

Bonni: [00:00:00] Today on episode number 242 of the Teaching in Higher Ed podcast, Kambiz Hamadani discusses using virtual labs an immersive reality to enhance student learning.

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Bonni: [00:00:26] Hello and welcome to this episode of Teaching in Higher Ed. I'm Bonni Stachowiak. And this is the space where we explore the art and science of being more effective at facilitating and learning. We also share ways to improve our productivity approaches so we can have more peace in our lives and be even more present for our students.

Bonni: [00:00:53] In continuing my partnership with the Cal State University system, I get to speak to many of their Innovation in Teaching Award winners and today's episode is no different. Today I get to speak with Dr. Kambiz Hmadani. His research involves the development and application of single molecule biophysical methods to study protein folding, function structure, dynamics, and evolution. He's the Principal Investigator of the first primarily undergraduate single molecule bio physics research lab in the world at California State University, San Marcos. Dr. Hmadani is a highly dedicated teacher scholar and is excited about the prospect of developing and using virtual labs and immersive virtual reality experiences to enhance student learning in his courses. Kambiz, welcome to Teaching in Higher Ed.

Kambiz: [00:01:52] Thanks very much for having me.

Bonni: [00:01:54] I saved to the last line of your bio for when you were on the line because I loved it so much, so I'm going to read it with you here and we can start from there.

Kambiz: [00:02:02] Absolutely.

Bonni: [00:02:03] His enthusiasm about innovative instructional technologies and fearless experimentation is driven by his commitment to reach as many students as possible. I thought that was really intriguing this idea of reaching as many students as possible. I wonder if he'd reflect for a few minutes. Has that always been your goal as someone who teaches in higher ed? Or is it something you began to pursue after you've been doing it for awhile?

Kambiz: [00:02:30] I guess I feel it's always been a major driving force behind my pursuit of academia in general. I think that students want to learn and there's a lot of them out there. I, as an undergraduate, was one of them and I sought out different opportunities to do research and faculty labs. And it was tough. It was tough to get a foot in the door. And I felt that and that stayed with me for throughout my graduate career and as a postdoc and now as a faculty member. And I feel like students that have that desire and drive to learn how to do research and to get involved in research, those doors should be open to them. And getting them to the point where they can be independent researchers is something that is well worth putting some time and energy into. So as a grad student, I get a lot of outreach activities to community colleges and had high school student interns in my mentors lab that I was mentoring myself. And I think that with the power of the Internet, with all of the different mechanisms for broadcasting knowledge, faculty have many more communication lines open to them. And why not use them? Make more dollars available to students.

Bonni: [00:03:59] That feeling you described, that you can recall so well, can sometimes become a distant memory for some of us where we don't put ourselves in enough situations where we are having to learn new things.

Bonni: [00:04:14] I just did a pilot of a series of games that I'm working on for Faculty Development and some of the faculty I was working with were saying, "Oh that was hard. I'm not sure I liked that. I kind of just more like to talk." And they're really describing being in something unfamiliar. How does this thing work? And that feeling is uncomfortable. But yet, I think we as faculty need to put ourselves in it as often as we can.

Bonni: [00:04:43] But the other thing about your work too is reaching as many students as possible. At some point in your teaching you discovered that you were not reaching quite as many as possible. Could you talk a little bit about maybe when you started to see evidence that some of your teaching could be improved with looking at redesigning your courses? And again, how that evidence came about? And then what process you went about?

Kambiz: [00:05:07] Yeah. So of course we only have a certain amount of time and energy and dollars that can be put into the resources necessary to reach students and to teach them. And that is, I think, something that we as teachers in higher ed struggle with constantly.

Kambiz: [00:05:25] I felt it in a course that I've been teaching now for a number of years, which is an upper division general biochemistry course that is mainly chemistry majors and biology majors take this course close to the last semester. And it's very very diverse. And to some extent, the two different populations of students that I have in that course have been taught to think about things in two very very different ways. Think about science. Think about matter and biochemistry in two very different ways.

