The Learning Curve

Episode 3: Engagement Tools and Virtual Reality with Dr. John Milligan

Presented by the Academic Commons

[00;00;00;18 - 00;00;13;15] **Jacob Santos:**

Welcome to The Learning Curve, a podcast presented by the Academic Commons.

[00;00;13;18 - 00;00;41;13] **Jacob Santos:**

Your hosts for today are me, Jacob and Demi. Our mission is to illuminate higher education, teaching and learning through the power of shared experiences and research informed practices through engaging discussions and expert insights. We aim to empower educators to transform their teaching practices, enrich student learning experiences and contribute to a culture of evidence-based pedagogy in higher education.

[00;00;41;16 - 00;01;05;18] **Demi Harte:**

On this episode, we'll be discussing engagement tools with John Milligan, PhD. Doctor Milligan is an organic chemistry professor in the College of Life Sciences at Thomas Jefferson University. His teaching practice focuses on increasing student engagement and supporting understanding of complex concepts, and he employs innovative approaches like teaching with virtual reality. So thank you, John, for joining us today.

[00;01;05;21 - 00;01;08;26] **John Milligan:**

It's my pleasure to be here.

[00;01;08;29 - 00;01;25;00] **Jacob Santos:**

Welcome to our podcast, John. So we're going to start with a simple question about some background about you. So can you tell us, a little bit about yourself, maybe your, academic pursuits and your role at Thomas Jefferson University?

[00;01;25;02 - 00;01;44;19] **John Milligan:**

Yeah. Happy to. So I'm actually have spent my whole life in different parts of Pennsylvania. It's kind of funny. I grew up in a rural area in southwestern Pennsylvania. I'm actually a first generation college student, so I kind of feel a certain connection to other first gen students that I teach. And then I did my undergrad at a small liberal arts college called the Allegheny College.

[00;01;44;21 - 00;02;04;07] **John Milligan:**

I did my PhD in Pittsburgh at the University of Pittsburgh, and then I came out to Philadelphia. The reason in part I'm here, actually, is because I got a postdoc at Penn and then kind of stayed in the area afterwards. So I've worked in different corners of the state. Now, of course, as you mentioned, I'm in the College of Life Sciences based on the East Falls campus.

[00;02;04;07 - 00;02;31;04] **John Milligan:**

So life sciences is actually interesting because we have two arms. We have the Center City primarily research arm and the East Falls Arm which deals in our college, at least exclusively with undergrads. So I'm teaching organic chemistry to undergrads. You know, class sizes are about 25 to 30, kind of typical of a smaller college. Of course, I also do research, not really our focus today, but I have a National Science Foundation funded research program as well.

[00;02;31;07 - 00;02;38;11] **John Milligan:**

But yeah, I'm happy to talk about some of the teaching that I do in the organic chemistry classroom.

[00;02;38;13 - 00;02;48;29] **Demi Harte:**

Awesome. So for our first official question, what do you consider to be the most effective engagement tool or tools in your teaching practice?

[00;02;49;02 - 00;03;10;08] **John Milligan:**

Yeah, I really like technology based tools. And, you know, I think that, the thing about the classroom of 2025 as compared to when I took organic chemistry in 2008, 2009, is that so much has changed, right? For example, I remember sitting in my undergrad organic chemistry and maybe 1 or 2 people had a laptop that was it, right?

[00;03;10;08 - 00;03;30;07] **John Milligan:**

And so it's remarkable how in just the 15 years since I was a college student, the whole game has changed in the college classroom. I think every single person in my class has a laptop or something. And, you know, there's a lot of contemporary debate, I guess, about the role of technology, especially in the K-12 space, you know, is that a good thing or a bad thing?

[00;03;30;09 - 00;04;07;21] **John Milligan:**

I would argue that, especially as adult learners in the college classroom, it's a good thing. And I think the reality is that these students will be entering a workforce where you have a computer in front of you. And I think it’s, it's a good idea to teach people how to leverage technology rather than avoid it. So to answer the question, I certainly think that the best engagement tools are those that use technology in a judicious way to kind of enhance what you're trying to teach in the classroom, and I think that's particularly suited to chemistry, and I’m happy to talk more about why I think that's important.

