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Transforming the Culture of Biology Teaching with Erin Shortlidge

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Welcome to PDXPLORES, a Portland State research podcast featuring scholarship, innovations, and discoveries pushing the boundaries of knowledge, practice, and what is possible for the benefit of our communities in the world.

Erin Shortlidge: My name is Erin Shortlidge, I use she/her pronouns. I am an Associate Professor of Biology and Biology Education, and currently an Academic Affairs Leadership Fellow and Inclusive Pedagogy in STEM Education at Portland State. So, my group's work is generally focused on understanding best practices and teaching and learning science. We're interested in this from multiple perspectives, including that of the undergraduates, graduate students, instructors, and administrators. And we'll use various theories and research methods to form and address our questions. So, I will be sharing with you today about a project I'm involved with called Evolving the Culture of Biology, or ECB, but first, I want to frame kind of the basic premise that guides much of this work. So, you may be familiar with multiple national statistics have been released that show that only approximately 40% of undergraduates that declare a STEM major end up finishing with a STEM degree. And so, therefore, we're losing 60% of our students, either that they're switching to another major, which might be fine and great for them, it may not be fine for others, or they're leaving altogether without a degree. And so clearly, this is an issue, and this trend is apparent in STEM fields, or Science, Technology, Engineering, and Math, in a way that it's not in other fields, such as the Humanities and Business. And even more alarming, we find that disproportionately students that are underrepresented in STEM already, so, students of color, women, first generation students, are not being retained at an even higher rate than their more represented peers, and so this is a problem that clearly needs to be addressed, and this underlies a lot of the work that my group does.

So, the attrition from STEM fields is happening oftentimes in Intro courses. So, research has been done on when students are leaving, and we're finding that that's often happening in their introductory STEM courses. And so, the question is why? What's happening in those courses that students are leaving? There are reports that introductory STEM courses can be overwhelming and “have a chilly environment”, especially for students that are marginalized in STEM, they're often seen as, and communicated as “weed-out courses” or “gatekeeper courses”, keeping students from achieving their goals as opposed to setting them up for success,

and students feel that they don't belong in STEM. They talk about not feeling like they belong in those classes, that the classes themselves are disorganized, the subjects are obscured, and then ultimately they end up feeling discouraged from becoming a scientist.

So, one thing that we know about these often large introductory STEM courses is that they rely heavily on traditional didactic or lecture-based approaches in teaching, and so this approach makes them what we call instructor-centered and not learner-centered. Instructor-centered teaching is when the instructor is up there telling the students what the instructor knows and expecting the students to then absorb that information, as opposed to a learner-centered environment, which is intentionally designed to engage students. And this is based in cognitive science. This is based in decades of research on how people learn, so, a learner-centered approach. Engaging students in their own learning process, meeting them where they're at, as opposed to expecting them to be at a place that they may not be, giving them opportunities through various evidence based practices. And evidence based practices, I mean teaching strategies or techniques that have been tested by the education research literature base and have shown to result in learning for students. And so, a learner-centered environment allows students to engage with the material and often these intro courses are simply not doing that. Like, as an instructor, it's not about us, it's about the students, and so, really reframing the way that we think about the purpose and the value of an introductory STEM course could be critical, and we know from research by Marilyn Stains and some other colleagues that still the didactic method is largely being used in intro courses. So, if we're thinking about the classroom community that we're hoping that students feel that they're part of, if we want to retain students, there are a number of reasons that we can identify that maybe point to why students don't feel like they belong. What are some of the examples that are used in classes? Are they examples that students can relate to? Are they examples that actually alienate a student from feeling like they're part of that class? We often see pictures of dead white guys who made an original discovery or developed a technique, which is fine, that is the history and the basis of our field, and that's great. However, this sort of example can't be the only examples, right? So, examples of what success can look like in the field are numerous. There are plenty of people of color, of women, of people from disadvantaged backgrounds that are out there doing amazing science related to the science being taught in courses right now. And so, intentionally integrating examples of those scientists and the work that they do and even having students engage with

that is a way that perhaps students can see themselves in the current science and maybe they can say, hey, this person shares this identity with me. I can now more clearly see myself succeeding in this field because clearly there's evidence of success for someone that might have a shared identity with me. And so, there are a great series of activities that I will point out here called Scientists in the Spotlight that is available online. I think it's scientistsinthespotlight.org or scientistsinthespotlight.com and folks can take activities that were designed for exactly this for students to engage in. and the research around this have shown that for students engaging in these types of activities, they do have more success in STEM. And not only that, if students design these activities, they also have greater success in STEM, and this is disproportionately true for students historically minoritized. And so, there are ways to mitigate some of these things that are happening in classrooms in ways that don't require you to upend your course and completely redo it. So, there are lots of these evidence-based practices that can be implemented to slowly begin to change the culture of Biology.