Kambiz: [00:06:05] The biologists tend to think about cells and memorize content in order to get through classes. Whereas the chemists are very very put off by the messiness of the cell. And so they tend to try and stick with mathematics and other chemistry based formulas when thinking about biochemistry.

Kambiz: [00:06:31] And teaching that to 2 different populations of students was a great challenge for me. And also because the two different populations of students had very very different backgrounds. And there was just not enough time for me to go through all of the material necessary to bring the biology students up to speed with reviewing all the O-chem and Gen-chem that they had by that time had at least forgotten.

Kambiz: [00:06:58] And then similarly there wasn't enough time in the semester for me to teach all of the basic biology and molecular biology and cellular biology, the content that's necessary to the chemists that actually had never had any of that content prior to my course.

Kambiz: [00:07:18] So there's a lot of stuff that I felt was necessary for these two different populations of students to have as kind of prerequisite knowledge for appreciating biochemistry. And of course in addition to that, this course is one where we have a lot of premeds that are going to be taking the MCAT and a lot of grad school bound research students that are already quite advanced in their thinking about biochemistry mixed in with students that are working full time, they have families and they just have had very little time to devote to school and their understanding of the content is just really not solidified quite yet.

Kambiz: [00:08:06] So in this quadrant of students, these basically four different populations of students advance versus not so advanced, chemists versus biologists. I really struggle to reach all of them. One of the challenges I think we all faces as faculty in higher ed is finding ways to deal with that diversity of backgrounds.

Kambiz: [00:08:32] And so that, for me, was the major task at hand for this class. And I struggled and experimented with all sorts of different strategies. I have a number of different tricks that I feel like have helped quite a lot. We can talk about them one by one. But one which I've stuck with since the very first, maybe second semester that I taught this class, was a buddy system.

Kambiz: [00:08:57] So this buddy system, it's not really anything related to the virtual lab stuff but I feel like that was a very very helpful way to encourage students to get together, chemists with biologists, advanced students with less advanced students and to help each other.

Bonni: [00:09:13] How were the buddy pairings selected?

Kambiz: [00:09:16] The first exam oftentimes I would have a bi modal distribution. So I would set a cutoff and have the more advanced students essentially pair up with the students that perform worse on the first exam. And I would allocate a certain number of points for students that either improved their own score, relative to the mean. Or if they already scored very well it's to their advantage to pair up with a student that didn't do as well in the first midterm and mentor them and tutor them and get their performance a little bit closer to the mean or even above the mean.

Bonni: [00:09:57] I've been doing this podcast a long time and that's the first I've heard about that idea. Perhaps it's done other places but that's the first I've heard about. How clever.

Kambiz: [00:10:06] Yeah it's kind of like a low budget supplementary instruction.

Bonni: [00:10:10] Well and one of the things that as we learn about different cultures, then there are cultures that are more collectivist. And so we try to force our American individualism upon them- every man, woman, and child for them for themselves in this learning process. That's going to disproportionately have a negative effect on some of our students of color. So that seems like an approach that would work very well.

Kambiz: [00:10:35] It's had some success. I think there are definitely some students that are not interested, they do not want to pair up with anyone. They're fine by themselves, and they love doing everything on their own. They just don't have it. And there are other students that are, just not able scheduling wise it's difficult to meet up. And I've tried to deal with that in various ways using online forums of various sorts. But it definitely helps for certain classes of students that are able to schedule time to meet up. And also for the mentors that are interested and giving their time and energy to helping others. And I think that that's a great thing to encourage.

Bonni: [00:11:20] Is the buddy system, therefore, more of a voluntary basis?

Kambiz: [00:11:24] Yeah. So I have the students that don't want to participate they can still improve their own scores and get just as many points, assuming that they improve it relative to their previous score on the initial midterm.

Bonni: [00:11:40] Yeah.

