Transcript

[00:00] [background music]

Derek Bruff: [00:00] This is "Leading Lines," I'm Derek Bruff. I am a virtual reality skeptic. That is, I am doubtful that VR will have a significant impact on postsecondary education in the coming years.

[00:19] Since this episode of Leading Lines is all about VR, I thought I should provide full disclosure before we get started.

[00:26] Why am I a skeptic? Because I remember Second Life, the online, virtual world that debuted in 2003. Because I remember how much hype there was around Second Life's potential impact on education.

[00:36] As it turned out, building virtual content in Second Life was a lot of work, which made the platform pretty hard to use in most teaching contexts. VR seems to have the same flavor to it. I can see some very specific applications in education for faculty with the resources to build content and apps, but it's hard to imagine regular use of VR across courses and disciplines.

[00:59] That said, here on Leading Lines, we're exploring the future of educational technology. We have a team of producers who make sure that we consider all kinds of topics, including ones I'm skeptical about.

[01:09] Producer Gayathri Narasimham, who is associate director at the Vanderbilt Institute for Digital Learning, is very interested in virtual reality and its potential in education.

[01:19] In this episode, she shares an interview with two Vanderbilt faculty, Bobby Bodenheimer from computer science, and Ole Molvig from history who co-taught a course

on virtual reality.

[01:30] As Ole points out in the interview, at this point in time, we just don't know yet what the potential of virtual reality is. Maybe, I should have a more open mind about its use in education.

[01:42] How do you figure out what an emerging technology like virtual reality can do? One answer, launch a team-taught interdisciplinary project-based course on the technology in question. That's what Bobby Bodenheimer and Ole Molvig did.

[01:55] In their interview, they share the challenges they faced in creating their course on virtual reality, and some of the lessons they've learned while teaching students in emerging technology.

[02:03] [background music]

Gayathri Narasimham: [02:06] Today, I'm talking with Professor Bobby Bodenheimer from the computer science department and Professor Ole Molvig from history of science and technology and the Institute for Digital Learning.

[02:17] We're going to be talking about a lot of different ideas and topics, but in particular, about the Cross-Disciplinary Collaborative course using VR technology. Tell us a little bit about your background in virtual reality and what brought you both together.

Bobby Bodenheimer: [02:34] My main research area is in virtual and augmented reality. I've been doing that for a number of years. In the computer science department, I teach undergraduate courses on virtual reality. I teach an animation course as well.

[02:51] People want to use animation. They want to create animations. People want to create virtual realities. They want to create virtual environments for their everyday use. It's fun for them to do so. They want to create games.

[03:03] Very frequently, people come into my office, and they want to talk to me about this idea that they have for an application area. There are application areas where we can find some interest in computer science, some area that I'm interested in, and some area that they're interested in that we can develop a collaborative research effort.

[03:31] There are many, many more where there's no real computer science research effort, and they have to go away dissatisfied.

[03:40] At a high level, I'm really interested in understanding and bringing people who are not technology specialists into an environment where we can create applications and see how really difficult it is by today's standards, as opposed to 5 years ago or 10 years ago, to create interesting applications.

[04:07] Having said that, I'm also very interested in training computer scientists to think more broadly. They're going to have to learn to work with other people, other disciplines, and particularly in computer science and in virtual environments.

[04:25] They're going to have to work with people with broad backgrounds, artistic backgrounds. It's good for them to be exposed to that at the undergraduate level and to learn how to work in interdisciplinary teams with broad backgrounds, with humanities-based backgrounds.

[04:43] From my perspective, this is a really good way to do that. That in a nutshell, is the motivation for this course for me.

Gayathri: [04:55] As you were talking, I was thinking it reflects the Zeitgeist right now, which is the emphasis on interdisciplinary collaboration coming from the administration, through the TIPs grants and other kinds of initiatives within Vanderbilt.

[05:10] Also, within the broader scope of the National Science Foundation and places like that where they have emphasis on computer science for all and making that being more accessible, not just the technology but working with the technology and being able to work with the interdisciplinary groups, like you mentioned.

Ole Molvig: [05:30] That brings me to my background. It is Ole Molvig. I teach in the history department here at Vanderbilt, history, science, and technology. My original background is in history of physics and astronomy, particularly, quantum cosmology area, Einstein, and so forth.

[05:47] I'm interested in how we understand things that are very hard to understand, how is something that is considered to be really difficult to understand, what is the process by which

we understand that.

