

Christopher Richmann: Welcome to Professors Talk Pedagogy, a podcast from the Academy for Teaching and Learning at Baylor University. I'm your host, Christopher Richmann. Professors Talk Pedagogy presents discussions with great professors about pedagogy, curriculum and learning in order to propel the virtuous cycle of teaching. As we frankly and critically investigate our teaching, we open new lines of inquiry. We engage in conversation with colleagues and we attune to students' experiences, all of which not only improves our teaching, but enriches and motivates ongoing investigation. And so the cycle continues.

Today, our guest is Dr. Tammy Adair, Senior Lecturer in biology and Director of course based undergraduate research in biology, and director of Baylor's undergraduate research and scholarly achievement program known as URSA. Doctor Adair also teaches course based undergraduate research experience labs, such as the phage lab sponsored by HHMI and the Science Education Alliance. Her undergraduate researcher group, the M&M bears focuses on microbial genomics. We are delighted to have Dr. Adair on the show to discuss active and then experiential learning in STEM education and undergraduate research across the academy.

Tammy Adair, welcome to the show.

Tammy Adair: Thank you.

CR: Let's start just by giving our audience a taste of some perspective on how you became involved in undergraduate research to begin with.

TA: Okay, well, I became involved as a graduate student in our lab. I was able to mentor several undergraduates. I just really enjoyed seeing them learning and developing their lab skills. And so I, as I became an instructor (so I'm a senior lecturer now, but I've always been on this teaching track) But I was able to continue to mentor undergrads in their honors' thesis. And so I didn't have an undergraduate research experience personally. I was a non-traditional student, but once I was in graduate school, I always had some undergraduates around me and I just thought it's a great, great way to help them learn what it means to do research.

CR: So how did that evolve in your time here at Baylor?

TA: So at Baylor I started out kind of this one-on-one idea that you, you mentor a student and you take them from a proposal through a final project. And that apprenticeship kind of model, I think is still pretty common. But in biology (I'm in the Biology Department) and in biology there are a lot of students and so I started developing ideas of how we could team, do teamwork. And so I'd get like groups of five or 10. And from that, I was in my professional society of microbiology, I was introduced to some of the core space undergraduate research programs that were national going on. And so we started that in about 10 years ago. And so those are the ways it's kind of evolve for me as like a one-on-one then a small group and now in larger sections of 24 trying to find projects that work that, that they can take ownership with. They can find new discoveries each time. So it's their own project. But where it's kind of worked out where you've, you're, you're planning on how to teach technique and scientific communication and how to read the literature. So you have these major learning objectives as well. It's not as much of an open research project. And so I think those are the two main ways you either have an apprenticeship model where they're doing their own research or working alongside someone, or you have kind of a guided inquiry. And that's how we've, that's how my, my work has moved, is more into a guided inquiry approach so that more students can get involved early,

CR: Right. So how do you decide what kind of projects to pursue in your area of biology?

TA: Well, in my area it's really, it's pretty easy in my mind because there's so much unknown. And so I work with diversity and in the microbial realm. So if you go out and take a spoonful of soil and you look at the microbes in that soil you're always going to find something new. And so there's everything from viruses to bacteria to amoeba or some type of protozoa or little worms--or there's just all kinds of life in the soil. And so the project that we do with C phages is what's called Science Education Alliance Phage Hunters—C phages--is they look in the soil for bacteriophage viruses that infect particular types of hosts. And so this is exploratory. Thing or they're not going to always find something, but they're going to find something enough to get a result. And so they learn this kinda succeed, fail to succeed model. And then after they find their virus, they characterize it. So there's a large diversity, so they find something new. They look at the DNA sequence and annotate the genes just like we do with the human genome. And then there's a lot of applications to this, with viruses in general, but also with like phage therapy, how you can use bacteriophage to treat antibiotic resistant genes. So I look for something along those lines that has a discovery aspect that they can take ownership in, that's Not always the same result, but, and it's not always successful. So they have to work pretty hard at it. But there's some literature there that they can get understanding and that there's new discovery that they can contribute to. So they contribute by publishing their sequences.

CR: So how are you connecting this to just the larger scientific questions about why anybody would want to know these things? What, what difference it makes?

TA: What difference does it make? So I think that, I mean, in the broader, that broader question about why do we do research, I think has a, a two or three layers. We're curious and we're creative people and so we just want to know. But then there's applications of the technique in the process of thinking, right? How do you go about gathering evidence to support or reject the hypothesis that, that modeling of that type of scientific thinking. And then there's the connecting. So we talk a lot about collaboration and cooperativity among your research group, but also between different disciplines. So how can you take what you've discovered and make it applicable to somebody who doesn't know anything about that? How can you learn from someone who's doing something completely different than you? How can you connect with this, I guess this intrinsic. We're curious and we want to know why, you know what, what, what is a reason. And so I think that we try to teach those processes, right? Thinking.