So the premise of the project, Evolving the Culture of Biology into 21st century teaching, or ECB, is that through training our future faculty in more inclusive and evidence-based practices, similar to the ones I've been talking about, we can hope to accelerate a STEM climate that is more welcoming to students of all backgrounds. And thus, as the research would show, more amenable to students having deep learning. The key to this, in our opinion, is graduate students and graduate students are this part of the education ecosystem that are often overlooked and undervalued, especially as it relates to undergraduate education. And so, take, for example, a large intro STEM course. You may have 200, 400, 700 students in that class and you have one or two instructors. The face time that that instructor has with the individual students is going to be a very small percentage of students. Their one-on-one interactions are going to be limited simply by a numbers game. However, most of these courses, especially in biology, have associated laboratory sections. These labs are taught by teaching assistants or TAs, which are graduate students, either Masters or PhD students, and those students typically lead a lab section that will have a much smaller number of students, so typically 24 students, and they'll meet with them for 3 hours a week. So that is a huge difference in the face time that graduate students may currently have with intro STEM students as opposed to faculty. And so, GTAs are not only critical to our current undergraduate education system because they have a huge influence, but they're also the pool of our future faculty. Most graduate students who continue

into academia will end up teaching to some extent, and so, we believe that we can really have an impact on STEM education by focusing on that kind of middle overlooked section that are the graduate students. They have the potential to make real shifts in the STEM climate right now, as well as shifts in the expectations for what we can expect for good and inclusive teaching in the future.

So, many graduate students in STEM fields go through their training with a real emphasis on their research and their research training, with very little emphasis on teaching and learning. And we do know that most graduate training doesn't focus on teaching at all, and if they do, typically students have to opt into this as something that's on top of all the other things they're doing and there are multiple studies that have looked at this and sometimes training comes in the form of like a general training on what harassment looks like or, you know, like the logistics of being a graduate student, but very little on pedagogy. Yet, graduate students day one sometimes are thrown into teaching a lab with no prep and so this level of support, this perceived support doesn't exactly scream like, "yes, we value graduate students teaching". And it follows that most current STEM faculty were also not trained in teaching or pedagogy unless they sought it out, perhaps as a faculty member or as a graduate student. There are some universities that have worked really hard to develop some great teacher training programs for graduate students, but it's hardly the norm.

Our campaign to evolve the culture of biology into 21st century teaching is through the development of teacher training for graduate students. And so ultimately, we can affect hundreds of thousands of future faculty through promoting and training them in intentional, inclusive evidence-based teaching practices. And we ultimately want to facilitate the development of effective TATPD. So, TATPD is Teaching Assistant Teaching Professional Development. So, the development of effective TATPD on a large scale such that essentially, we would like to change the landscape of biology education, and I know that's a big goal, but it's something we're really excited about.

So, I keep saying "we" and clearly, I could not be doing this work alone. So, the work that I'm talking about, this ECB project, is work funded through the National Science Foundation through an IUSE grant, which is Improving Undergraduate STEM Education and it's collaborative and cross-institutional, and the team of folks that I'm working with is composed of six folks from six different institutions who are all deeply engaged and passionate about

