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SARAH Today on *Chalk Radio*, letting experience be the teacher.

HANSEN:

ARI EPSTEIN: I always believed in the power of people having control of their own learning, and I believe in it much more strongly now.

SARAH My guest for the episode is Ari Epstein, Associate Director and Senior Lecturer in the Terrascope Program at MIT.

HANSEN:

ARI EPSTEIN: So Terrascope is a learning community for first-year undergraduates at MIT. We have at MIT four of these learning communities. It's entirely voluntary. About a fifth of the first-year class is involved in one or another of the learning communities. And we vary in a lot of different ways.

What we have in common is that all of the learning communities are both social and academic in nature. We go on outings, and we have meals with them, and we do a variety of things. We really build a social support network that is multigenerational.

So upper-year students also have a role in the community. Alumni also have a role in the community. So it's this support network that doesn't depend on your major, or your dorm, or your clubs, or your fraternity, or sorority, or teams. It's another intergenerational network that holds students up and helps them make the transition to MIT, which is sometimes really hard for people.

SARAH These learning communities also include academic offerings where students can explore topics and issues that interest and inspire them.

HANSEN:

ARI EPSTEIN: Academically, we have a number of classes. What they have in common is they all have to do with sustainability, and they are all classes where students have an enormous amount of control over their own academic experience. So our flagship class, our cornerstone class, our main class is called Solving Complex Problems.

And every year, we pick a problem. It's always a real problem. It always has to do with sustainability. It's always a problem where there is no perfect solution, so you have to learn how to make compromises. And it's always a problem where it looks as though science and technology might be the most important thing, but they're not.

It turns out that understanding history, and culture, and economics, and the people who live in the area where the problem is occurring, and their history, and their history of working with the problem-- those are all much more important than the science and technology. And we give them the problem and basically say, go.

We don't do a lot of teaching. Our role is to create a setting in which a lot of learning happens rather than to do a lot of teaching ourselves. So we give the students a lot of support.

There are a couple of instructors. There's a teaching assistant. There ARE undergraduates who work as teaching Fellows.

There's this whole array-- they're librarians, alumni-- this whole array of support. But we don't tell them what to do. And in fact, they have the power, if they like, to change the problem, to rewrite the problem, to throw out the problem and start again, and they do.

SARAH
HANSEN: For a first-year student, that must feel a little strange, to say you're in control. There's not a set way to solve this problem. You can change the problem. You're in the driver's seat. Do students ever feel anxious about this?

ARI EPSTEIN: So it's interesting. So when we tell them, it's up to you, their natural impulse is not to fully believe us because people have told them a lot of things are up to them. And then it turns out, no, there's all these rules. That's been their past experience.

And they've been trained through the K-12 experience in doing what they're told. Even people who are very independent-minded also learn you have to follow whatever the rules are, and that's how they've made it through K-12. So when we tell them it's up to you, there's a little period of what I like to think of as intellectual vertigo, where they just don't really-- they don't know what to make of it. And they're waiting for us to take the mask off and, OK, we'll really tell you what to do now.

And then gradually, they come to realize that we mean what we say, and it helps a little bit. And we tell them what their deliverables are going to be. At the end of the semester, they need to create a website that describes their proposed solutions in as much technical detail as they can. And then a week later, we bring in a panel of experts from anywhere in the world, and they need to defend their solution in front of the experts. But how they get there is really up to them.

SARAH
HANSEN: It's such a powerful thing to have a real audience of real experts out in the world to present your work to. Could you tell me a little bit about that, what that's like for them?

ARI EPSTEIN: It's really scary for them, and it's supposed to be. It's supposed to be a really scary experience. They're supposed to really want to do their best.

And I think one of the key things-- in all the Terrascope classes, the final product, the final outcome is judged not by us. As the instructors, we aren't judging them. We are helping them prepare for this wider, scarier audience.

So what happens is they come up with this presentation, and they've been working on it, and they went through a number of iterations. And then they present for about an hour, and then there's an hour and a half or so of Q&A, maybe two hours of Q&A. And that's really the cool part because, gradually, the panelists start to realize that they can actually ask the hard questions.

This is not, oh, it's a nice school project, and we'll ask them nice questions, and everybody will be happy. They start asking the hard questions, and the students-- no one student knows the answer to every question, but some student knows the answer to every question or knows an answer to every question. And they gradually come to realize just how much they've learned, and just how much they've accomplished, and how, as a group, they have this extra competence and this extra knowledge that they just didn't have two and a half months ago. And that's a really beautiful-- seeing that happen in real time with the students is one of my favorite times of the year.

