My Top Ten Topics in Geoscience Education Research

Kim Kastens, June 15, 2002

for Conference on "Bringing Research on Learning to the Geosciences"

Many of the most exciting advances within Geosciences are now coming from the study of interfaces within the Earth System, for example the ocean-atmosphere interface, the core-mantle boundary, the coastal zone, outposts of the biosphere within the solid earth. One interface remains understudied: the interface between the Earth and the human mind. How do geoscientists and geoscience students "get our minds around" some aspect of the Earth or environment? I am looking forward to thinking about this at the upcoming conference.

Here is my personal list of topics that I think would benefit from research on learning,, and from dissemination of existing research results to geoscience curriculum developers and front-line geoscience educators.

(1) How do people learn to comprehend vast expanses of space, using a mind that evolved to cope with spaces one could see across or walk across?

(2) How do people learn to comprehend vast expanses of time, using a mind that evolved to cope with time scales bounded by the human lifespan?

(3) How do people learn to comprehend, and mentally manipulate, objects, processes or phenomena in three-dimensions (or four dimensions including time)?

(4) How do people learn to make and interpreting spatial representations, including maps, cross-sections, block-diagrams, stereonets, etc.

(5) How do people comprehend, and learn to make predictions about, systems in which there are multiple interacting causality chains, and/or circular causality chains (feedback loops)

(6) Most geoscientists are trained to think about the past. But society is now asking us questions about the future, about earthquakes, global warming, and so on. What mental processes are involved in thinking rigorously about the future, and how can we foster this ability in our students?

(7) Most students today learn most things from human beings or from human artifacts such as books, computer programs, videos, etc. For a student who has grown up in this situation, what does it take to enable that student to learn directly from Nature, by direct observation, in the field, of rocks, organisms, etc.?

(8) How can we foster students' ability to learn from data?

(9) How can we foster students' ability to learn from models, either by building models or manipulating models made by others?

(10) How can we foster equation literacy in our students, i.e. the ability to translate from a holistic understanding of a situation into a quantitative equation-based description, and vice versa.