CR: Speaking of disciplines in your role here at Baylor, you probably have a better vantage point about of, of undergraduate research across many disciplines and departments. So I'm curious what your thoughts are about how undergraduate research differs from one discipline to another. What, what you see there.

TA: Yeah, so okay, So as the Director of Undergraduate Research and Scholarly Achievement, URSA, So we're in the office of engaged learning. And so you're right, we have students from every single discipline that, that are interested in doing the research. And I've learned a lot over the last four or five years, but I don't want to say anything wrong because I am certainly not an expert in humanities, but from my friends in the humanities, they often explore philosophical interpretations of works, right? They look at books or music or art, and they explore the historical context of a discovery. So they're interpreting works. And that is discovery in itself, right? And so I've learned to appreciate that more than anything, is that we, and maybe that's the big picture of how disciplines connect is that we don't only connect because they might have something informative that I could use. But they have, they have the ability to help me see that everybody has something important to, to, to think about. And I think that's important to teach our students not to be with their blinders on and in a vacuum, but to see why it matters to everyone else around you also--that this connection of making relationships and working together and being respectful and appreciative are important ways to live. No matter what you do.

CR: I know it's hard to, to compare disciplines. But from your, from your perspective, are there certain disciplines at Baylor that are just really knocking it out of the park when it comes to undergraduate research.

TA: Well, I would say based on Scholars Week, the historically STEM, the Science and Engineering Group has been more numerous. So psychology, neuroscience always has a big group, communication sciences and disorders has a large group. Biology and Chemistry and Biochemistry have a large group. But we also have, I have a list of like different departments. We have Political Science, right, that participates; modern language and languages and cultures. We have history. So there's, there's really someone religion always has a group at scholars week. So there's always somebody in almost every field that participates. So I would say that maybe there's some participation going on in ways that we don't capture with URSA, that I'm really curious about, like to get a better handle on, right?

CR: So how do you encourage faculty to get involved in this? Because it really, I would think that it has to often be the faculty member pushing for this either in their classes or in a in a relationship with a student, right?

TA: Right. Okay. So we have to skip a couple of years, right. And everything we do. So the last two years were virtual symposium. Yeah. And I was really happy about how many students put together online information in, and some of those are still on the Scholars Week web page if people want to look at those. But even before that, there's usually about a 100 students or so during scholars week, a 100 group set, participate. So that's not a large percentage of the university, and it's probably not a large percentage of the research that's going on, the undergraduate going on. And so I wish I had a good answer of how to encourage more people to get involved. We tried to make it easy to apply, put your abstract up. This year at scholars week, I'll put a little plug out where we're looking to have a session, a new session to explain to new faculty and faculty that haven't been involved, How to get involved in what to do. We have a web page to put that, marketing it out there and we try to send out some e-mails through the Baylor news e-mails that come out on Wednesdays to to get the word out. I think I'm, I'm guessing that the problems with getting involved are just time.

CR: Sure. Right.

TA: Yeah. It's hard to manage everything that you do sometimes and plus, help a student get their presentation together, right?

CR: Well, maybe one of the ways to enter that conversation is to take a few steps back from the logistics of it and talk about the benefits for Learning. So as you see it, how do students benefit in their learning when they participate in this kind of research?

TA: I think that's why I'm so passionate about it. It is so obvious, right? And in a large classroom when you're lecturing and you're pouring out your information into their head and they're trying to just absorb all of that, It's sometimes really hard to tell whether learning has taken place or not, right? You're teaching, but are they learning? But when you're working on them and they are coming up with the ideas and it's their turn to think and be curious and creative, they get so connected with it and so excited about it that they go out and read ten papers you didn't assign and they don't get a grade for it and it's just what they're doing. So It's really inspiring, I think, to most teachers to see that kind of work going on in the class or with their students. And so, I mean, I think really that's the motivation for most people to do undergraduate research is that's, it's your discipline. You want the next generation of researchers in whatever your discipline to be trained and to connect with

them. But also you're making a difference in an individual's life, right? You're giving them an opportunity to be a scientist or to be linguistics or let out whatever your study.