[00;04;07;23 - 00;04;32;20] **Jacob Santos:**

Awesome. So we'll get more, I'm sure, into kind of the tools that you're using as we continue and talk about, you know, specific areas of focus. As I mentioned earlier in our introduction. So you mentioned how when you were a

student, there are very few, laptops or pieces of technology in the classroom. And obviously technology in academia has evolved quickly, over a relatively short period of time.

[00;04;32;22 - 00;04;47;17] **Jacob Santos:**

And when you really think about it, so can you answer kind of what obstacles have you encountered when implementing, new engagement tools, and how have you addressed these obstacles, especially with new technology?

[00;04;47;20 - 00;05;05;23] **John Milligan:**

Yeah, I think there's two main obstacles that come up. One is just this thing you're always going to face when technology is and doesn't always work the way you expect that some people will have uh you know glitches here and there, but we just kind of can tackle that on a one off basis. I think the bigger, overarching challenge is getting people to buy in, right?

[00;05;05;23 - 00;05;28;16] **John Milligan:**

Getting people to be on task and kind of focused on the task at hand. And I think that has a lot to do with classroom environment. I think building environments in the classroom that support this, non-judgmental, that's enthusiastic, get people to buy into it. I think that's key. And I try to do that in my classroom. One thing in particular I like to use a lot as far as specific tools, is Nearpod.

[00;05;28;19 - 00;05;53;09] **John Milligan:**

So maybe some listeners have heard of Nearpod. It's a free program online, although there are some benefits to having a paid subscription like we have at Jefferson. But basically, when my students walk into the classroom, they see a Nearpod code on the screen, they log in, and they actually see my slides on their device. And they also have the activities, for example, dragging and dropping , discussion boards, polls.

[00;05;53;12 - 00;06;16;05] **John Milligan:**

And I think that is helpful to get people to buy into the materials because, you know, people use the phrase active learning. I think that's what active learning is about. You're not sitting there listening to a lecture, but rather you're contributing to it. I think that's the that's a hallmark of how engagement tools are helpful. So to deal with the problem of a lack of engagement, I kind of trying to turn the tables on.

[00;06;16;05 - 00;06;24;14] **John Milligan:**

So it's almost like a mini flipped classroom by having students contribute using online engagement tools.

[00;06;24;16 - 00;06;48;08] **Demi Harte:**

Yeah, we, we love Nearpod. It's a great software and platform for for instructors and for students to use. So to jump into our next question, we wanted to talk more about, teaching more complex concepts. So what strategies do you employ to make intricate topics more accessible to students?

[00;06;48;10 - 00;07;12;25] **John Milligan:**

Yeah, I think like I mentioned before, that's a particularly important challenge in chemistry. Well, chemistry has a reputation maybe resulted in so that it's a hard sell, especially organic. If you call the average medical professional, they generally don't have a lot of nostalgic things to say about organic but I think in part the reason it has that reputation is because organic, it's a new way of looking at chemistry.

[00;07;13;02 - 00;07;36;24] **John Milligan:**

It's a very visual basic chemistry whereas students in high school and first year of college are used to math as chemistry. So the real challenge, I think, is to get students to grasp the new symbols, the new visuals in a way that they maybe haven't challenged themselves and think visualization and before. So I think that using graphic driven engagement tools has been important.

[00;07;37;00 - 00;08;05;07] **John Milligan:**

And back to the conversation about 15 years ago versus now. There's so much more rich material online that's free. I mean, just because the quality of graphics doesn't include so much in data storage has improved so much that you can have students look at, for example, a 3D crystal structure on a website in a way that you couldn't do that before, and that allows students to really see with their own two eyes that kind of sense of what organic molecules are.

[00;08;05;09 - 00;08;13;03] **John Milligan:**

So, I think that those visual web resources are really a strategy I use to make those more accessible.

[00;08;13;05 - 00;08;38;26] **Jacob Santos:**

Talking about all these amazing resources that are available, it's awesome that you're incorporating what you can find into, your curriculum. And it can be hard, you know, when there is so much out there, that you can pull from. How do you, as an instructor, stay informed about what new methodologies for teaching complex subjects exist? And, how do you incorporate them into your curriculum?