Kambiz: [00:11:41] So it's basically kind of a value added assessment of students continuing to improve over the course of the semester. So if a student does well on the second third or fourth midterms on their own, they get all those points. And the students that did poorly on the first midterm, they get points for improving. So it's to their advantage to find a good mentor and put effort into improving their scores over time. The only difference is now that the mentors also have, in addition to being able to improve their own score in the course over the course of a semester, they can now get some extra points by helping others.

Bonni: [00:12:23] One of the things I want to mention at this point, were on episode 242 which is relevant because if you go to teachinginhigherred.com/242 or if you're inside of your podcast player right now, you'll see these links that have been provided as part of this episode. And one of the things that you did which was magnificent looking at it an e-portfolio for your 2016-17 course redesign which you've been describing here. So this was for the general bio-chem lecture and then you also have an e-portfolio which is linked too because I mean you have so many wonderful things we can gain from, but we can go in here and go explore your very well documented e-portfolio, again 2017-18 course redesign with technology for general organic and biological chemistry lecture lab course.

Bonni: [00:13:15] And I wonder, should we spend a little bit of time on that? Because this one has a little bit of a different component. Or is there anything

we really should say before we move away from the Bio Chem lecture redesign?

Kambiz: [00:13:24] Yes the only thing I did want to mention, the buddy system was not really a virtual lab component but the other aspect of the course redesign for the general biochemistry course was this Labster virtual labs component that I incorporated. Labster is a company that makes virtual labs for higher ed. They had designed some really nice enzyme kinetics modules that I incorporated into the course and I felt like this would be a nice way to engage students in this lecture only course by having them actually carry out some activities, laboratory activities offline.

Kambiz: [00:14:02] And so I had them also perform some of these virtual labs, I assessed their performance on items that tested them at different levels. So either recall questions, which basically were more like textbook learning regurgitation kind of questions. Or more applied type questions, which asked them to take the content we were learning in lecture and apply it in a slightly more real life setting, something that I would imagine is more practical in terms of the skill sets that the students have been needing.

Kambiz: [00:14:38] And what I found was that the virtual lab activities actually encourage students to do better on those five level questions.

Bonni: [00:14:48] One of my favorite things when I was going through the lobster materials and I may be going out of order here because it might have absolutely nothing to do with this course. But my favorite part is that you can have the students blow up the lab and no one gets hurt. I was sort of- I don't know if it's overreaching, but it seemed like a great way to encourage experimentation in one's learning without of course I mean there are devastating effects in the real lab situations but am my overreaching by saying that that's why those things are there to encourage that experimentation? Or is that like a bad example?

Kambiz: [00:15:20] That is a huge part of what I think students gain when they have a virtual lab to play with when you compare it to a hands on lab. So a hands on laboratory section, you have really very few chances, one most of the time, maybe two, to get an experiment right. And you have a fixed amount of time, it has to be done in one chunk. And it's very difficult sometimes for students to process all the procedures and content that they're experiencing and learning in that lab section in one day or one couple of hours.

Kambiz: [00:15:59] So the virtual labs, because you can make mistakes and because you get feedback when you've made the mistakes on what the mistake was in a very precise way. Something which I struggle in my lab classes that I teach sometimes it's very difficult to catch students in the act of making a mistake and correct them. You have maybe 15-20 students in a lab section. There will be some missed opportunities there, but not so in a virtual. So students can make mistakes, they will get immediate feedback on those mistakes. They will be able to redo procedures, at least virtually. And there's a lot to be gained from that. Students I think understand and appreciate that.

Bonni: [00:16:42] Is there also- you had mentioned students having multiple jobs and family priorities, lots of conflicting priorities in their lives. Are these ones they can participate in at any time versus if I did come to your campus that would be a scheduled time?