CR: Yeah, yeah, especially with the ownership that the students take over over their learning. I mean, there's so much research that shows that there's this deep connection between motivation, student motivation and a sense of autonomy or a sense of ownership. And so this is one way to, to make that happen. How do you, how do you advise faculty to talk to students to prepare them for doing this? Because it's kinda next-level, thinking, right for and academic tasks for a lot of students, how do you, how do you set them up to do it well?

TA: Well, I think in our department, everybody has a little different kind of application interview. This is how many hours a week that students normally spend and this is the expectation that you will have this finished. But yes, so just kind of giving them the expectations. But I think more than anything, just asking them what their motivation for doing it is and seeing if it's in line with, with that, because you don't want somebody to take on a research project just to say I've done research or whatever. And so I think having that communication early is an important part. Most, most students, all students that I know of that are that in there because I want to learn and they want to explore certain areas. Don't have any trouble putting in the time.

CR: Do you have any perspective on how these research experiences help develop students sort of confidence in science or their science, self-image or self efficacy? We think a lot about that, especially in terms of the, the women and minority students in STEM and encouraging them early to, to see themselves as scientists. So do you see that in this work too?

TA: yes. And there there is there's quite a bit of scientific science education research in that area. The program that I referenced earlier C phages has done a large scale study on that on students attitudes towards science before and after. And it's, it's really helpful in bringing students that have a poor image up to a higher image, right? So yeah, if you already think you're good to go read, write, and you still stay there. But it's because they recognize that they are capable and that they have something to bring in, that this is something that they are able to do. And so the image of a researcher is transformed in their mind, right? I can be, I can do that.

CR: Yeah, yeah, brings, it, brings us back to those those experiments we're all familiar with. The draw scientist and the kindergarten students are drawing men, white men in lab coats. Well, what is the image of a scientist? And there, and that, that traditional image is pretty tenacious. And so universities have a lot of work to do to help dislodge that. And I think the undergraduate research is a great starting point for that. Have you, have you received any have you followed any students' careers into grad school, into their own science careers and have you gotten any sort of post hoc feedback about how these undergraduate experiences really help them?

TA: I do, I, I, I think I receive emails a couple of times a month from someone now. It's very, very--It makes my day every time, right?

CR: Yeah. I bet.

TA: You know. It's a it's a learn it's like a learning cycle. If you see where you want to go and you know how to get there and then you assess, did you do it well—it's kinda the same way with research. You get into a project, you do well. You, it opens your eyes to other things. Somebody sees you as capable, they'll get you on. And so the Office of engaged learning is really working toward helping students get those next tier opportunities and some of these scholarships. But in med school, they'll say, I know how to read the literature or I understood the process that drug discovery

or those kinds of things that are tangible and yellow. But I think just the metacognitive awareness of what it takes to really understand something transforms the way that they perform as graduate students, that they go in so much stronger.

CR: While I do hear that from, from the graduate students that I work with, that a lot of them in their undergraduate experience, if they didn't have some kind of research experience imbedded into it, they have a hard time with just those sorts of things like learning how to read the literature. And I've literally had STEM graduate students tell me like, I never really had to read primary literature as an undergrad. And then it's like you just get thrown into it as a grad student and you've got accepted to a program because your GREs are great and all that. But it's like the practical stuff of, of doing science. There's a huge learning curve for that, very, very steep.

TA: And I just feel strongly that that's our responsibility as an undergraduate educator in STEM is to teach them what scientists actually do it, right? We don't sit there with our textbook and learn vocabulary. All right. We got data. We what do we with our notecards. And so, yes, it's a lot more fun too.

CR: So give us a little bit more perspective on the scholar's week and, the symposium. How does this work? When is it and what what would someone expect to see if they participated or just a witness, these things? First of all, we planning to in person this year?

TA: We are. And we will have the abstract applications open, very short labor, we're just working on the form. But if you go to the Baylor.edu/URSA and then there's a tab for scholars week. You can look at the last couple years of scholars week symposia that's on there because they were all virtual and so we've left, left them on there. You can see all the different ways, but what happens is on Monday and Tuesday in the SAB, we have oral presentations going on. And so there'll be from all different disciplines, but 10 or 15 minute short talks from their research.

CR: So that's kinda like academic conference style.

