the country hosted 120 Integrative Graduate Education and Research Traineeships (IGERT), a National Science Foundation fellowship, to the tune of $67 million and involving around 1,800 students.

But did Rhoten and Hackett expect more from the interdisciplinary students because of their experience in such programmes? "I think there was a little bit of feeling at first that we're the non-IGERT people, we're from the wrong side of the tracks," says Ryan Atwell, a doctoral student in landscape ecology at Iowa State University in Ames. But Rhoten and Hackett stress that they aren't out to demonstrate the superiority of interdisciplinary programmes. "The upshot of this may not be flattering to IGERTs," Hackett says. "We have evidence from some of our fieldwork that there are some IGERT students whose disciplinary technical skills are not up to the level the discipline requires." Such problems can arise as late as when a student is submitting a dissertation. "We haven't found the right balance point between enough breadth and enough depth," he says.

Rhoten and Hackett assured the students that they were not competing with anyone, either within or between groups. And they tried to play down any *Survivor*-like aspects of the weekend. No one would be ejected from a group, although anyone could leave at any time. But the rules were complex. "It's like a Russian doll," remarked Chris Bail, a social-science doctoral student from Harvard, who served as one of the group observers. "It's got layers within the inner layers."

Students could draw only on the resources available within their group. "You don't call your faculty, you don't call your friends, and you don't ask somebody at MIT to run some data for you," Rhoten said at the opening session. To this end, each working suite contained just two laptops with Internet access and a basic software package. The researchers plan to analyse the web searches and other information students gathered during their work.

Under observation

Each group was assigned an observer, a social-science graduate student, who would sit in a corner taking notes on the group's activities. Observers were instructed not to interact with the students, and vice versa. Every 15 minutes, the observer would note exactly what was happening in the group at that moment. Was someone making a declarative statement? Was a certain person expressing scepticism? Has the group reached a low point? Have subgroups broken off? By analysing these notes, the researchers plan to look for what they call interaction hot spots, to be studied further through the video recordings.

It wasn't easy to catch up with the students, as many were tucked away in their working suites — practically around the clock. But some took time off for cocktails, hikes up the steep slopes of Little Cottonwood Canyon and even group trips to the hot tub. So between gulps of mountain air and after-hours refreshments, students relaxed and discussed their experiences.

All eight groups said that they gelled remarkably well. But many students expressed frustration at the initial stages, when they were bogged down in defining their research question. Some arrived at a consensus on the first morning. For others, the entire first day was filled with frustration over not being able to choose a particular ecosystem service or geographical area. "To be honest, when I went to bed Friday night, and when I got up Saturday morning, I wasn't excited about coming back," Atwell says. "I thought it was going to be one of those group experiences where you see and

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respect the people you're working with, but we just don't come together." But Saturday brought a breakthrough. By then, Atwell says, "we knew who was excited about what study systems and what questions".

Semantic quibbles

When students disagreed, it was mostly over terminology. For instance, Czarnomski's group got stuck discussing what is meant by ecological resilience — a fundamental concept in ecology. "When I think about it, I think of it in more of an applied fashion and not necessarily in the theoretical constructs that a community ecologist would," Czarnomski says. Florence Bocquet, a doctoral student in atmospheric chemistry at the University of Colorado in Boulder, says that her group also quibbled over semantics. "People were explaining the same concept using their own words, phrasing the idea differently, and re-explaining the idea," she says. "I did not say, 'what you guys are saying is the same darn thing, so let's move on.' But I really wanted to."

In the end, most groups settled on proposals involving land-use change, water-resource management, and patterns of urbanization. One presentation, "The American Dream — Have a Lawn and Eat it, Too", looked at how suburban development is straining the ability of surrounding ecosystems to provide the

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Grad idol: a multidisciplinary panel of experts questions the students about their research proposals.

services, such as fresh water, that the communities rely on. New housing developments are being designed and marketed as having a reduced environmental footprint, although there is no comprehensive study of the true environmental impacts of individual developments. So the group proposed a comparative study between conventional and tightly grouped 'cluster' housing communities.

Horses for courses

Another group proposed comparing the Hudson River watershed in New York State and the Han River watershed in South Korea. The two basins are geographically and climatically similar, with agricultural activities and development upstream that can contaminate water downstream. The group proposed to study how human impact on the way nutrients move through the ecosystem can be taken into account in urban and rural planning.

Each team presented their findings to a seven-member panel of scientists, who ranged from pure mathematicians to ocean managers. The students pulled off relatively strong proposals, most of the experts agreed. "Were they NSF-quality proposals?" asks panel member Ann Kinzig, who studies urban ecology at Arizona State University. "Not quite yet. But did they accomplish a huge amount? Absolutely. These students only had two and a half days to work on what in some ways is a very difficult problem that senior researchers are still trying to crack."

To everyone's surprise, students tackled the problem similarly, irrespective of whether they had interdisciplinary or traditional training. Rhoten and Hackett hesitate to draw conclusions before all the data are in, but both agreed that it was difficult to spot which groups were which. Rhoten says that the early observations bring into question whether interdisciplinary programmes train students to think or approach problems differently. "This is not a criticism of IGERTs," she says, "but it raises the question of whether they're actually changing students or just housing students who have these preferences." Although this is a long-standing question, few opportunities exist to test these hypotheses properly in group settings. Rhoten stresses that such a finding would not diminish the importance of programmes such as the IGERT. "Without the IGERT, perhaps those currently enrolled in them would have a graduate school experience that did not respond to, support or accommodate their learning preferences," she says. "That would be a huge loss."

Crossing the line

Temporary forays into interdisciplinary work, such as immersion in a charrette, may be valuable in extending the opportunity to more students without the need for multi-year fellowships. Steve Gaines, a marine ecologist from the University of California, Santa Barbara, who was not involved in the study, teaches a week-long course dealing with the interface between science and policy. "It's dramatic how students change in just a week," he says. "So I'm not surprised at all that you can have a lot of progress over the course of a couple of days in an intensive exercise like this."

Knowing when and how to bring interdisciplinary work into one's career is a question for many researchers. Kinzig notes that many scientists feel strongly that students should become expert in one discipline before crossing boundaries. But, she adds, "I think we have an increasing number of students who aren't that interested in being disciplinary. I think if I had had to focus narrowly within a particular discipline, I would not have finished graduate school. I just would have gotten bored."

By the end of the charrette, many of the participants shared that sentiment. Ramona Walls, a doctoral student at the State University of New York, Stony Brook, was a fashion designer before she chose to become an ecologist. "It never occurred to me that I could set up a collaboration with an economist or some other social scientist, and now that I've done it, I think it's a great idea," she says.

Perhaps it is in this balance between traditional disciplinary science and synthesis-driven approaches that solutions to today's environmental and social issues will be found. "There's still glory in that other kind of science that's not problem-oriented, that's just completely curiosity-driven," Kinzig says. "We can't lose sight of that." ■

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