[05:59] The last several years, I've been trying to extrapolate these lessons we learned from science studies of looking at the past, the other kind of environments to how does it help us understand things moving forward. I've really been focused on this concept of emergent technologies.

[06:10] These are technologies that are near the cutting edge, but they're still broad enough that people are becoming widely aware of them. A few years ago, I think VR represented this concept of emerging technology well. It was new to the consumer market and has a long research tradition, but it's becoming aware to everyone.

[06:27] One of the things that compels me about studying emergent technology is we don't always know how they're supposed to be used. They're novel enough that we know they're likely to be important, although sometimes we're wrong.

[06:39] We're pretty sure that they're going to change a lot of things, but we're not sure how, when, and why. The motivation for me and for joining this class -- I've not been studying VR for much of my career -- has been how can we develop, in this case, a course.

[06:55] Then we'll tell you about the structure of our course in a second that inherently mixes technical skills, technical backgrounds with non-technical backgrounds, but also brings in problems that range, in this case, across the academy from very different disciplines.

[07:09] The way we structured this course was it is a collaboration of an upper level computer science course that Bobby has taught a number of times previously, that's usually upper level CS students who've had a certain threshold of programming experience.

[07:24] The other side is, essentially, everybody else who's not that. They could be students from the arts and humanities, or from pre-med, or pre-law, or whatever the case might be. We team them together in roughly equal numbers by projects of about five groups. Then we have faculty mentors or clients from all over campus.

[07:49] We've had anthropologists. We've had English professors. We've had medical doctors come in and serve as a client. Some of them have been very familiar with VR. They worked in it before, but the majority haven't. It's something that's also relatively new to their own field

and are curious what kinds of things could they do.

[08:05] Our students then can also act as a translator. They help this faculty who's never experienced VR, for example, learn what is possible and also what's not possible in the current state of VR. They decide together or sometimes the faculty have a project they can already jump into.

[08:20] That is going to build a specific environment that has a research or communication aspect that's legitimate. It belongs to a particular field. It's something that a faculty member is invested in. We'll talk about some of the examples we've had before.

[08:37] This model of having two professors from different disciplines, teaching student teams that are inherently interdisciplinary, and then bringing in faculty from a bunch of different disciplines really catches my concept of the uncertainty of emergent technology well.

[08:50] We don't know where it's best going to apply. It could be in gaming. It could be in simulation. It could be in therapy, but we should be trying all of these things and experiment on that. That's brought me to work on this course with Bobby.

Bobby: [09:02] The other thing that's interesting about that is that we both have found that it's very challenging to teach a course like this when you come in from two very different disciplines.

[09:14] The groups of students are coming in from two very different backgrounds and trying to get them to mesh together into a team well, to get them to buy into the structure of the course. After the second round of teaching this course, we have some strong ideas about how to do this for this next iteration that will be coming up in the fall.

Gayathri: [09:35] Awesome. I was going to ask you about the challenges and to expand on the particular challenges. You mentioned that the students are coming from two different backgrounds. One, I presume, is the computer science-tech background.

[09:45] What's the other background? Are you talking about all the other kinds of majors as a separate background, or do you think that there are even nuances in those kinds of backgrounds?

Ole: [09:56] Yeah. It's an interesting pragmatic question to understand as our computer science students are in this for a particular reason. They need a project-based class to graduate.

[10:07] All of our other students are in it because they are interested in the topic, that it does not necessarily fulfill any particular graduation requirements. Just that basic bureaucratic motivation ends up having a different reason that our students are in it and who we are gathering.

[10:25] The students that come from -- we call them the university students -- because it's a format we use here on the campus. It's a university course sponsored by a different part of the university, is their fundamentally interested in the technology. They want to know what it can do.

[10:38] They tend to be fairly optimistic about the possibilities of virtual reality. Some of our CS students are much more familiar with the nuts and bolts of what it takes to program in new environments. What is hard to do, and what is easy to do, and learning to talk to one another and getting that breadth.

[10:57] Ideally, I wanted to have as broad a set of students as possible from the university side, mixing our students from the arts, from the humanities, and social sciences, and from the natural sciences to engage in this class. We've seen pockets of that. I would say there's definitely been some concentrations.

[11:15] We've had a number of students that are clearly coming from the arts. This is an aspect of a new medium for artistic expression as well as narrative. I've seen one cluster around that. I'd say we've had a number of computer science adjacent fields.

