



THE 2015 APPLIED LEARNING SUMMER INSTITUTE:
DR. TRICIA KELLEY'S KEYNOTE ADDRESS ON APPLIED LEARNING



I believe that students learn best by doing – in other words, when they apply what they have learned to real-world problems or new contexts. In my smaller classes at both the undergraduate and graduate level, students are directly involved in doing the work of science by collaborating with each other and with me on authentic research projects. In my large introductory classes I try to instill an appreciation for science by involving students in constructing course content, for instance by proposing and testing hypotheses – again, applying what they have learned. But it hasn't always been that way. Today I'd like to describe my pedagogical journey and my current approaches to incorporating applied learning in my teaching by allowing you to eavesdrop on a few of my classes.

When I began teaching in 1979, the standard pedagogy (we didn't use that word then) was lecturing. Even in graduate courses with two students, faculty lectured! Thus my goal as a novice teacher was to become an excellent lecturer. I hoped to emulate my PhD advisor, Stephen Jay Gould, a superb lecturer who captivated his students, inciting them to applaud nearly every lecture. I was certain that if my lectures were clear and well organized and followed the syllabus predictably, I too could be an excellent teacher.

The approach seemed to work. My student evaluations were strong, I attracted graduate students, and within ten years I was a full professor and the University of Mississippi's Outstanding School of Engineering Faculty Member. Yet I felt myself growing dissatisfied, even bored, with my teaching. Perhaps that's why I welcomed opportunities for challenging administrative positions, first at Ole Miss and then at the National Science Foundation. Administration allowed mobility, and I accepted department chair positions at University of North Dakota and then UNCW (trading in Dakota blizzards and floods for Carolina hurricanes and floods).



During the fifteen years in which administrative duties claimed more of my attention than teaching, the academic world began to change. I don't think I was aware of these changes consciously, but I began inventing new pedagogies (though I still don't think I knew that word). I found myself trying to enliven my courses (and enjoy my teaching more) by making them more interactive. At North Dakota I introduced hands-on research projects, using samples I'd collected in my field work, into my graduate paleoecology course. I started pausing my undergraduate paleontology lectures to allow students to brainstorm ideas in small groups. And the students seemed to like it, reporting in focus groups that these activities aided their learning.

When I returned to the classroom full time in 2003, I was eager to develop my new pedagogies more fully (I think by then I had learned that word). I'd had success in incorporating authentic research in my graduate paleoecology class, first at UND and then at UNCW, so why not try it with undergraduates! Thus I refocused the laboratory for GLY 337 Invertebrate Paleontology from traditional exercises (sketching fossils from the paleontology teaching collection and answering questions about them) to one in which students conduct semester-long original team research projects.

Let me paint a scenario of my invertebrate paleontology classroom. Imagine yourself in DeLoach Hall 105 on a typical Tuesday afternoon in spring 2013, where the students and I were pouring over a vast array of two-million-year-old fossils from a local outcrop.

"I hate *Mulinia*!" Katherine* declared.

McKenzie* commiserated. "I know – I've counted over a thousand *Mulinia* this afternoon!"

"If you want to ID these last gastropods, I'll switch to *Mulinia*," Anna* offered, "if that's ok." She looked at me.



“You guys can organize your team however you want in order to get everything done,” I responded. “Remember, you need to finish species identifications this week so I can check them. There are only a few weeks left to tabulate and analyze data and test your hypotheses. Plus we need to make sure there’s time to share rough drafts of your sections with your teammates and me so you can make revisions.”

I spoke confidently, but underneath I was a bundle of nerves. For ten years, I’d included a semester-long authentic research project in this undergraduate course. Each year, we collect bulk samples of fossiliferous sediment and students extract and identify the fossils. Each team develops hypotheses and collects and analyzes the relevant data to test them. Students collaborate to write a research paper in professional journal format and present the results orally. Finally, we submit abstracts of our results to a professional meeting. Typically several students attend and present the posters.

There’s always pressure to produce publishable data, but this year it was worse. When UNCW embarked on its Quality Enhancement Plan, I had jumped at the chance to continue to refine the applied learning approach I had developed for the course. While participating in the first QEP Applied Learning Institute, in summer 2012, I realized that my course was missing pieces of intentionality and critical reflection. I applied for an eTEAL grant, and Invertebrate Paleontology was chosen as an eTEAL early adopter course. Although I’d already published my pedagogy in the geoscience literature, I wanted to demonstrate its potential to my colleagues across disciplines in our Applied Learning and Teaching Community. Plus the class would figure prominently in QEP assessment. I knew my colleagues here at UNCW would be watching closely.