Kambiz: [00:16:56] Yes. So that's another very important aspect of it is scheduling. So my campus is one of the smaller newer CSUs. We've been a community campus for many years. We're now growing rapidly, maybe a little too rapidly but it's very exciting times. But we have a lot of students that struggle to working one, sometimes two jobs, families that they have to take care of. Making it to a lab section which oftentimes I mean some of the lab sections are four hours five hours. I mean this is large chunks of time that have to be blocked out. That too can be a huge challenge. And virtual labs you can stop and start and continue whenever you like. In the middle of the night. There's no scheduling conflict really. It's just you having put the time aside to read the material, carry out the activities, and perform the assessments. So that's a huge huge advantage especially for the students that we serve in the Cal State University system.

Bonni: [00:18:02] Tell us a little bit about these customized take home lab kits.

Kambiz: [00:18:07] Yes. OK so now we switch gears to the general organic biochemistry course. This is a one semester course that's primarily for pre-health science majors, so kinesiology students, pre-nursing students. And this is a one semester course in which you have to teach all of general organic and biochemistry. There's a lot of content and there's a lab associated with this course, which is different from the general bio-chemistry course, which did not have a lab associated with it.

Kambiz: [00:18:41] But the lab had a series of activities that were not completely aligned or synchronized in time with the lecture material. And one of the things

which I wanted to try and do was to achieve better synchronization between the lecture and lab content. So the timing of the labs was something that I wanted to fix.

Kambiz: [00:19:07] The other thing which I was playing around with was finding a strategic way to remove certain hands-on labs, labs that the students were performing in a physical land space here on campus and turned them into take home lab experiments, things that they could do at home, in the comfort of their own home on their own time without any what I call, "lab space time resources."

Kambiz: [00:19:38] So many of these pre-health science majors, we have a lot of them taking courses in our college, the college of science and math. But Kinesiology and Nursing are in other colleges. And it's a huge challenge to offer all of those sections of GOB-chemistry together with all of the science lab courses that our college has to offer. We have a limited amount of lab space and a limited number of fume hoods.

Kambiz: [00:20:09] So many of the GOB course labs, they don't really require being on campus and using fume hoods. They're not doing dangerous very very challenging laboratory activities. So I redesigned some of those lab activities so that they could carry them out at home using essentially a homemade lab kit.

Kambiz: [00:20:33] So I picked up a number of different items on the Internet, purchased some some pocket scales, molecular modeling kits, some graduated cylinders, things that they would have used in the physical Face-To-Face lab. But now with a take home lab kit, which they actually return at the end of the semester. So it can be used so there's no real cost to the student. They can carry out a lot of these simpler procedures at home without taking up lab space time that could be used for the science major courses which do actually require being on campus and being in a fume hood or being perhaps a more dangerous experiment that they shouldn't be doing at home.

Bonni: [00:21:20] How did they demonstrate to you that they completed the lab? Actually I'm looking at the lab kit right now, the baking soda and the vinegar. Do they show you that they completed it? Or is there is some measurement that I could provide that would show you that I did that the experiment?

Kambiz: [00:21:35] There is a lab right up which they have to perform and submit. However, we did also in in the course of the semester as I was tinkering with the

various approaches to facilitating lines of communication between the instructor and the students that are now at home doing these experiments. Right. So they don't have their lab partners to ask. They don't have the instructor to ask some help from. And that was a huge problem. And we actually ended up using an online video discussion forum system.

Kambiz: [00:22:15] So there is a company called Voice Thread. I think there are probably other companies as well that this is the one that I ended up using. It's an online platform for video commenting, asynchronous discussion forums but in a video format. So you could, and we did in fact, have pre-lab demonstration videos of myself and the laboratory instructor performing the lab. So the students could see what the procedures were, what the steps were, they could fast forward through some of those videos if they wanted to, if they felt comfortable with the procedures. And then they could also submit recordings of themselves asking for help and saying, "at this point in the process I don't understand what you were doing here or why we're doing this. Am I doing this wrong?" And post that question to the whole class as a video. And the instructor would respond and correct the procedure. And that was actually a very very important piece of the puzzle I learned which I'm not exactly sure if I would do it again exactly the same way. I think that an asynchronous forum is not the best way to do this. I would probably favor a synchronous form of some sorts, but that takes away some of the advantage of these scheduling issues. But it still saves the laboratory space time by allowing folks to do these experiments at home.