[11:31] These would be students that do not qualify in the computer science requirements for that half of the class, but nonetheless, have a strong mathematical or scientific background, and are, maybe, doing this as a CS minor even and are seeing this as related to their field.

[11:46] We've had fewer of the students, I would say, are like really distant, have any connection to VR. When you stop to think about it, that makes perfect sense, particularly as there is no bureaucratic or intrinsic motivation to take this particular class outside of being somewhat just inherently interested in the topic.

Bobby: [12:03] When you put an interdisciplinary team together, and you have a number of computer science students and a number of non-computer acience students together. At some level, there's going to be code involved in it.

[12:16] The computer science students tend to come in and think, "We've had, at least, three semesters of coding. We've taken all these other coding classes. Why don't we just take over the project because these non-computer science students just don't know anything about coding?"

[12:33] Yet, the fact of the matter is, there is a tremendous amount of modeling and building that goes on, that is not really code-related. In the best projects we've had, there's been a balance there, and those groups have worked that out on their own.

[12:52] We adopted a model last year to address that better, but we need to do a stronger job of that. We have ideas about how to do that.

Ole: [13:04] One of the fun parts about teaching this class is we came in the first time focused on how to teach the tools. We chose Unity 3D as the primary platform that most of the projects that we built in. Unity 3D can be done either through a graphical interface for much of it but not all of it.

[13:21] There's a coding aspect done in C#, which some of our students had experience, but most of them did not specifically have experience in that. We focused the first half of the class on, this is how Unity works. This is how you code in C#, or how you code with Unity in C#.

[13:35] By the second half of the class, we're letting them loose on their individual projects that the mentors have presented. What's been surprising is second time around, we are now realizing that those are important, of course, but the team components has been the thing we've probably been thinking about the most.

[13:51] This has been the area that has taken the most of our effort to think through it and make sure that it's fair, it's equitable, but also it's as productive as possible. Get them across the sense that this is realistic.

[14:02] This is how post-school projects are more likely to work than, maybe, they've been

used to in other ways. That's been a lot of the challenges we've had, but we should also remember to talk about some of the exciting projects that we had in past years. There's been some amazing results that come out of this.

[14:20] Remembering that, it's only a semester project from students who've almost no one had any prior experience. At the end of every semester, we run a Demo Day that's been a real success. We take over ar floor in our innovation center. We have between 5 and about 10 projects that are being demoed.

[14:36] We've had up to 100 people come to these and experience these various projects, It's so gratifying to the students to see all the kind of hard work and frustrations of teamwork, and so forth, be then seen by people who have never put a headset on, or have only been playing a certain kind of games to see what they were able to accomplish.

Gayathri: [14:55] I want to ask briefly about the particular challenges, the impact on the students. As you were saying, you focused on your first semester of teaching, you focused on the tools, but on the second semester about the team organization and how they are working well together.

[15:12] My question is, how do you assess in this class? What is the metric of assessment? Because it seems like you have a very diverse group of students. Anything that the computer science students can do, the others are not going to do as well. How did you do that? How did you come up with a metric for assessment?

Bobby: [15:34] What happens is that the teams are formed. They're tasked with forming a specification for their project very early on. They have to form a specification. This is the goal that they have to achieve by the end of the semester. That's done in collaboration with their mentor.

[15:58] Ole and I sign off on it. This is also where our experience comes in. If at that point, even with talking to the mentor, we think the specification is too ambitious, we'll trim it down. We get it to where we think it's reasonable. The specification is not immutable.

[16:20] It can change over the course of the semester, but we want them to have a goal. We want them to have components of the specification. They have to come up with a work plan. Throughout the semester, they have certain things that they have to meet. Every week,

they're responsible for showing us what they've done.

[16:42] They have to achieve certain things. They get to pick those things every time they meet. We can tell if they're not doing anything or if they're floundering. By doing this, we can tell who's working in the group and who's not working in the group, and the group dynamics emerge. You can develop rubrics for assessment through that.

[17:07] Every week, they have to get up. They have to present what they've done in the last week in five minutes. Ideally, we told them to do a two-minute two slide presentation. It ended up more like being a three slide, five-minute presentation but that's OK. They presented what is called a burn down chart.

[17:29] They have a list of things that they're supposed to do. How many did they get chopped off that week versus they look at the rate that they're going. They can see they have a deadline which is the Demo Day, or are they converging to zero. They have to get down to zero.