But the samples weren’t cooperating! I was alarmed when we sieved our bags of sediment and found the most discouraging fossil assemblage in 20 years of incorporating authentic research in graduate and undergraduate classes. Among more than 60 species to be identified were thousands of *Mulinia* - a nondescript species a few millimeters in size!



“Let’s have a contest to guess the number of *Mulinia*,” John* laughed. “Winner gets an A!”

“I’ll take the winner to Denver to present the projects,” I said.

“Ha! You know we’re going regardless!” Tim* retorted. And the students laughed and bent over the samples with renewed enthusiasm.

I credit eTEAL and the Summer Institute for our success. Students thought specifically about what they hoped to gain from the eTEAL project, and they seemed more eager than in previous years to finish the “traditional” part of the lab each week and to jump into sorting and identifying their shells. Ultimately, despite counting 23,276 *Mulinia*, their final critical reflection pieces were glowing, and a majority of the class presented their results at the national Geological Society of America meeting in Denver!

That’s a lot of *Mulinia*. Is it worth it? Since 2003 I have offered GLY 337 nine times, including last semester. We’ve published and presented 16 abstracts, with two more planned for this year’s national meeting, as well as several peer-reviewed articles. I’ve found it useful in addressing questions in my own research that require massive data collection – though publishing with students definitely is more work than doing it on your own. Nevertheless the benefits for the students are worth it. The approach promotes student learning objectives related to understanding course content, critical thinking, problem solving, and oral and written communication. Students experience authentic research from conception to dissemination – just like real paleontologists! And the students seem to like it! Over half the students who have taken the course remained involved in paleontology following the course by presenting the work, requesting to continue their research as a DIS, taking additional paleo courses, or pursuing graduate study in paleontology. In fact, three of my students who have participated in my in-course research projects now have PhD’s and are using the same approach in their courses!



Ok, I've given you an example of a semester-long, lab-based applied learning experience. You may be thinking, "Well, that's a science class. It's easy to include applied learning in lab-based science classes. I don't teach science. And I have too much content to cover – we can't spend a whole semester on an applied learning project." Let me paint a different scenario for you.

Imagine yourself back in DL 105. I'm meeting with the 18 students in my Honors Seminar on "Evolution & Creation: Conflicting or Compatible?". They're not all scientists; students' majors also include humanities, business, and secondary education. They're diverse otherwise, too - religious affiliation varies from atheist to mainline Protestant to evangelical to Roman Catholic to Muslim.

My goal was to explore the supposed conflict between evolution and faith using insights from several disciplines -- geology, paleontology, biology, education, philosophy and religion. We explored what science is and how it differs from religion. We examined basic principles of evolutionary theory as well as creationist views. We also considered educational, political, legal and religious issues surrounding the controversy.

They were a good group of students. I could easily use the pedagogies encouraged in the Honors Faculty Handbook. They dived into all the hands-on and active learning activities - for instance, using specimens from the paleontology teaching collection to investigate change in life through time, or interpreting data from my PhD thesis to decipher modes and mechanisms of evolution. We delved into opposing viewpoints on each issue, and daily discussions were animated. We even held debates on the topics "Is evolution science?" and "Is creationism science?" They weren't shy about expressing their views. But could I push them a step further? Could I get them to apply what they had been reading and discussing to what could be a real-world situation? Once again I was a bit nervous. But the UNCW Honors handbook said we should take risks....



You've come into our classroom as we are preparing to hold a mock school board meeting for an imaginary school district in Mississippi. Students were randomly assigned roles (e.g., pro-creationism parent, pro-evolution teacher) and are busy inventing personas and lining up their arguments. I pretend to be the moderator, a high school teacher pushing a creationist agenda. Time to call this meeting to order! I clear my throat and attempt a Mississippi accent.

“Good evening, I’m Beulah Faye Anderson, and I’ll be moderating this meeting. For those of you who don’t know me, I have a degree in Music Education from Ole Miss and I teach science at the high school. My husband Carlie Arlie Anderson is preacher at the Hallelujah! Jesus Christ is Risen in Glory Tabernacle. We are co-founders of PIMPED, “Parents and Instructors Making Progress in Education.” We are sick of evolution being crammed down our throats and bronchial passages. It’s time to get creationism into the curriculum. Our goal tonight is to brainstorm ideas for how to do that. I am opening this meeting for suggestions. Please introduce yourself when you make a comment.”

One of the students says, “I’ll start things off. I’m Bertha Butts, and my twins are in the 10th grade. Our state doesn’t have an “opt-out policy” so I think our school board should adopt one. Parents should be able to decide what their kids are taught and take their kids out of classes on evolution.”