TA: Academic conference style. Yep, So they're doing PowerPoint presentations and the small Siberians and the sub and taking questions. And usually there's a judge in the room That's fielding some how well did they perform and that kind of thing. And then in the BSB on the first, second floor, there'll be poster sessions. And so occasionally there are humanities posters, but these are mostly stem posters. And so students will rotate. There'll be four different sessions where they'll put their posters up, take them down and, and students will stand in for other posters for 30 minutes to an hour and just answer just a regular academic poster session. And so we try to dress it up, have a little bit of food and make, make it as authentic as we can to having aProfessional symposium. And then we have a speaker—it hasn't been hasn't been verified who that will be yet. But on Thursday afternoon we'll have a speaker, and then on Friday we'll have an awards ceremony. And so we ask each discipline to pick a couple of two or three top, top group of presenters. And so we give them a certificate. And then we are joining that with our faculty awards. So the Elizabeth Bardem awards that you have. The faculty awards will be given during that time as well.

CR: That's great. Yeah. I remember I wasn't involved in any undergraduate research when I was an undergrad, but I remember the first academic conference, I presented that as a as a master's degree student. And boy, just like all of a sudden overnight you just feel so professional and it just kind of gives you the strange boost up like yeah, I can do this, right? Even if you get tough questions from the crowd, you know, it just it's such a, it's such a game changer for how you see yourself academically and professionally.

TA: I think so too. And so I'm really looking forward to be in face to face and being virtual was better than nothing. But it's hard to really do that, to interact and be the professional behind the screen.

CR: Yeah. Yeah. So how long has Baylor been doing this?

TA: I think about 11 years. This is my third year as the director. Dr. Braton, Susan Breton started the whole URSA program. And so it has it has grown, of course in size. But it's also think that URSA grants, we also had this program where we can give money for undergraduates That's also grown some in money, dollar amounts. And so students can apply to either pay their self. So that could be like a stipend that they can have. So we're hoping that that helps with this inclusivity and writing out the opportunities to people that might have had to go work at McDonald's or something. Instead, they could use the stipend. They can buy supplies or they can pay for travel to a conference. And so we have that money available and it's also on that webpage. And so I think it's, there's a good feature here.

CR: Yeah

TA: Everyone in the university is looking for ways to improve undergraduate research opportunities. so whoever's listening, Let's send me or send me your suggestions and we will work towards that.

CR: So aside from just growth and the development of these grants, are there other ways that you've seen The Scholars Week in the symposium develop over the years?

TA: They had been run the same, basically the same way--this year we did develop a new way of putting the grants out there. So for historically like they had been faculty written grants and then the faculty would decide on which students they were going to use the money for. And we decided as a steering committee to make it more student-driven so that the students have opportunity to learn how to write a proposal. So now they write the proposal and they're already committed to the project. And then they get their faculty mentor to, to recommend them. And so we're hoping that that will, that will be successful in both ways--I think that will help grow what we would want our undergrads to know, to know how to write proposals and how, where you get money and how all that works because that's a really important part of it. And then, like you say, have the ownership right, but they have to be informed that it's there. And since this is the first year, we need to get that word out to all the faculty that this is how we're doing it. So tell your students to apply.

CR: So I'm sure you've seen a lot of titles and a lot of abstracts, a lot of proposals, a lot of presentations. What, what have been some of the most memorable either types of projects or research endeavors that you've seen students really pull off?

TA: Okay, So there's such a large variety, but I think some of the environmental studies projects have been really interesting. The communication sciences and disorders. I've enjoyed getting to know some of that group out the VA, that mentor some of our students. Dr. Stephanie Body, last year, she had a very interesting project that was a good example of how interdisciplinary projects can work. She had some engineering students and some that were interested in STEM education and then some social work students that we're interested in not having STEM education in the community and how they could work together to, to make that improve. One thing I think is really, from my perspective, that's really been helpful is to think about first-year students in this process. Because the students that I have in C Phages have always presented their posts. That's always been so transformative to them that they want to go to the microbiology meetings or that they want to take another course based research project or get into a lab. Because like you were

talking about it just kind of seals that they can do it, that they are scientists, that they are capable of doing that. And so I think anytime you could get some first-year students to go, not just your seniors that are finishing up their work but The first-year students as well. I think that's always been Fund Dr. Martie Harvey has a bunch of first-year students and always present and that's always really interesting to me what projects they came up with and why and what they were thinking. So yeah, there's just a large variety of projects and talking to students and hearing their enthusiasm and their reasoning is, It's worth a couple hours of moving around the campus to talk to them during that week.

CR: While I'm thinking about first-year students involvement as I think many faculty, that's not the first thing you think of. When they think of undergraduate research, they probably think more in terms of the upper-class students who are closer, maybe on the cusp and thinking about grad school and all that, all that kind of thing. So really doing this with a first-year students reminds me of how undergraduate research falls under this broader umbrella of what we sometimes call it high impact practices. So like study abroad and in undergraduate research. These things that, that really make a difference when it comes to student retention and students sense of belonging and graduation rates, just all these kinds of things like not just, not just as important as learning objectives are and development as professionals might be, just college success, right? This is, this can be a key ingredient to that as well. So for first-year students, I'm, you know, I can't imagine how that, how impactful that can be.