[17:46] Sometimes, the specifications changed because they realize that this task that they thought was going to be easy suddenly exploded on them into 5 subtasks or 10 subtasks, so the burn down chart goes up. They realize they have to work harder. Eventually, they realize, "Well, we're not going to meet these kinds of things."

[18:07] As in our project, we had a project that our group didn't get to some of the things. We don't count off very much for groups that didn't get to all their goals as long as they proceeded well, they were well organized, and they worked hard. Those are the things.

[18:31] As long as they're doing well on their week-to-week evaluations, that's generally how we assess and they come together. If the group dynamics are working well, and they're buying into the process, then those are our key assessment metrics.

[18:50] The project needs to come together in some way, shape, or form at the end.

Ole: [18:55] This is why we instituted this agile model. The burn down chart is the first year which we did not include this. It allows four in a group. One of the things we wanted to avoid was the group of one person takes an unfair amount of that burden. That could either be because it's left upon them or because that person grabs more of that burden.

[19:12] In a project that's left to the end, it only increases the chances for that kind of uneven distribution to happen. By doing this, this low burn down chart, where we're checking in as regularly as we did, it helps distribute that. That distributes that kind of burden amongst the students.

[19:27] It also aware who's not pulling their weight. We can find ways to make interventions earlier on. This reduces that opportunity.

Gayathri: [19:34] Have you had anecdotal evidence from faculty who have worked on the different projects? What was their experience? How did they like working on these projects?

Bobby: [19:42] Why don't you tell us what your experience was?

Gayathri: [19:46] [laughs] I thought it was very impressive.

Ole: [19:47] Why don't you go ahead and explain the project that you guys had students work on a little bit?

Gayathri: [19:55] The project that we worked on was creating an adversarial maze, somewhat like what is in the Harry Potter's "Goblet of Fire" movie. The maze would change as a person navigated it. It had several landmarks. It had several target items that a person had to acquire.

Bobby: [20:17] To give some more background, if you think about how you figure out from sitting in your office, how you go home, or how you learn to get to a new place, there are sort of different mechanisms you can use.

[20:30] One way is you can learn to navigate by using landmarks. There's a big tower up there, or a water tower, or something. You know that if you go close to the water tower, then the building you want to get to is on the right of it or something like that.

[20:49] That's navigating by landmarks or beacons, as it's called. Another way is you learn to go by route. You know that if you go outside the office and you turn left, then you turn right, then you turn left again, you get to the elevators and you can take the elevators down. That's route knowledge.

[21:07] You can put all of those together. Eventually you can build what's called a cognitive map. Then you have what's called survey knowledge of where you're going to go. It's a little more complicated than that, but that's the basic idea.

[21:22] What we wanted to do in this adversarial maze is force people to use either route knowledge or landmark knowledge by making one or the other of them unreliable. In the maze, if people were trying to use route knowledge, the route is going to change.

[21:38] Then they have to use executive function to decide, "Oh, I can't use route knowledge. I have to navigate by landmarks, or I can't use landmarks because the landmarks are changing on me, so I have to use route knowledge." That's the basic theoretical motivation for what we're doing.

[21:54] The idea was this is happening in the Goblet of Fire in the maze that the wizards are going through. The maze is changing all the time so they have to find their way out doing that. That's the basic idea of this maze.

Gayathri: [22:11] The idea of executive education is what I was going to also talk about which is the changes that you have to encounter from moment to moment, and adapting to those changes, and making split-second decisions, rethinking your process, and working on those using your memory, using spatial orientation.

[22:35] All of these are a part of the executive functions. I was very interested in testing that out. The project itself was just to create the maze. We haven't tested it out yet.

[22:47] What I thought in my experience was that the students…I was very impressed how organized they were in coming together and making a plan for what needs to happen and how they're going to accomplish this. Obviously you were there to mentor them and gave them a sense of what could be accomplished and what couldn't be.

[23:10] I was very impressed with the way…even though the one student, who was not a computer science student, seemed to be very involved in how this whole project was structured. I thought this expedience is a very useful experience for them, mimicking almost real-life kinds of projects that they'll have to do later.

Ole: [23:28] The thing about that project you guys described, that's one of the traditional

areas that VR research has been done, a combination of computer science and psychology kind of learning. In the VR environment, you can make realms that are either similar or dissimilar to the ones you could make in the real world.