graduate teaching teacher professional development, training graduate students, working with them and really kind of changing the landscape of the way that we teach to be more evidence based. We met, we were all part of a network called the Biotap Network. And BioTap is Biology Teaching Assistant Project. And so, the Biotap Network was also an NSF funded project. It was a research coordination network that got together folks who were interested in doing research on teaching assistants. The seven of us that are part of this particular project were put together on a sustainability taskforce. We decided that in order to be sustainable in this domain, we needed more money and we needed to write a grant to try to fund us to move into the next phase of BioTap. So now, two years later with a NSF grant, we get to think more about what it means to move graduate Teaching Assistant Teaching Professional Development forward. And so, my team is Mitra Asgari at University of Missouri Columbia, Adam Chouinard, Oregon State, Stephanie Gutzler, Georgia State, Kaleb Heinrich at the University of Alabama, Star Lee at UC Irvine and Debbie Lichti at the University of Michigan. And we will be bringing on a postdoc this summer, Tiala Shihade, joining us from Berkeley. So together, we are going to develop, facilitate, and evaluate a series of workshops. So, these are the ECB workshops, and they are designed to host teams of scholars from up to 60 unique institutions across the span of four years. So, each team of ECB scholars will engage in what we see is this very contextually-rooted and reflective process to develop or hone their own existing teaching assistant professional development, TATPD program at their respective institutions. The scholars will remain engaged in the project through ongoing virtual learning communities online, and ultimately contribute a product to an online repository dedicated to teaching professional development for graduate students, and will be publicly available for others in the field to access, and we are hoping that some of our ECB scholars will then become facilitators in our upcoming grants.

We expect that the scholars, the ECB scholars, will be working on components of their own TATPD from their institutions that will include three main components, and one of those components is the organizational context of their program. Another is the TPD program features and expectations, so, how often are graduate students meeting? What are the tenets of the program? And then lastly, what instructional practices are used in the program itself, such as are the TPD facilitators role modeling equitable teaching practices for then graduate students to practice?

So, our ECB workshops are holistically designed to meet four main learning outcomes, and we've designed this three and a half day workshop to meet these four learning outcomes in multiple ways, and so I'll just tell you these four learning outcomes and hopefully they make sense in this context. So, we aim for the scholars to justify the value of teaching professional development for transforming bioeducation to be more inclusive and student-centered. And what we mean by justify, it's like, can you make a good case for a sustainable program at your institution? Can you get by and can you convince yourselves and the folks around you that this is something that's really important? The next learning outcome is to reflect on institutional context and current TD offerings to evaluate the strengths, identify areas for improvement, and what levers they have for change. The next learning outcome is for folks to identify evidence based models and methods for implementing and assessing TPD that are tailored to individual contexts. And then lastly, to create and revise a strategic plan to improve TPD models and share resources with other practitioners. Those objectives essentially outline the program that I just told you about, but we are very excited that our first workshop will be taking place in Atlanta this summer at Georgia State hosted by my colleague Stephanie Gutzler, who's on the PI team. And we are very excited that we received four times as many complete and excellent applications from institutional teams than we could accept. So, we were able to select ten teams from ten different institutions, and they represent a variety of higher ed institutions. We have Masters-granting institutions, as well as Phd-granting. We have high research. We have HBCUs, which are historically black colleges and universities and minority-serving institutions, and making up our first set of ECB scholars. And what we're really hoping is that we will foster a community of learners during these workshops with this kind of small enough cohort feel, and that we'll end up having about a one-to-five ratio of facilitator to ECB scholar. And in these three and half days, we'll meet the learning goals I outlined earlier, but really we want the teams of institutions to take a critical look at their current TPD program and decide how they'd like to move it forward. So, we acknowledge fundamentally in this project that each team is going to have various constraints and supports at each of their institutions, and we'll encourage them to work within their own contexts. Wherever they're at, that's okay. We're not expecting the programs to look the same or to meet the same marks, but essentially, we will be working with ECB scholars as they decide which goals related to the TPD structure, the pedagogy, the inclusive practices assessment curriculum that are the most salient and doable for them both in

the short and long term. And I want to make clear here that we're using a "train the trainer" model. So, I've talked a lot about graduate students and how important it is to train them. Well, these folks that we're working with, the ECB scholars, are the trainers, and so, they're not graduate students necessarily, but instead they are teams of folks who are, say, in charge of designing curriculum and training TAs in an institution. So, our dream institutional team is, say, a lab coordinator who works directly with TAs every week, an instructor of record who's in charge of the curriculum and, say, a department chair. And that piece of administrative support could be crucially important to sustainability, because we all know how many initiatives are started or folks go off and do a ton of work to develop a program and then there's a turnover and things get dropped, so we're really hoping to get some administrative support and buy-in for the work that these teams are doing.