[00;08;38;28 - 00;08;57;25] **John Milligan:**

Yeah, that's a good point. And I agree, there's more out there than any one person can do. My undergrad mentor, Shaun Murphree, who is at Allegheny College, once told me, that way to think about this stuff is not to jump on the latest bandwagon, but sift through all this literature and find the thing that jives with you the most.

[00;08;57;25 - 00;09;20;06] **John Milligan:**

And for me, I think that's Nearpod and the VR stuff I will talk about in a minute. But yeah, I think that this idea of using things that fit your style, in the classroom is important. And I think it's also important to be part of a good community where people are willing to be supportive of one another. Share ideas, and at Jefferson, we have that with the Center for Teaching and Learning.

[00;09;20;12 - 00;09;37;17] **John Milligan:**

For example, Chris Pastore who is in East Falls, has these talking teaching meetings. I've gone to over the years where people just talk shop and share ideas and I think that kind of culture here at Jefferson, makes it easy to try something.

0[0;09;37;20 - 00;09;51;10] **Demi Harte:**

So now we can jump a little bit into the VR virtual reality content in education. So in what ways have you utilized virtual reality to enhance the learning experience in your chemistry classes?

[00;09;51;12 - 00;10;16;25] **John Milligan:**

Yeah, so I'm excited about this. To be honest, I haven't done as much with VR as I have with Nearpod, but it's kind of a thing that I want to put more into. So the backstory is that Jefferson has made a commitment to invest in some VR assets. So specifically here at the East Falls campus, we within the last year or two, opened up what's called a VR cave in the basement of Gutman Library, and it's this really neat space.

[00;10;16;25 - 00;10;49;20] **John Milligan:**

You can see pictures online, I would estimate, like maybe 20ft of like a large VR concave display where students can actually step in and feel as though they're immersed in the VR experience. And I think the initial kind of ideas of use cases would be for the design and architecture programs that we have here, which certainly I can see the value, but it occurred to me why can't we also think about this for chemistry, especially organic chemistry, a very visual driven science.

[00;10;49;20 - 00;11;08;06] **John Milligan:**

And I just talked with some people like Mike Finnel, and Jeff Cepull. It was a cool idea. And so I have to give a shout out to Anthonio Maduahichie, who was a co-op student, actually from Drexel, that was here with us last year. He and I talk when he was like, sure, I'll uh, you know, you give me what you want to do.

[00;11;08;06 - 00;11;31;03] **John Milligan:**

We'll work together and design a VR environment. And he did a great job. We actually made it look like a lab. We kind of set up tables in this lab and microscopes and stuff. And anyway, we basically had molecules that spun in the air. And so the idea here was that schools would look at what's called stereochemistry. So you have a very mini 30 second chem lesson here.

[00;11;31;06 - 00;11;52;28] **John Milligan:**

The thing about organic molecules is there's often left handed and right handed forms. And the two are the same constitution, but you can't match them in the same way that you can't exactly match your left and right hands. So a real challenging skill to get students to grasp is this idea of which form isn't the right or the left hand, and how do you think about this?

[00;11;52;28 - 00;12;11;24] **John Milligan:**

And so that was the focus of the VR task that I design was you look at these molecules in VR and think about their form. So that's what we did last year for the first time. We had all 120 students in our organic chemistry classes go down to the cave and try it out and do a little task.

[00;12;11;24 - 00;12;22;18] **John Milligan:**

And it went very well, and I look forward to thinking about other ways for my class and others that we can try out this kind of VR research.

[00;12;22;20 - 00;12;50;05] **Demi Harte:**

No, that's great. I think with especially with science and chemistry and all that. You know, when I think of taking classes before in school and it was just very difficult, I think, because there wasn't a lot of visual content or very engaging content. So I think utilizing the, the markdown screens and, virtual reality, just to better enhance and show that content to the students is really beneficial, especially for this topic.

[00;12;50;08 - 00;13;16;14] **Jacob Santos:**

Yeah. I mean, I saw, when we were kind of preparing for this podcast, I saw the pictures that were posted are kind of on your, you had shared on your LinkedIn. And it was really fascinating, you know, seeing these, molecules, you know, visualized in front of learners and seeing them interact with them. So can you, talk and you mentioned, in your answer to that question, talking about how this is something that is not just unique to your content.