[23:43] You did not, for instance, give them magic wands, I understand. They blast their way through as the movie had done, but that could have been an element of added, too. Let's say we brought this into the literature department. That's one of things that's been really exciting about the kinds of projects we've had.

[23:57] They've gone from core research projects in an area with another really nice one done this year, with a computer scientist on data visualization and looking at the third dimension of being immersed in a 3D environment.

[24:07] How does that affect the ability to read data visualizations? In that project, they recreated a classic study in 2D data analysis of trying to figure out changes to representation, what it means to understanding. They brought that into the third dimension and did some tests on that which was really a nice one.

[24:26] We've also had projects going from an English department recreating a kind of a canonical place in a movie, "Ready Player One." The book is about virtual environments. They recreated one of the few non-VR environments but in VR, which is a nice set of playful exploitation.

[24:41] I had a project that was trying to create a rule of physics that is hard to find on campus. We tend to have Newtonian or Einsteinian relativistic physics departments around here. I'm trying to understand the concept of how Aristotle's mechanics would work in the different trajectories that, say, a cannonball would run in the VR environment.

[25:05] We can change those physics. We can have the trajectory look different to the viewer. It's a good explanation for how VR cannot just recreate spaces that do exist, that are hard to find, or that are distant, but that actually don't exist in our normal world. We had a medical example…

Bobby: [25:24] I want to ask you about that. I wanted you to talk about that a minute because you worked very closely with your group. I know you did, and yet they did something very different than what you expected.

Ole: [25:35] [laughs]

Bobby: [25:35] Talk about that a little bit. That's an interesting mentor group reaction.

Ole: [25:41] Yeah. In addition to having the outside mentors, Bob and I both also mentor one group within these classes. I tried to role play a version of the mentor different from the faculty who is teaching the actual "How to develop a unity" part of the class.

[25:59] I wanted to give them the opportunity to also treat me as a client where they are going to explain what is possible and what's not. I give them a few rubrics. I am interested in what I call these alternative physics environments.

[26:12] I wanted them to come up with a way of experiencing that environment that was of interest to them, so they felt motivated to complete the project.

[26:21] They decided to do a game based on archery where you had to decide which element in Aristotle's universe -- air, earth, wind, fire -- would then traverse the environment with different rules. Mostly around trajectory to complete certain kinds of puzzles.

[26:41] That was different than what I had in mind, was building a world in which the all of the physics was going to be somewhat different. Then you would have to reorient how you would navigate that world in a particular task, like knocking the tower over or something, might be.

[26:55] I really liked that they took the core constraints I gave them, and made it into something that they thought was of enough motivation, that they wanted to do a really good job. They did an excellent job. They worked really hard on making this a fluid and impactful environment to work in.

[27:14] What motivates me on this project is there's a really classic concept in the history and philosophy of science called incremental ability that Thomas Kuhn famously came up with a half decade ago or a century ago.

[27:27] In there, the concept is if you live in one paradigm, one world -- to say the Aristotelian paradigm or the Newtonian paradigm -- you cannot understand what it's like to live in the other one. All of your perceptual environment is theoretically laid in in some way by the set

of rules you think it governs by.

[27:47] To see a world in which the trajectories are different is so disorienting. Anyone who's been in there and has picked up one of the arrows or one of the balls or see it just fly in a path that's not what their mind expected as one of the ways of visualizing this concept of incremental ability that I really thought this project did really nicely.

[28:06] One of the real possibilities of doing this with the faculty mentors, not just so they can help us out but for many of these mentors, their project is going to continue in some way or another.

[28:13] One of the longest running ones is with an anthropologist here, Steve Wanke, who's been working in 3D modeling of a site in Peru for a very long time. He's got a really nice three dimensional assets but hasn't really been working up to this point in virtual reality.

[28:27] He's been working two semesters now with students to make that a site that you can visit in VR, navigate it, and sometimes make accurate scientific measurements in there. He's presented on the VR side of his project to a number of groups that I've had an opportunity to listen in on.

[28:46] I really appreciate how he and his students have talked about the experience of using VR for their work beyond the 3D models they'd already made. Several of his students who have not yet traveled to Peru will have been in the VR environment.

[29:00] They've always commented on how when they actually do make it down there, but they've been in so many times in the VR environment, they feel they've already been there.