There are two major outcomes that we're expecting to come from the work by these scholars from this whole program. So, one of the products is the TATPD program itself. So, they're going to improve upon or design from scratch a plan for that program, an action plan moving forward, and then the other product that will result from the workshops is this catalyst product that I described earlier, which is something to be added to an online repository. So, it might be a curriculum that they developed and their training for graduate teaching assistants. It might be an observation protocol. It might be a rubric to assess what's happening in the training, but we want them to develop something. We will be guided along the way that can then be shared publicly and live in eternity on this online repository that I think will be hosted through the Oregon State University. And again, those final products from their efforts will be shared broadly, and so this can allow us to further disseminate these results by, you know, if you're someone who's working with TAs and you only have 30 minutes, but you really want to do something different, we're hoping that you can browse this online repository, say, hey, this meets the learning objectives I was looking for, let's see if I can adapt it from my setting.

Most NSF projects ask for an external evaluator, which is great, and we will have an external evaluator on this grant who will essentially be there to process, check us along the way and make sure that we are meeting our goals and essentially all getting along and doing the things that we said that we do harmoniously as best as we can.

The program itself will be evaluated by an external evaluator, but the workshops and resulting Teaching Assistant Teaching Professional Development programs will be evaluated as part of

the research component of this grant project, and we will use mixed method research to do so. Our overarching project is guided by a change theory called the Teacher Centered Systemic Reform Model, or the TCSR, developed by Woodbury and Gus Newsom. And the TCSR postulates that there are multiple factors that can influence instructional practices and choices, and those factors include contextual factors, personal factors, as well as teacher thinking and beliefs. And sometimes we know that teacher beliefs are in alignment with our actions and sometimes they're not, and so we thought this was a really interesting way to kind of look at the choices folks were making. And we designed the mixed method research plan in part to assess how the elements of the TCSR are informing the decisions and experiences of the scholars, as well as the TAs who participate in the reformed TATPD. We know from the literature that beliefs and thinking about teaching can be uncovered and challenged through reflections, intentional reflections, and we also know that developing reflective teachers is one of the few ways that can consistently seem to be linked to driving institutional reform. And so, we've built in reflection, as well as work to assess the beliefs and actions of the ECB scholars, and then we're going to transfer that same research plan in question towards the graduate students. So, our research plan is actually still evolving as we speak. We are just in year one of this project, in our first set of workshops is this summer. Inevitably, as far as these things go, we will realize that we miss things or we want to shift things a little bit, do them a little differently, but as of now, our plan for assessing and evaluating this project, we're going to be using pre- and post-surveys that are modified from existing instruments to measure teacher beliefs, teacher actions, teacher efficacy, as well as gather individual, personal and institutional contexts. So, those are those factors of the TCSR that we're interested in sort of compiling a profile of each of our participants and then we'll be triangulating that quantitative data collected through surveys with the reflections, so those open ended reflections that we'll be collecting throughout the year, so that they can think about and check their own assumptions as well as challenge their thinking and work to identify how they influence their practices, and then we will be holding focus groups, so, our qualitative measures or focus groups, potentially interviews with both the ECB scholars who participated in the workshop to see where they're at and what they think about the project and how it may or may not have changed what they did at their institution. And then also we'd like to do focus groups with the teaching assistants who participate in the TATPD without the facilitators to get a better understanding of how the

program may or may not have influenced their actions and the classroom and how they think about teaching and learning. And we hope to learn how the elements of the TCSR are influencing both the scholar and the TA decisions as they're moving into more classrooms. We truly believe that the potential broader impacts of this work are huge. So, for example, if we extrapolate out on how many instructors we could potentially influence with this project, graduate students that participate in the TATPD, and then undergraduates who are affected by the graduate students who participate in it, we're talking tens of thousands of undergraduates potentially per term. As we expand this project across institutions and so, ultimately creating an influx of future faculty who are skilled in inclusive evidence-based practices, and hopefully believe in the value of this type of pedagogy, then we can in turn benefit countless current and future STEM undergraduates, and this results in the horizontal and vertical, broader impact that in our minds is hard to beat. We hope that these workshops prove successful, and that we're able to grow them, train more folks to facilitate them, and which would beget more money to continue to pay for them, and potentially get sponsors to bring these workshops into a broader audience.

My name is Erin Shortlidge. As a biology education researcher, my primary goal is to understand best practices in teaching and learning biology and the sciences.

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