Kambiz: [00:23:46] Having the instructor there as the students are performing these tasks is very important. And I think that that was something which we found in that in that course redesign that students do not like and which was probably not optimized quite yet.

Bonni: [00:24:04] I imagine too that you could have synchronous, but offer for a little bit more choice than a lab environment might traditionally offer even if it's three choices versus I would have only had one time.

Kambiz: [00:24:18] In effect, it's possible to imagine having students attend any one of ten different online sessions where there's different instructors who can help you through the procedure. And there's no real limit on how many students are connected to a particular instructor at a particular time. So I never actually thought about that so thank you.

Bonni: [00:24:42] It's a fun little puzzle to solve. And I know enough to be dangerous about Voice Thread, one of the things I think is neat about it, like

some of the other tools, is where- because discussion boards, they are just too rote and they're not for teaching a complex series of things like you're trying to teach. I like how you could have a time based where I could say at this exact point in the lab when you asked me to do step c, I am lost. And you can see the little dot that's where she's having trouble versus the discussion board wouldn't let me do that.

Kambiz: [00:25:14] Yeah I struggled with that for quite some time in the general biochemistry course. And when I discovered Voice Thread and I started using it also in that course, the discussions, the peer discussion forums took on a very new direction, a new way to use them, which I think the students valued. I still struggle to get the students to buy into the Voice Thread forums because it's a little bit of work getting them comfortable with making comments and figuring out how to point to things using that little doodling tool. But ultimately I think that that's been a valuable thing for them and for me.

Bonni: [00:25:54] Before we go to the recommendation segment, I don't want to miss getting- I mean there's so many things I wish we could talk about but we're going to run out of time. I don't want to miss talking to you about how you have just continually pursued this teaching excellence. So it's not by accident. And we can go and look at these portfolios that will be in the show notes. But you and I just had an idea here, how do you take the ideas as you're having them? How do you? Where do you keep track of them? How do you decide what to take action on? None of us can take action on every idea we have. How do you?

Kambiz: [00:26:29] That is a really tough one honestly and I have to say I struggle with that. I have had to limit myself significantly because I do tend to you know tinker a little bit too much into some of these exciting technologies and tools that have been developed to help students. And we are bombarded with all of them constantly. And so it's a little hard to say no when there is perhaps an opportunity to help students.

Kambiz: [00:26:56] So it's been tough. But I think talking with people who have tried some of these tools and taking incremental steps towards implementing larger scales some of these tools and course redesigns I think is the way to go. I did have to learn the hard way for the biochemistry course redesign that I did. I redesigned and implemented one virtual lab module in the first semester that I implemented. And it seemed to work so well that I jumped the gun a little bit and I implemented with five or six different virtual labs the second semester. And I tried to assess the impact of all of those virtual labs in a single semester, that

was too much. It was too much for the students and it was too much for me. And I think you have to very slowly wade into that pool of course redesign and assess things carefully, slowly and steadily.

Bonni: [00:28:00] One of the things that I do is it's part of a book that's called Getting Things Done. The author's name is David Allen. And one of the practices he recommends is having a someday/maybe list. You know don't put on your task manager every idea that you have, realistically you're not saying I'm going to try things but I allow myself during the breaks that we have summer and I just put air quotes around the word "breaks." But that's my time for experimentation if there's a new Ed Tech tool I want to try. That's the time when I'll pull that list out and then prioritize to which ones I think could have the greatest impact because otherwise I would- I mean people say "How do you do this podcast? And you hear all this? And how do you do it all.?" Well the thing is I don't. I listen to a lot of people. I let the ideas go in, but it's only a certain number of them that will bubble up. But I do think that someday/maybe list keeps me a little under control so I don't go crazy. It will drive students crazy too, it's too much for them to try too.