[29:07] They are so much more familiar with the layout and where to go and this sense of, "Oh, right. That reminds me of this thing that Steve was telling me about." They also mentioned how much better it is to talk to a site visit. Steve who'd been there many times is trying to explain the key component of one of the measurements in one of the rooms that are made.

[29:27] When they go into the VR environment to see if the level of visual detail that reminds Steve of the things to describe, to talk about is so much richer than when it's not, when it's either just on a screen or just on a written paper.

[29:40] That's one of the things that the graduate students have really come down to as the effectiveness from their research perspective of having these visits that allows for such richer memory recall.

Gayathri: [29:49] Bobby and Ole, you've offered this course now two times. You have a lot of insights about bringing together these kinds of groups of students who have either a technical computer science background or not a technical computer science background.

[30:05] What are your insights? What's your advice for others who might be interested in offering a similar course in the future?

Bobby: [30:18] I think that there are two key things from my perspective about making this course successful.

[30:26] The first is a very pragmatic concern. That is, people are always very concerned about the VR equipment and getting the equipment. From my perspective, that's not a major concern. You're either going to have, let's say, $20,000 possibly less to buy the VR machines and the headsets and whatnot, or you're not.

[30:51] If you don't, you can't offer the course. It's going to take some amount of money, at most $20,000, depending on how much you want.

[30:58] We have 10 VR machines so we can host 10 groups, at most. We put about five people in a group. We can have a course of about 50. You know that going in. You're either going to have that equipment or not.

[31:16] What is the key thing for us and has always been a bit of a struggle, was a huge struggle before we even offered the course the first time is where are you going to put those machines. You need the space. Space at a university, as you know, is a really hard thing to get.

[31:33] You need a certain amount of space. It's just not getting a desk. Those machines have to be set up. You need space to move around in for the VR. Those machines, in some sense, have to be dedicated and students work on off-hours. The space has to be available to them.

[31:54] They don't work Monday through Friday, 9:00 to 5:00. Their projects are never going to get done if the space is only available to them 9:00 to 5:00. Where are the machines going

to go? That's the first thing.

[32:08] The second thing is where does this course fit within the curriculum? On the computer science side, as Ole alluded to earlier, the computer science course has a very definite place within the curriculum. The university course does not. Why would people outside of computer science want to take this course?

[32:31] If you're offering a general virtual reality course and you want people to take it, does it have a place in the curriculum? Are people going to be interested in it? Just beyond the few who are interested in emergent technology. I think that's a key thing that you have to figure out.

[32:48] If you're just going to offer it to computer science people, of course, computer science people are going to take it. They're interested in this technology. Those are my two things about this.

Ole: [32:58] If I'm imagining another high school or university that's interested in offering classes like this that might not have a team of CS faculty, and a non-CS faculty, and a fair amount of technical support that we're always struggling to find more of that.

[33:15] Beyond all of those concerns, I would also really highlight that the world of VR is really broad that you can do 360 video which is going to require no programming whatsoever. For purists of VR, wouldn't even count as virtual reality in terms of, maybe, an immersive environment.

[33:37] Based on the students you have, the skills that the teachers are competent at doing and the kinds of projects that you're hoping to accomplish, making sure those are well aligned, I think almost anyone can teach some version of a virtual reality or immersive environment course.

[33:55] The struggle is when the expectation of what's possible really doesn't match which tools are being used or which skills are being highlighted. An environment that is really visually rich and created from scratch for a particular imagination requires a level of computer artistry that, for example, we don't have an enormous amount of on this campus at the moment.

[34:18] We've actually restructured our projects to avoid as much of the bespoke digital asset creation. There are ways, photogrammetry and scanning, that allow for some kind of other ways of bringing in the assets.

[34:32] We've had to adjust the kind of projects that we've done based upon to teach that well would really take away the time that we have to teach the interactive coding.

[34:41] If you want an environment that you could interact with heavily, that's going to have a lot of coding. If you want an environment that's going to look a very particular unique way, that's going to take a lot of asset creation. If you're going to want an environment that is photorealistic, that might go through video instead of through computation, computer graphics.

[34:59] Matching up skills, techniques, and mission is really important because it gets really frustrating when, say, the client, in this case, assumes that one thing is possible, but actually we're set. We're teaching a different kind of set of skills. Just making sure those are all aligned is my best advice for people who'd like to try this.