SARAH
HANSEN: One of the things I love so much about Terrascope is how, by the end of it, students truly gain a practical education about a real-world problem. I asked Ari about some of the problems these classes have focused on.

ARI EPSTEIN: So last year's challenge was to come up with proposals to make long-range transportation of freight more sustainable and more equitable. And the students decided they wanted to focus on ships, trucks and ports. And they weren't going to talk about rail, and they weren't going to talk about air, and they weren't going to talk about pipelines. That's their choice.

But here's an example of the kinds of panelists we had. We had the incoming president of the Teamsters. We also had someone from the Union of Concerned Scientists who's working on their project on clean energy. We also had the former director of the Port of Boston, who, at that time, had then moved on to be the director of the federal government's Volpe Transportation Center here in Cambridge. So those are real people.

And one of the reasons it was great to have the Teamster president there was the students had decided early in the semester, you know, the part about people is really complicated. Let's just talk about the trucks and the ships and stuff, and let's not talk too much about the people because that's just-- like, the people who sail the ships and who drive the trucks. Let's just not talk.

And we nudged them a little bit and said, well, maybe that's important. Especially. When we talk about equity, maybe that's important-- people implementing their changes. But that's the direction they chose to go.

And what we decided was that, for the final panel, we wanted them to at least have to face that. And so when we told them a couple of weeks before their panel showed up who was going to be on their panel, they realized that they needed to think about the problem in a little more depth. And then this past year's problem, as stated to the students, was to come up with ways to take pressure off of the Clean Water system within Navajo Nation. And ideally, those should be ways that originate in or at least are compatible with Diné tradition and custom, where Diné-- people whom we call Navajo call themselves Diné. And so that was the problem.

In Navajo nation, water is very scarce. There's a drought. And a lot of the water that exists is contaminated by uranium and arsenic.

And so it's a really complicated place from the point of view of fresh water. And our problem for them was not come up with new sources of fresh water, but come up with ways to take pressure off of the fresh-water system. And there are any number of ways they could have gone with that.

But what they did was they thought about the problem in a whole lot of ways, and they thought, you know, water is really important. But one of the reasons water is really important is food security. And food security is a problem in Navajo Nation, which it really is.

It's a nation roughly the size of West Virginia. There are a total of 13 supermarkets. So food security is a problem.

And so they decided what we would like to do would be to encourage traditional Diné agricultural techniques and to encourage education in traditional Diné agricultural techniques. So their whole proposal was for an educational program, a K-12 educational program to potentially be implemented within Navajo Nation to help young people within Navajo Nation learn how to farm the way their ancestors and their elders had been farming.

SARAH Who was on their panel of experts?

HANSEN:

ARI EPSTEIN: So the director of the Navajo water project for Dig Deep, which is an NGO that works on water, health, and sanitation, someone who works at New Mexico State University in their agricultural research station, but who also does traditional Diné farming techniques in his own home and who is, in his out-of-work time, an advocate for helping people move back to traditional farming, a Diné farmer, who helps to direct a cooperative organization of a number of smallholder farmers in a particular part of Navajo Nation, the principal of a school whose students are mostly Diné that already has traditional Diné gardens-- so they're doing some of the kinds of things the students proposed-- and let's see, a hydrology expert from Arizona who has strong interaction with Navajo Nation already.

And not an official panelist, but the father of the woman from Dig Deep works for the Navajo government as an environmental official for a certain part of Navajo Nation. And he was not an official panelist, but he came and he was sitting in the audience. And somebody asked a question, and one of the students answered the question, and he got up and went over to the microphone and reacted to the answer and said, well, let me clarify a few things for you about how things really work in Navajo Nation because that might change your answer.

And that was fabulous. It was a great moment. It was a wonderful moment.

SARAH HANSEN: One amazing opportunity for Terrascope students is the class called Terrascope Radio, where they learn to communicate science stories using sound.

ARI EPSTEIN: Terrascope Radio is a class we teach in the spring. Ideally, folks who take Terrascope Radio will have taken the fall class, but they don't have to. It intersects in interesting ways with our field trip.

We go on a field trip every year during spring break to a place that's relevant to the year's topic. So in Terrascope Radio, students learn how to tell stories using only sound. And their big project is to create a story, somewhere around 15, 20 minutes long, about the year's topic.

And that's really all the direction they get. It can be any format, it can be any style. So the students need to learn technically, how do you gather sound? How do you edit sound? They also need to learn much more complicated lessons in, how do you tell stories when all you have is sound?

How do you engage a listener? How do you keep the listener engaged? How do you make it so that they don't just change the station or turn it off? How people who may not come into it-- you know you're excited about this topic. They don't. How are you going to get them to listen to you?