Bonni: [00:29:01] Robert Talbert who's been on the show many times before he always talks about really minimizing the number of separate tools that we're going to ask our students to learn and I think that that's really good as well.

Kambiz: [00:29:10] Yeah I agree.

Bonni: [00:29:12] This is the time in this show where we each get to give our recommendations and mine is a musical one, I have shared about this group before they're called. It's a nonprofit called Playing for Change. And since I was going to be talking with you today and we were going to be talking about virtual labs an immersive learning experiences, this is kind of like that but with music.

Bonni: [00:29:31] What they do is they get wonderful musicians from all around the world and they each record their own separate track and then they bring them together in one beautiful piece of music. And I've recommended some of their music before. Today, it's the song Sittin On The Dock Of The Bay by Otis Redding. And I understand it's to celebrate Otis Redding's life, music, and legacy. And this is celebrating 50 years of this classic song. And so you have Otis Redding the third, Dexter Redding, Corrine Bailey Rae, Jack Johnson, just to name a few of the many musicians that participate in this great musical collaboration and I'm going to play just a little tiny bit of it. I suspect many

people listening know this wonderful song but I'm going to play a little bit and then we'll come back to you and hear about your recommendation.

Sittin on the Dock of the Bay: [00:30:44] *Clip from Sittin on the Dock of the Bay plays*

Bonni: [00:30:49] That as Jack Johnson that we were hearing at the end of it. And Andrew who does our podcast editing was telling me another recent musical interlude I did, I always hate when you turn the volume down, but I know we've got to keep the clip short so we don't break any copyright law. But it sure is fun to get to see the music. I think these are videos you definitely want to see too because you can see all the different parts of the world. My daughter watches a lot of these with me and she'll say "Mommy where's that? Where's that? Where's that?"

Kambiz: [00:31:14] That is a lot of fun.

Bonni: [00:31:16] Oh it's so much fun. It's a great one and this is just a wonderful celebration of an amazing musician. So I'll pass it over to you, Kambiz to share yours.

Kambiz: [00:31:26] I would recommend that as much as we can, we spend time with our families and our loved ones. And don't forget to come out of our caves every once in a while. I've been in in my grading cave. It's the end of the semester so I've been grading a ton. And it's important to spend time with family and connect with those around you, your students as well as your immediate family and extended family and anyone who is in your circle of friends. Don't forget to maintain those contacts.

Bonni: [00:32:01] When we first started this conversation you were talking about those relationships for you, going to school and sometimes feeling that struggle and it's those relationships really that carry us through those difficult times in our learning seasons. And then of course we need our families and loved ones to carry us through our difficult seasons in our teaching as well.

Kambiz: [00:32:20] Yep, absolutely. And they reinforce each other. I think that you can be a better teacher, better instructor, better researcher, if you have those connections and contacts and support systems available to you when things might get a little rough.

Bonni: [00:32:37] Kambiz Hmadani, thank you so much for spending time today on Teaching in Higher Ed. I've already learned so much from you and I can't wait to dig in even more on the materials that you've provided for the show notes as well.

Kambiz: [00:32:48] Thank you very much for having me. It was a pleasure.

Bonni: [00:32:53] Thanks once again to Dr. Kambiz Hmadani. It was wonderful hearing about all of your teaching innovation and your deep desire to get learning out to as many students as possible.

Bonni: [00:33:07] Thanks to all of you for listening. This is definitely going to be a set of show notes you've got to go check out. You get them in your podcast player but if you want to bookmark them for future reference, you'll want to go to teachinginhighered.com/242.

Bonni: [00:33:22] And also if you want to not have to remember to go to each one of the episode shows you can receive a single email each week with those shown notes and also an article about teaching or productivity written by me. You can subscribe at [Teachinginhighered.com/subscribe](https://teachinginhighered.com/subscribe). Thanks so much for listening. I'll see you next time.

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