“Not so fast, Mrs. Butts! Opt-out policies are bad for schools, school districts, and students. Our students won’t be able to get into college if their parents won’t let them study topics they object to. They’ll do poorly on standardized tests and make our whole district look bad. Oh, I forgot to say that I’m Dorothy Adams, and I teach chemistry at the high school.”

“If you’re a teacher then you should know it’s only fair to present both sides. If evolution is taught, creationism ought to be taught along with it. Oh, my name is Ricky Bobby. I’m on the school board.”



The student portraying the chemistry teacher responds, “Fairness should not have anything to do with what’s taught in schools! You can’t teach something that’s illegal! It’s my responsibility to teach the facts, regardless of whether you think that’s fair or not.”

“I’m a parent, Eula Mae Meriwether. You’re not from around here, are you, Mrs. Adams? We need to teach all the evidence having to do with evolution – the weaknesses of evolution, not just the strengths. We should “teach the controversy.””

“But there isn’t any controversy! Sorry, I’m Joel Hughes, and I teach biology. There’s a ton of evidence for evolution, and it’s fully accepted in the scientific community.”

“I’m a teacher too – middle school earth science. Suzy Rae Carson. Academic freedom gives me the right to teach anything I want, including creationism.”

“You can’t teach religion in public schools. It’s unconstitutional!” the student playing the biology teacher cries in frustration.

Well, as you can see for yourself, I didn’t need to be nervous. Students flung themselves into their roles with enthusiasm, insight and creativity. The role play helped them synthesize ideas from throughout the course. By being placed in a (nearly) real-life situation, they are better prepared to make informed public policy decisions (e.g., teaching of creationism). Course ground rules meant that we all respected one another; the diversity of backgrounds and perspectives (simulated and real) made for a truly enriching experience for all of us!

Ok, all this is fine in small classes. But what if you’ve got 100 students? How do you do applied learning in a setting like that?

Imagine yourself in my Prehistoric Life class – 100 students crammed into 100 seats in DeLoach 114 - a room designed for traditional lecturing, with fixed, closely spaced rows. Most students are there to fulfill University Studies. They are not science majors and some are initially skeptical of, or even threatened by, evolution – a foundation of the course. Traditional lecturing is a poor vehicle for overcoming resistance to learning about evolution, as students



can easily “tune out” material perceived as offensive or at best learn passively (memorizing enough to pass a test) without internalizing the material.

The answer? Applied learning, of course – as well as a whole range of other approaches that create a “student-centered classroom,” overcome the difficulties inherent in the traditional lecture format and venue imposed on this course, and engage students who may feel threatened by the course material.

I’ve written about my approaches in the latest *Best Practices in University Teaching* volume edited by Diana Ashe and Carrie Clements, so I won’t repeat all the details here. My approaches include interactive activities that enable the students to construct course content with me, group work, minilabs, writing assignments, and participatory demonstrations. Although teaching this course, if any, should make me nervous, I long ago got over being nervous, as you can tell from the video that won the eTEAL Instagram contest.

So, as I was saying, imagine yourself in my DeLoach 114 classroom. We’re studying the diversification of mammals and other vertebrates after the dinosaur extinction. The key concept is ecological guilds – different ways of making a living. Guilds were medieval associations of tradesmen (which I illustrate with slides from a trip to Krakow), but we still use the concept today (e.g., the Screen Actors Guild). Ecologists and paleoecologists use the concept of guilds to describe groups of organisms that compete for the same resources in similar ways. Guilds tend to be organized by where a species lives, what it eats, and what size it is.

Oh wait – we don’t have to imagine a class on this topic – we can re-enact it! You are all my GLY 135 students, and we are going to do some applied learning with beany babies. We’ve talked about the guild concept. Now work together in teams to figure out what guild your beany baby belongs to. When we get the hang of it, we’ll apply these concepts to the fossil record.....

[applied learning activity]



So, as you can see, applied learning comes in all shapes and sizes. We're used to thinking of applied learning in the form of DIS research, capstone courses, honors theses, and field practica. But you can do applied learning even if you can't devote an entire semester to it. An applied learning activity can last for one class session – or five minutes.

And it's ok to be nervous. Teaching is most fun for you – and your students – when you – and they – move outside your comfort zone. It's so much fun to share the excitement of our fields, stir students' curiosity, teach them to think critically and to question conventional ideas, and enable them to learn by doing. Thirty-six years ago I could not have envisioned how my courses would evolve. What a joy to find new ways to engage students and enliven their minds!

**student names changed to preserve anonymity*