So part of what the spring break trip is there for is for ground truthing. You show up there, and you see, would our solution have worked? Would it not work?

So I'll give you a great example. One year, the problem had to do with balancing tourism, development, and sustainability in the Galapagos Islands. And the students came up with this idea that everybody who lives in the Galapagos Islands should have a certain kind of house that's very green in a variety of different ways. And they had this really interesting idea.

And then we went there. And folks whom we visited were mostly living in cinder-block houses with metal corrugated roofs, with all the materials brought in by oil-burning freighters. And they realized, oh, this part of our solution wouldn't work.

But the other experience they have is they go and they talk to people and they go, oh, this part of our solution actually really would work. And that is really good. It's affirming for them at the same time as giving them the context that, well, we weren't really experts. We didn't get all of it right. And so it's important for us for that field trip to come after they've already had that problem-solving experience.

SARAH
HANSEN: One of the most important aspects of this class is helping students learn and gain experience in the art of science communication, something that, in the face of climate change and disinformation, has become critically important for the strength of our social fabric. I asked Ari how he goes about framing this idea of science communication for his students. What do they need to think about to be effective science communicators?

ARI EPSTEIN: You need to think about with whom are you trying to communicate. And what do they care about? And what do they want to know? And that focus is just so important. And the class really lives in that zone.

I've spent a lot of time asking alumni of the class, OK, you took the class 10 years ago, five years ago. What does it mean to you now? And one of them writes about how, as a scientist, she now is recognized as somebody who really knows how to communicate her science and who has a natural talent for science communication. And her belief is not that she has a natural talent for science communication, but she learned it.

We have another who is an environmental scientist herself, but who spends a lot of time working with staff from zoos and aquariums on how to communicate ideas about climate change. One of our alumni went on to become a science journalist, a Pulitzer Prize-winning science journalist.

SARAH
HANSEN: While many of Ari's students have found success in careers in the science field related to their time in Terrascope, every student participant receives skills that will serve them in their life, even outside of science.

ARI EPSTEIN: Yeah, I mean, that's one of the big secrets of Terrascope is that mostly, we're teaching life skills and professional skills. Well, we're not teaching them. The students are learning life skills and professional skills through the experiences that we're helping them to have.

I always believed in the power of people having control of their own learning, and I believe in it much more strongly now. I have become much less convinced of my ability to teach anybody anything. You go into teaching because you like it and because you think you're good at it.

And yeah, I care about what people learn. I care about creating a setting where they learn. I don't have to be the one telling it to them.

A lot of the students come in feeling that they're going to invent the gizmo that solves the problem. And it's not their fault that they come in feeling that way. We've told them that. We've told them, you're going to design the thing that solves the world's problem. And come to MIT and do that.

And it's not that MIT tells them that, but the world as a whole is telling them, oh, go solve the problem by inventing the thing. And we would like them to make the transition to thinking about the people involved in the problem. Any problem they're going to work on as engineers is actually a human problem.

So think about the human beings. Think about the people who live there, who have a lot more lived experience with the problem, who have probably tried a lot of different things, who probably are doing a lot of successful things, who have a deeper understanding and who have a greater stake in a solution. And think about them and acquire a certain amount of humility and respect, and start thinking about these as human problems, not as technical problems.

And the thing about Terrascope is we don't tell people a lot of stuff. Our sense is that learning is richer, and deeper, and more long-lasting if people develop ideas on their own, rather than us standing in front of them and telling them things. So if we help provide them with experiences that help them make that transition, that's really good. And it's in their first semester at MIT. They've got lots more time at MIT to be working on technical problems. Wouldn't it be nice if they always started thinking about the human beings involved?

**SARAH
HANSEN:**

That was Ari Epstein, Associate Director of and Senior Lecturer in the Terrascope Program at MIT. Along with this episode, we're sharing in the *Chalk Radio* feed one of the recent Terrascope Radio pieces about the Navajo Nation and water sustainability. So please check it out.

You can learn more about Terrascope and listen to their radio productions on their website, terrascope.mit.edu. You can also get to them on our MIT OpenCourseWare website.

Thank you so much for listening. Until next time, signing off from Cambridge, Massachusetts, I'm your host, Sarah Hansen from MIT OpenCourseWare. MIT *Chalk Radio's* producers include myself, Brett Paci, and Dave Lishansky.

The show notes for this episode were written by Peter Chipman. The Terrascope resource on OCW was built by Yunpeng Wang and Eliz DeRienzo You can help others find *Chalk Radio* by subscribing to the podcast and leaving us a rating and review. We're funded by MIT Open Learning and supporters like you.

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