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Changing Teaching Practice: Much More Than A Diagnostic Test

My intention here is to use my experience with an action research program to stimulate discussion about what it takes to change faculty's conceptions of teaching and learning. In addition, I address some issues concerning dissemination and faculty development. For a Biology Misconceptions project I will be partnering with Andy Anderson and his Diagnostic Question Cluster (DQC) group from Michigan State.

Practitioner Research using TIEE

While there is a large literature about students' misconceptions in science, much less studied are faculty's misconceptions about teaching and learning. To address this, the premise we work from for the Practitioner Research project is: "Faculty who do research on their teaching fundamentally change their conception about learning, and consequently of their teaching".

Several years ago we received supplemental CCLI support to establish a team of ecology faculty *practitioner researchers*. (I use the term "practitioner research" to describe inquiry conducted by faculty on their own practice, encompassing action research, classroom research, and scientific teaching.) Briefly, in a workshop setting a group of 15 selected faculty from a wide range of institutions sorted themselves into research teams based on specific questions they wished to address. Each made use in some way of *Teaching Issues and Experiments in Ecology* (*TIEE*; tiee.ecoed.net), a peer-reviewed electronic journal published by the Ecological Society of America (ESA) designed to help ecology faculty include more student-active approaches in their teaching (D'Avanzo 2006). (I am lead editor of *TIEE* , which has been funded by CCLI). Our hypothesis was that a collaborative team with similar research interests, and with the ongoing guidance and support, could achieve significant, publishable results about their teaching even in a single academic year.

A critical aspect of this project is that the faculty developed their own research questions and crafted the experimental design and instruments they used. The team members focused their study on a specific research question, such as, "How can students' quantitative skills be improved?" and "Can classroom learning (increased knowledge) really lead to changes in core environmental values?" Throughout the school year team members worked together on their questions, instruments (such as pre/post tests), and findings. One year after the initial workshop, in Aug. 2006, team members presented 6 co-authored posters at the annual ESA meeting. Their peer-reviewed papers on this work will be published in the next volume of *TIEE*; we intend this to be a step towards publication in a traditional education journal.

We are still in the process of evaluating this project, which will be based on hour-long interviews with each participant and examination of their research instruments, experimental designs, plus classroom materials. However, there are a few generalizations we can make at this point. Each professor has stressed the importance of ownership – that they worked on questions they asked with approaches they designed. As a result the faculty believed that they were more motivated to do the study. Critically, in designing the instruments, the faculty were forced to think hard about what they most want their students to learn, whether their teaching actually promotes this learning, and how they might study whether this was so. In other words, they became more conscious (metacognitive) about their thinking about their teaching and their students' learning. As one of our research practitioners put it "Now that I can verbalize these ideas, I can apply them and communicate them to students as well as colleagues…. In short, before … student active concepts were in my head. Now, I can better apply these student active concepts and improve my teaching strategies to improve student learning."

Application of the Research Practitioner project to this workshop

My experience with this project prompts several questions and comments relevant for this Biology Misconceptions workshop. While some may think it is too soon to be thinking about some of these issues, such as dissemination and faculty support, plans for national programs will require a great deal of thought and a fair amount of lead-time.

- *The 'buy-in' issue*: how can we motivate faculty to use misconception diagnostics to deeply study their students' learning? Uncovering and addressing students'

biological misconceptions takes commitment, a good deal of time, follow through, and thought. What will be the impetus to spend this time and effort?

- *Adapting Instruments*: A central foundation of *TIEE* is that faculty should modify assessments and materials for their own use. This engages them and also what they develop is appropriate for their students and settings. Should faculty modify a diagnostic for their own use? This could increase buy-in but would reduce cross-site comparison.
- *Focus*: Important to the Research Practitioners' success was their focus on a small set of questions that they could fairly address in a semester class. If faculty try to do too much (e.g. deal with too many different misconceptions), they may well get overwhelmed and confused.
- *Misconception-Active Approach Link:* One reason why use of the Force Concept Inventory helped faculty improve their teaching is because clearly defined misconceptions were linked to specific student-active approaches and questions teachers could easily use in their classes (e.g. the 'clicker questions'). *TIEE* also links specific active approaches to teaching/learning of specific concepts and information.
- *Support & Interaction*: It was critical that the *TIEE* Research Practitioners worked together in teams, which provided support throughout the semesters. For instance, we brought team members together via monthly conference calls. Also, our evaluator, Deborah Morris, who is very experienced with assessment instruments and classroom research approaches, provided invaluable help with instrument development and experimental design. How can we provide similar help and support for users of misconception diagnostics?
- *National dissemination*: to appreciably change biology teaching, we must reach a disparate group of biology faculty throughout the U.S. who teach in many different types of institutions. One reason why *TIEE* has been effective in reaching large numbers of ecology faculty is because it is published by the ESA and the society promotes it. How will we reach biology faculty who belong to many different professional societies – or who may not often go to professional society meetings?

- *Common Goals & Language*: the faculty in our project were all ecologists who shared common teaching goals; the self-selected groups had similar objectives. Similarly, physics teachers who use the Force Concept Inventory, to some degree a model for the Biology Misconceptions project, share common learning goals about mechanics. However, faculty who teach introductory biology classes are physiologists, geneticists, ecologists, and so on. Is there a small number of essential concepts and ways of thinking that we share?

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D'Avanzo, C. et al. 2006. Design and evaluation of TIEE: A peer-reviewed electronic education resource. *Frontiers for Ecology and the Environment.* 4: 189 - 195.