[00;13;16;14 - 00;13;47;11] **Jacob Santos:**

Right? Instructors can look at their content and maybe try to look at it outside the box and think about how can I make an interactive, engaging activity, for my learners in my content? So, a question I would ask is, related to that is what differences did you notice in student engagement and understanding of material when using, VR compared to, traditional, teaching methods?

[00;13;47;18 - 00;13;56;00] **Jacob Santos:**

You know, did you receive any particular unique feedback from students and kind of what was that process like altogether?

[00;13;56;02 - 00;14;16;27] **John Milligan:**

Yeah, I would say students, incidentally, really enjoyed it and kind of made an appreciation for something different and different perspective and just kind of a different way of seeing things, because that's the real challenge with, organic chemistry and technical drawing, is that everybody's stuck with the challenge of doing a 3D depiction on a 2D piece of paper. Right.

[00;14;16;27 - 00;14;45;16] **John Milligan:**

And so bridging that translation is hard. And the students mentioned that VR was a nice way to help them make that jump from a 2D piece of paper to understanding what that's really representing. I do hope in the future to do a more substantial chemical education study. So like for example, a pre and post analysis of student understanding to get some harder data around this and kind of understand what specific aspects of VR are good for this particular topic.

[00;14;45;16 - 00;14;53;14] **John Milligan:**

So yeah, incidentally, so far so good, but I definitely aspire to make more of a hard study on it in the future.

[00;14;53;16 - 00;15;10;16] **Demi Harte:**

And so when it comes to creating this content, I know this is your first, you know, big move with it with the Mechdyne, what considerations so far do you think are important when trying to create virtual reality content for educational purposes?

[00;15;10;19 - 00;15;32;24] **John Milligan:**

Yeah, that is a definitely consideration. I think that you want to make something that's not too complicated, right? For example, if you make a VR environment with all these different pieces to it and aspects and nooks and crannies, especially for someone who is maybe not a professional gamer, so to speak, they might be kind of freaked out and limit the educational benefits.

[00;15;32;24 - 00;16;11;14] **John Milligan:**

So yeah, obviously you want to make it rich enough to be worthwhile, but not too challenging. And of course, it's always you have a spectrum of students in the classroom with regard to their aptitude and interest. So that is something I've been thinking about. I think for this first round, I sort erred on the side of simplicity, but certainly I think we can take what we've done and build more, more onto it. The other kind of thing about that is, and I guess this gets to the next question about accessibility is you have to consider what if you have students who just, you know, for example, maybe they have motion sickness issues or potential epilepsy

[00;16;11;14 - 00;16;32;19] **John Milligan:**

concerns. So for the spirit of inclusivity as well as the make sure people got the VR piece, we also did a mirror of this with traditional balls like plastic ball. What we call model kits in organic chemistry. And students were able to manipulate them with their own hands, which I think in and of itself was a potentially valuable way to to this topic too.

[00;16;32;22 - 00;16;44;22] **John Milligan:**

So I think having kind of a multifaceted approach to VR, in other words, like a backup is a good way to make sure that we're making the point that we want to make.

[00;16;44;24 - 00;17;05;23] **Demi Harte:**

Yeah, it's absolutely important to make sure to have alternatives just for accessibility issues. And, as well as, you know, students that maybe are a little nervous to try something a little different. And, you know, like you said, starting simple is great because you don't want to start too big. And then you realize, oh, this is too difficult.

[00;17;05;23 - 00;17;15;04] **Demi Harte:**

And then you, you know, get discouraged from to keep going and keep trying. So I think starting off simple is is always the best way to go about it.

[00;17;15;07 - 00;17;40;29] **Jacob Santos:**

All right. So, we want to kind of, transition a little bit into kind of, the, the interrelation a little bit between engagement tools and, teaching these complex topics. You know, just listening to you talk about it. I can understand why some people probably don't talk about their chemistry classes like this, because, I mean, I never took, chemistry because I was intimidated by, this kind of content that you're talking about.

[00;17;41;02 - 00;17;52;26] **Jacob Santos:**

How have you if you have combined kind of these engagement tools, innovating teaching methods and VR to, enhance student learning if you have.

