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Science and Science Education – Why the Disconnect?

Vexation

When I think back on my undergraduate career there is one education class that stands out. The class was titled *Teaching Diverse Populations*. All I remember from that class is walking in, taking my seat with about 60 other students, and copying notes from an overhead projector for one hour Monday, Wednesday, and Friday all semester. I couldn't understand how we were "learning" to teach diverse populations when the instructor taught the same way everyday. Whatever research or theory about teaching she was presenting completely contradicted her very own classroom approach.

Later in my science classes professors lectured and labs were cookbook, verification exercises. That was my experience, whether it was biology, chemistry or physics. As an undergraduate I accepted the situation and became adept at doing well in those environments. Then I took another education course, this one much better than the first. It was in this class that I learned about inquiry methods, the learning cycle, doing the lab first and then figuring out the principles of teaching and learning at work in a classroom. We had discussions about why these strategies were important, how we could use them in our future classrooms and suddenly I was confused again. I had spent several semesters learning and doing science, and even delved quickly into some education courses, but now I realized I had never experienced what was considered the right way to teach. To the credit of my professors, I did learn a lot and still love science, but I have come to believe that these experiences could have been so much better.

For whatever reason there seems to be a disconnect between the science education movements and science teaching, or simply teaching for that matter, at the university level. Studies have been done that support the use of strategies like the learning cycle and inquiry teaching, yet that doesn't seem to matter in the college setting. Some may argue that classes are too large, the standards and rigor of courses must be maintained, or that there is a greater focus on research than teaching. I believe there is some merit to all of these arguments; however, I don't believe they should preempt our attempts at change. I feel that there is the old problem of teachers, in this case professors, teaching the way they were taught. We see this problem with our public school teachers using methods that were around during their undergraduate days. This has spurred many professional development opportunities to help them 'see the light,' yet there doesn't seem to be the same push for college faculty.

There are some curricula out there that focus on using inquiry methods for teaching science. One in particular, *Physics by Inquiry*, focuses on teaching introductory physics through the use of inquiry. I think these classes that employ such curricula are very useful and successful for teaching physics content, but there is still a missing link in the chain. Here at FSU the *Physics by Inquiry* inspired class is only offered to elementary education majors. But even here, there is an important link missing. In my opinion, part of the focus of this inquiry-based course must be on a close examination of how and why inquiry methods should be used. Unfortunately, currently there is an air about the class that simply doing inquiry and learning science that way will somehow result in future teachers being able and disposed to teach in a similar manner. Discussion about the methods and rationale and their implications for future teachers are missing from this class, and others like it, and don't seem to be made up for elsewhere.

It is safe to say that I am unsatisfied with the quality of teaching at the university level, but I also recognize the cultural underpinnings of the matter. We cannot truly attack the issue of quality teaching without discussing the validity of what is being taught. While I am pushing for better teaching practices I understand that such an alteration may demand curricular change on a university or even systemic level.

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Honestly, I am very pessimistic when it comes to my ventures in this area, mainly due to my status on the faculty and the lack of extra letters in front of or behind my name. My ultimate solution would be to teach professors how to teach. That is not meant in a derogatory way, I think that many are just unaware or unreflective about their teaching—they had no training as teachers, just training as scientists. I am realistic enough to know that the professional development of professors is a very large and unlikely undertaking, at least as a first step. Therefore a more systematic, “baby-step” approach would likely be more productive, one that starts here at home in FSU’s own Physics Department.

The best starting place I see is in the area of science laboratories and their role in the undergraduate curriculum. Moving away from cookbook, confirmation style labs would be a big improvement. I would like to work with a small group of physics professors, who have shown past interest in improving science teaching, to redevelop some of the undergraduate lab exercises. Most lab exercises can be reshaped so they follow more of a learning cycle or inquiry-like approach. I would also like to have these professors use lab activities as a way to introduce certain topics that are later discussed in the lecture setting. Some creative scheduling would allow these activities to precede lectures to delay concept introduction until after exposure to the subject matter. The second half of this initial effort would need to address the role of the teaching assistants (TAs) that often lead undergraduate labs. During the initial weeks of the semester, when no labs are conducted, the TAs would become familiar with the strategies being employed in the lab activities. Learning about these methods would continue during the already required weekly TA meetings.

Turning to the *Physics by Inquiry* course that we teach to elementary education majors here at FSU, it is intended to teach physics content, therefore it may be inappropriate to alter its curriculum to accommodate discussion of teaching and learning strategies. However, I think it would be appropriate to have a methods class accompany this course so that the students have a chance to learn about the methods the course uses. I plan to suggest that an Elementary Education representative work with the Physics department to become aware of the intricacies of the *Physics by Inquiry* course. This partnership would ensure that the course achieves its content goals and receives just consideration in the methods courses of the Elementary Education department.

Now, what to do about professors that are unaware of research-based teaching practices? To require workshops or training sessions would likely be counterproductive and cause resentment between the science and science education faculties. I think the tactics must be more covert. I hope the improvement in student learning will be demonstrated with the initial efforts of revamping the lab activities. These improvements would serve as a springboard for further changes in instructional practice. I would like to demonstrate to the professors, the same cadre as before, the usefulness of eliciting preconceptions of their students. This step is not so drastic as to abandon the lecture format that professors seem so comfortable with, however, it does allow for some sort of engaging activity to begin the lecture. These activities will help the students form “conceptual hooks” upon which to hang the substance of the lecture.

If this nucleus of professors can adopt and embrace these changes it will serve as a foothold in the department. With their buy-in and excitement I would hope the methods would begin to spread and begin to foster a relationship between Science and Science Education Faculties.