Gayathri: [35:20] Awesome. You've offered it twice, and you have plans to offer it a third time. Do you have plans beyond that because it seems you're clearly passionate about this? It seems like a lot of fun for the students. The projects seem to be really a lot of fun, too. What are your thoughts on that?

Bobby: [35:36] This is in my wheelhouse. It's a mainline CS thing. I can continue to offer a version of this as a CS project course in the future. The question is what's going to happen with our cross-disciplinary course? I don't think we know the answer to that yet.

Ole: [36:00] I don't think we have a solution worked out. We both are committed to finding a solution that's going to work, and I expected it is one. It is something for faculty or a tech administration to think through is when and how to support really effective cross-disciplinary teaching. It takes two of us to teach this class. I can imagine this class being taught by three people.

[36:22] I could imagine it being taught by one person, but it wouldn't be the same class.

Bobby: [36:26] If I had to teach it by myself, it would not be the same class.

Ole: [36:30] Same for me. One of the things that we play with in our class is much of the history of VR as taught by our computer scientist. I do a fair amount of the unity development teaching in the class as well.

[36:41] By switching those expectations, as both model and for our students, that there's not set rules that you have to follow, but it allows for a kind of experimentation. I've often talked about this class.

[36:52] For me, as the class that I'm not the expert in the way I am the expert in my history of science classes, classes that I've taught many times before. I got a PhD in the area. I'm used to being the authority in the room. I run this class. I call it a facilitation class.

[37:07] I am, in many ways, learning alongside my students. I'm helping them find resources that I'm also finding to better make those advancements. That's a really exciting mode of teaching for me as well. It's also sometimes terrifying.

[37:18] Sometimes, I worry I would go into a class and everyone's going to know what I'm trying to teach except for me. I want to make sure that happens as infrequently as possible, but I don't want to, therefore, not teach it because I haven't gone and spent 10 years learning how to do this to get the accreditation, and then come back and teach it.

[37:35] By then, the technology will be completely different. That level of being willing to switch mode from expert to facilitator. For Bobby, he is an expert in this topic in this class. Having both of those kinds of models of teaching available at the same time, I think, is effective for our students to see.

Gayathri: [37:51] That's great. They're looking at the actual collaboration between your own expertise and coming together with this class, too. I think they get the benefit of that.

Bobby: [37:59] You say I'm an expert in the class, but Ole knows a lot of the tools. I don't know the photogrammetry tools as well as he does. He brings a lot to the class that I don't bring as well.

Gayathri: [38:10] You both bring expertise. That's what I meant.

Bobby: [38:12] He brings a lot of expertise to the class.

[38:14] [background music]

Gayathri: [38:14] I look forward to future iterations of your course. Thank you so much, Bobby and Ole, for talking with me today.

Bobby: [38:22] Thank you for having us, Gayathri.

Ole: [38:24] Thanks for having us, Gayathri.

Derek: [38:26] That was Bobby Bodenheimer, Associate Professor of Computer Science, Electrical Engineering, and Computer Engineering, and Ole Molvig, Assistant Professor of History of Physics and of the Communication of Science and Technology. Both faculty members here at Vanderbilt University.

[38:37] Longtime listeners will know that Ole Molvig used to be a regular contributor to our podcasts. We're happy to have him back on, in an interview capacity.

[38:45] As for virtual reality in education, OK, maybe I'm less of a skeptic now. I definitely appreciate Bobby and Ole's efforts to see what's possible by matching student teams up with faculty across campus. I really like that students as producers model for exploring emerging technologies.

[39:02] I also appreciated their thoughts on team teaching a course across disciplines. Sometimes, faculty underestimate both the challenge and the potential for interdisciplinary team teaching. I'm interested in exploring ways to better support that kind of teaching on my own campus.

[39:16] For more on Bobby and Ole and their course, see the show notes for a few links. You'll find those show notes, as well as past episodes and transcripts on our website, leadinglinespod.com.

[39:26] If you have thoughts about this episode, please share them, either on the website or on Twitter where we can be found @Leadinglinespod or via email, leadinglinespod@vanderbilt.edu.

[39:35] Leading Lines is produced by the Vanderbilt Center for Teaching, the Vanderbilt

Institute for Digital Learning, the Jean and Alexander Hurd libraries, and the Associate Provost for Education Development and Technologies.

[39:47] This episode was edited by Rhett McDaniel. Look for new episodes the first and third Monday of each month. I'm your host, Derek Bruff. Thanks for listening.

[39:56] [music]

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