[00;17;52;29 - 00;18;24;20] **John Milligan:**

Yeah, that's a interesting question. And what I've thought about, like, how do you, for example, bring VR into the traditional classroom? I think the answer, honestly, at this point is a little tough. I mean, this cave that we have in East Falls is localized in the library, right? So it's a little tough to full on integrate VR. But I think in the future, my prediction is that VR tools are going to be more accessible, kind of like the way the phones were only for a few people that, you know, were adventurous back in 2008, but now everyone has one.

[00;18;24;23 - 00;18;41;13] **John Milligan:**

I hope that in the future, VR is kind of one of these things where it's everywhere, right? That people can just grab goggles at the beginning of lecture and toss them on for five minutes, and then carry on with the lecture. Right. So I hope that in the future I can actually bring VR into the routine lecture room.

[00;18;41;13 - 00;19;14;02] **John Milligan:**

But for now, in the you know, in the absence of having that opportunity, I tend to bring in a lot of content online. So here's, animated video online. Not VR per se, but kind of the same spirit of showing web based images. And I think that that kind of combination of using engagement tools and then supporting that with good explanations in an involved active learning classroom, I think that's really a powerful strategy for doing organic chemistry.

[00;19;14;05 - 00;19;25;06] **Demi Harte:**

So how do you assess the effectiveness of these tools in your classroom and not just speaking on virtual reality content, but things like Nearpod and other tools that you utilize?

[00;19;25;08 - 00;19;57;13] **John Milligan:**

Yeah, we do a lot actually. I'm the chair of our colleges assessment committee and so I kind of have a vested interest in this question. But there is of course always the standard course surveys we do at Jefferson, and students consistently remark, especially about Nearpod, because Nearpod is a cool way to kind of be involved in the lecture and kind of rather than just sitting there and not participating in any way they feel like almost as though they're co, you know, owners of the lecture, which I think is important.

[00;19;57;15 - 00;20;19;00] **John Milligan:**

So yeah, there's those comments. But also we always benchmark our success in chemistry against what's called the American Chemical Society of Standardized National Exams, in which we make pretty competitive

scoring compared with the monthly averages. So it seems as though the way we're doing this is really thinking, well, which is good.

[00;20;19;02 - 00;20;39;10] **Jacob Santos:**

It's awesome. So, you talked about, you know, surveys, the tools that you're using after the learning is done, to kind of assess, how this is working. I'm curious, as a former, educator myself, you know, when you bring something new into the classroom, you're always trying to and you're watching your learners engage with it.

[00;20;39;13 - 00;21;00;21] **Jacob Santos:**

You're always trying to kind of get a sense for how are they responding in the moment to what you're working with, whether that's a Nearpod or, the VR when you're doing the cave work. So I'm curious, can you talked a little bit about how students have responded to these innovative tools and methods that you've introduced.

[00;21;00;23 - 00;21;27;18] **John Milligan:**

Yeah, I would say pretty positively overall. I mean, I think that the reality of a student in 2025 is they're pretty open minded to this kind of stuff, right? I would say they even appreciate it more so than was sitting. I think that across the board even in K-12, students don't like it as much. And lecturing where we sit there passively and take notes going, ugh. I just think that I mean there might be underlying reasons for that.

[00;21;27;18 - 00;21;50;09] **John Milligan:**

But I just think students like to be involved these days. And I think to that question, they pretty consistently are on board with it. They enjoy talking to each other about the Nearpod and kind of working on topics collaboratively. So yeah, and in a nutshell, I think students really are open minded to trying things in the classroom like this VR or Nearpod.

[00;21;50;11 - 00;22;04;20] **John Milligan:**

Awesome. Thank you. Yeah, love to hear. We love hearing those response because I think that's part of the help, the motivation, right, to get others to jump in on these trends with you. You know, you're hearing these responses from learners. So that that's awesome to hear.

[00;22;04;22 - 00;22;20;08] **Demi Harte:**

So how do these technological tools assist in breaking down the complex scientific concepts for better student comprehension? I know you kind of brought up a little bit of what you've done and what you've taught, but an example, I guess.

[00;22;20;10 - 00;22;41;12] **John Milligan:**

Yeah, I mean, I think as I mentioned about the right and left hand thing, that's a prime example of, you know, in organic chemistry you really have to see it more so than bunch with numbers. Right? And I think anything that

really helps students translate what's on a paper into a physical reality of a molecule is something that's helpful for organic chemistry education.

