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Creating A Computer-Enhanced Geology Learning Environment

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Introduction

"Sometimes I would walk out of a lecture that I gave and say, "That was a really powerful lecture, that was worth the money these guys paid." But my students would say, "hmm?" indicating that they didn't quite understand. And instead of saying, "Well, those stupid students," I would say, "If all the students in there didn't understand what I was saying, then I didn't teach them what was necessary, and now I need to figure out how."

--Eric Frost, UCSD Professor

Why use technology to teach geology?
In the past, students learned structural geology via textbooks, lectures, a multitude of pictures, and years of field-work. With current technologies, the necessary learning can occur at an accelerated pace while students simultaneously gain a deeper understanding of the processes that shape our earth. Numerous forms of geology have become dependent on technology and several new research areas have emerged from the use of digital imaging. Much of the work that geology professor Eric Frost carries out at San Diego State University (SDSU) has become possible with the advent of computer imaging techniques.

In his course Eric uses software that allows students to see complex three-dimensional shapes, and therefore understand geological processes in a way that would be very difficult without the use of technology. The tools he uses vary from simple color tools like Chromatek and VRML to high-end tools such as VoxelGeo and GOCAD. His classes also use numerous other software packages that allow for interactive processing of imagery such as Photoshop and commercial image processing programs such as ENVI, Earth Resources Mapper (ER Mapper) and Image Web Server and several Envrionmental Systems Research Institute (ESRI) products such as ArcView.

What happens on a typical day in Eric's classroom?
Each one of Eric's classroom sessions acts as a stepping stone. At the beginning of a semester he poses a broad question or research problem to his students who then collaborate in each class to solve it. To solve the problem, they use all of the visualization software mentioned above. Eric says that, "by focusing them on a research question whose solution is beyond any one member of the class, and which requires far more tools and expertise than any of them have, they see how coming together in a knowledge building, community effort can help them attain the goal." Once he sets the process in motion, his role in the class is largely one of, as he puts

it, a "cheerleader." Students are left to come up with ideas on their own about how to solve the problem while Eric facilitates the process by sending emails between classes about relevant news items, URL's of companies doing similar things.

Is Eric's approach working?
According to Eric, his department chair and his students, the answer is yes. Eric told us, for instance, that technology is not only useful but essential if one is to fully comprehend certain geological processes.

> **Eric:** Using the technologies elevates your understanding. It brings your understanding of the models and concepts to a much higher level. You can ask more challenging questions about the subject matter at hand and communicate at a level that industry is working at.

Gary Girty, Department Chair of Geological Sciences, says that when it comes to using technology to achieve this heightened understanding, Eric Frost has no equal.

> **Gary:** I know of no one in my entire academic career who has been as successful as Eric has at what he does. I would put him on a pedestal and say if you want to chase technology, if you really want to try to use these things in a university, in a state school like we have, then you need to go talk to Eric Frost. And you need to watch, you need to look at how he's managing to do this. I just don't know anybody who does it better than he does.

Shane, one of Eric's students, also testifies to his effectiveness as an instructor by pointing out his ability to challenge students to think.

> **Shane:** His goal for any class is to get students to think in a way that they would not normally think. For example, he'll give students a problem, but never, ever give the answer. He'll give you a project on, say, the Middle East, and say, "Okay, here is a problem, see what you can dig up, see what new kinds of ideas you can formulate," and then present it back to the class. He is not the traditional talking head kind of teacher. He pretty much lets the class teach themselves.

Wow, how can I get my students to learn like that?
Read on. Through the following links, we offer you a more complete and comprehensive story of Eric Frost's efforts to improve the quality of student learning in the hopes that his experience may serve as a guide to others.

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