CREATING THE NEED TO KNOW

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Context-based teaching provides a strategy that gives the responsibility of learning back to the student. This approach is being used at Virginia Tech in a number of settings, including an introductory Biology class with 325 students.

Remember when you were a student listening to another lecture that followed the sequential format of the textbook? I venture that it was not only boring, but you were probably wondering why you needed to learn facts that had no immediate relevance. Were you engaged in learning? Probably not! As an instructor, are you constrained by standards of learning? Do you feel that you need to teach everything in the text, but you do not have enough time? Has it gotten to the point where you do not enjoy going to class? Why don't you change your teaching strategy?

There is a strategy that gives the responsibility of learning the material back to the student instead of having to teach it all. And it is fun. It is called context-based teaching. You may know it as case-study approach, or as thematic or situation-based learning. Case studies are usually presented as questions at the end of each chapter or as a supplement to a textbook. What makes this model of teaching different is that the facts are learned in context, as needed and with relevance.

I have experimented with context-based teaching in three of my college classes. The first was an introductory Biology course with 325 students where the students are presented with questions that required critical thinking, collection and integration of seemingly disjunct facts. In a 75-minute class session, the students only received a 20-minute mini-lecture based on a concept map. The rest of the time was in discussion of possible solutions to the problem of the day.

The second was a six-week on-line general Biology course that followed a traditional text, but in part it also incorporated Aldous Huxley's *Ape and Essence*. An open-book question required the integration of diverse facts and concepts found throughout the textbook. Each

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student was asked to determine if the purification rites of Belial would be effective in reducing the number of radiation-induced mutations in a human population. The student was also asked to propose a screening test for people who did not phenotypically express mutations so society could decide if they could breed or not. If mutations were identified, the student had to discuss the techniques they would use to repair these defects. They also had to estimate how many generations and years would be necessary before they knew whether this selective breeding program was a success or not.

The third course was a sophomore-level, three credit Ecology class that met four hours per day, five days a week, for three weeks. There were no lectures. Instead, I asked the students bring the Serengeti to Virginia. The ecosystem had to have a minimum of 25 species integrated into a viable food web. The system had to survive at least three times the life expectancy of the top carnivores, and students had to prove it by constructing a Serengeti food chain using Stella, a software package. In addition, if they modified the Virginia environment, they had to justify the modifications. Finally, they had to identify which biogeochemical cycle they would use to indicate ecosystem health. Not only did these students efficiently cover the material in the textbook, but they were also researching material typically presented in graduate level courses.

Currently, I am designing a course that will be totally context-based. There will be little or no lecture. I propose teaching a two-semester General Biology course by asking the students only three or four meta-level (first order) questions that will ultimately cover most of the material in the text. Students literally create their own learning environment as they brainstorm answers to their own questions. In turn, each question generates more questions and the need to learn new material. When the students have answered all the possible questions, they will have covered most of the material in the textbook. Factual material is learned as needed rather than being presented as a linear sequence of facts.

The first three meta-questions they will be asked in this new course are: 1) Cheetahs - an endangered species: can and should they be saved?, 2) Water, why should we care?, and 3) Biotechnology, is it a panacea? As an example, the question "Cheetahs - an endangered species: can and should they be saved?", should generate several new second-order questions. There are at least five second-order questions that could be asked: 1) What is a species?, 2)

What is an endangered species?, 3) Why are species becoming extinct?, 4) Why is the cheetah of interest to ecologists ?, and 5) Why are taxonomists interested in cheetahs? Each of these questions should generate new questions. There are no limits to the number and diversity of questions that can be asked. In this module being developed there are approximately six levels of questions. Once a student has researched each meta-question, he or she will need to pass a quiz to demonstrate that they have sufficient knowledge about the subject before they make a decision about the future of the cheetah.

Context-based learning does not need to stop with biology. Context-based learning can integrate biology, sociology, ethics, politics, etc. As it turns out, cheetahs have virtually no genetic diversity. So a student may decide that they do not want to save the cheetah. If a student decides not to save the cat, then he or she will need to learn why countries have signed an international agreement to preserve biodiversity. If a student feels we should save the cheetah, they need to decide how much they are willing to pay for this effort. If cost is not an issue, then the student will need to identify which social programs may need to be dropped or how much taxes should be increased to pay for this effort. If the student changes their mind at this point, they again must address the issue of conservation of biodiversity. However, if they still want to save the cheetah, then the next question is how will they increase cheetah genetic diversity? Now we come full circle. Students now will have to understand biotechnology and decide which techniques can be used to increase the genetic diversity of cheetahs. When I presented a class with the problem of increasing genetic diversity of cheetahs using biotechnology, they proposed 13 different solutions to the problem. The diverse answers included the use of drug therapy to make the animals better mothers, selective breeding programs, repairing cheetah genes by using genes from lions or other cats, using genes from cheetah museum skins and mummified cats from Egypt, and controlling the predators of the cubs.

Context-based learning also allows for multiple ways to enter a module. The five second-order questions noted above offers the student a choice of where to begin to answer the meta-question. Students who have a choice of which question to answer first are apt to be more motivated to learn. To gather the appropriate information to answer the meta-question, a conscientious student will at least have to answer all the questions posited. A student could also enter the module by asking a very specific question. For example, when studying viruses

and bacteria, a question could be asked about the impact of diseases on the population dynamics of wild animals such as cheetahs.

The initial response to the use of meta-questions in teaching has been received with enthusiasm by the students. It is not uncommon to hear the student make comments such as these: "Thank you for not covering the same material that is in the text," "This was fun," and "Now I understand why I have to take Biology." And so forth. From the instructor's perspective, I enjoy teaching much more than I did as a lecturer. This does not mean that context-based teaching is easier than lecturing. It is not easier because I do not know exactly what will happen in class each day, nor will I know all the answers to other questions a student might ask. However, it is not important that I know everything, but it is important that I serve as a role model of how we all use scientific thinking in our daily life, solving problems and answering questions. ■