TA: I think that part of the success for sure in C phage is that the groups, so they work in groups of three and those groups of three are still together their senior year, yeah. I mean, these are lifelong friends. Some of them have even gotten married. I don't want to predict that, but let me say that. No, it does make such a difference to not work as a group where you just divide and conquer, but work as a team where everybody has a part and you start to just I don't know. That's just it. They're proud there. They are proud of who they are working with. Yeah, work hard together and it's like a football team or a basketball team or whenever you all have your position and you need each other and it works out and you just form that close relationship that it's a part of learning, right? Yeah, I agree. And there quite a bit about retention there in the literature about undergraduate research and retention are correlated very strong.

CR: Yeah. Do you have any thoughts about how now as Baylor kind of it has moved into the R1 sphere officially. And we think about ourselves now as R1 and not aspiring R1. How does undergraduate research work into that? Do you see it having a role?

TA: Well, I hope that it's a parallel path role because to me, the more R1 research opportunities that you have, the more opportunities you have to put an undergraduate in those programs? And I know in the sciences that's often part of the NSF or NIH grant, is how, what is the impact that you had undergraduate population. But even beyond that, it, it's a level of, of your team. If you talk to the PIs, they love having the undergraduates in there—it keeps the good questions coming it keeps than excitement coming there. They're part of that environment, that part of that community. And so I'm hoping that the more as we grow those places will grow the places for undergrads because that is one of the problems in some departments is there's just more students than there are faculty mentors, right?

CR: Sure. So maybe speaking just from your own experience, but also what you've heard from other faculty. How does getting involved in undergraduate research help, help a faculty develop their own sense as an instructor or as an a, as a mentor for students, right?

TA: So I think that whenever you have that relationship, that closer relationship with your student-- And so it probably depends on that department. Some departments have those small classes anyway, and you form those relationships in your teaching. But undergraduate research almost ensures that, right, because you have to communicate, you have to read and edit and you have to communicate your, your questions and your, your thoughts clearly to the student. And so it makes you a better instructor because you're, you become better at talking about what year you're thinking. But I think it also I don't want it to sound like it's you're not bragging about it, but you just feel good about it. You're just doing something good for someone that you don't have to do. Yeah. And the benefits that come, I think are from that intrinsic part of that. But just knowing that sharing what you love with somebody else that that has that interests too. And that's why most of us are in this.

CR: Yeah. What I could see too is that that getting involved with, with students in research, it either sidesteps in a good way or buffers the, the, the traditional grade thing that's in the middle, that's always this thing in the middle, getting in the way of the student-teacher relationship, if I can be frank, Right? But when you're involved in, in in actual research, you're standing shoulder to shoulder and you're not, it's not adversarial, right? It's, it's you against the unknown that you're trying to discover.

TA: Right, that's the perfect way to think about it. Yeah, so students always want to know what grade am I going to get into this class? There's something that's always say you're going bigger and work, right? Yes, to say that there's more to learning than being measured by a grade. And what do you understand? What can you communicate?? Why does it matter? How are you going to solve that problem? How are you going to troubleshoot? Always troubleshooting. Teaching that much more enjoyable than deciding how many points to take off on a rubric, right?

CR: So in addition to our hopes for what R1 may mean for undergraduate research here at Baylor, Are there any other sort of new vistas that you're sort of things that are on the horizon for, for this area of our development?

TA: And so I would like to find a way to have a council of undergraduate researchers campus-wide so that we have a little broader, you know--we have a steering committee. It's a university steering committee that a few people are on that we try to make these big grant decisions and things like that. But I'd like to have more of a vision where we have discussion going on all the time about what kind of research is going on in each discipline and how, you know, how many students are involved in little, maybe short symposia for this one or that one. So just kinda to broaden it and in, so that we are a lot more informed as a community about faculty, but also as students about what research means in history or what does research mean in religion or those kinds of things I'd like to work toward that somehow.

CR: That sounds great. Well, thank you so much for joining us today and for sharing your insights.

TA: My pleasure. Thank you.

CR: Our thanks again to Dr. Tammy Adair for speaking with us today. If you want to learn more about Baylor undergraduate research and scholarly achievement program including the Scholars Week and the related symposium, you can find the link to their webpage in our show notes. That's our show. Join us next time for Professors Talk Pedagogy.