[00;22;41;12 - 00;23;05;15] **John Milligan:**

So that's where I focused on it most. We also have things in organic chemistry called mechanism, which is oftentimes a real challenge for students because many see it as a memorization task. I just have to brute force memorize what happens with this, combining this and showing arrows on how the molecules join. But I think when you do instead animation based teaching showing, oh, this is moving.

[00;23;05;15 - 00;23;22;02] **John Milligan:**

for this reason, I think that helps students kind of get away from the brute force tendencies they tend to have and think more holistically. So those are two kind of ways that I think that visual technologically aided learning is really helpful for organic.

[00;23;22;05 - 00;23;55;28] **Jacob Santos:**

All right. So, John, we're coming close to kind of the end of our interview here. And I want to make sure thank you for the time you're dedicating, to, speak with us. I was wondering if you could, provide, 1 or 2 pieces of advice to your fellow educators who are interested in adopting, these approaches in their teaching, whether, it's active engagement tools or, VR, like where, where, where can they start?

[00;23;55;28 - 00;23;58;02] **Jacob Santos:**

Kind of, I guess.

[00;23;58;04 - 00;24;27;17] **John Milligan:**

Yeah. My advice to anyone trying this out would be, don’t be afraid to make it an experiment much like we do in the research lab. It's not a bad thing to try something it and not work perfectly well. To be honest, the whole Nearpod thing was a complete experiment, especially considering that my first year at Jefferson was 2019, 2020, right? So I was essentially surviving the pandemic at the same time, I was refining my whole Nearpod approach, and it was one giant experiment.

[00;24;27;17 - 00;24;47;05] **John Milligan:**

And I admit freely that there was plenty of things I did that didn’t stick with students that students didn’t like as much. And it's been a constant game of refining and proofing for several years. And certainly the VR stuff I mentioned. While it was a first pass this past fall, it was a success, but a success that I think has plenty of opportunities there.

[00;24;47;07 - 00;25;07;10] **John Milligan:**

So yeah, that's my advice is, like I said before, sift through all the literature, all the suggestions you get, and think about that 1 or 2 things that really jive with you as an educator try them out as an experiment and see what the results are. Just like a real science experiment and edits your approach based on what those results tell you.

[00;25;07;10 - 00;25;17;26] **John Milligan:**

And I think if you try that approach, so you'll find something unique and something that you that can really be something you're proud of and take ownership of in the classroom.

[00;25;17;28 - 00;25;40;04] **Jacob Santos:**

That that's it. That's awesome. I love your, that commentary you're making about, you know, it's like an experiment. I remember, when I was when I was in the classroom, educators would always tell me it's going to take 5 or 6 years before you're the best teach-. You're at the level that you want to be. And that process is a lot of trying it out, seeing what's working.

[00;25;40;04 - 00;25;52;28] **Jacob Santos:**

And I think that can hold a lot of people back. So I love hearing from you that you're saying, you know, treat it like an experiment. Go in, try it, assess it, and move forward from there. So this is awesome. Thank you. Thank you very much.

[00;25;53;00 - 00;25;57;00] **John Milligan:**

Yeah it's a pleasure to be here. And again thank you very much.

[00;25;57;02 - 00;26;10;28] **Demi Harte:**

So that does bring us to the end of our interview today. So thank you so much for taking the time for us to out of your day to be here with us and sharing your knowledge and expertise. Thank you so much.

[00;26;11;01 - 00;26;11;23] **Jacob Santos:**

Thank you.

[00;26;11;26 - 00;26;18;07] **John Milligan:**

Yeah, I appreciate it. Thank you guys for having me.

[00;26;18;09 - 00;26;44;05] **Leah Miller:**

Thank you for joining us this month on The Learning Curve. You can find more information and resources related to this episode at **academiccommons.jefferson.edu/thelearningcurve** and we hope to see you at some upcoming Academic Commons workshops. If you would like to be featured on a future episode of The Learning Curve, please contact us by using the button on our show page.

[00;26;44;12 - 00;26;45;18] **Leah Miller:**

Thanks for tuning in.