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Kristine: We're not all experts because of the multidisciplinary nature of IoT, we have faculty that are cybersecurity experts, electronics experts, programming experts. In their field they're the subject matter experts, but not all of them. So, when we're collectively together, we really "bring it." So, it's really kind of fun because you hear the different aspects and the different perspectives of each discipline coming out through their voices.

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Mike: From the Center for Occupational Research and Development, welcome to ***Preparing Technicians for the Future of Work***. I'm your host Mike Lesiecki. In each podcast we'll reach out to people who are actually on the front line of the future of work and hear what they have to say. That means interviews with industry, interviews with working technicians, forward thinkers in the field. We'll do some background research, and we'll curate that research to make sure you have the most up to date and relevant information. And in every episode, we'll suggest action that you can take. We want to inspire you to take that action.

This podcast is brought to you by the Center for Occupational Research and Development, known as CORD, with financial support by a grant from the National Science Foundation's Advanced Technological Education program. Opinions expressed in the podcast do not necessarily represent those of the National Science Foundation. You can find out more about our project and our approach at "PreparingTechnicians.org."

You know listeners, on our podcasts, we often talk about what the "emerging technologies" are. But today we want to focus on a different approach to thinking about how to incorporate them into Community and Technical College's programs. Now, to that end, we have two guests here. And I'd like to introduce them to you. Let's start with our first guest today: Chuck Bales. Chuck, you're a Professor of Mechanical Engineering at Moraine Valley Community College. Will you tell us a little bit about your background? And what your interests are?

Chuck: Yes! Actually, I'm a Professor of Engineering Technology, which is a little bit different than "Engineering." My degree is in Mechanical Engineering. I have a Bachelor's and a Master's Degree in Mechanical Engineering from University of Florida. But I focus on teaching in the Engineering Technology area, which is a little bit different.

I like teaching in the Engineering Technology area, because as we'll get to during this conversation, I'm sure, there's a lot more hands-on, a lot less theoretical instruction. So, my background kind of came from the engineering field, but it led to this area of Engineering Technology, which is really relevant nowadays, especially at the two-year technical and community college area. And it's a good jumping off point for a lot of our students.

Mike: Good, Chuck. By the way, how long have you been at Moraine Valley?

Chuck: I have been at Moraine Valley for 28 years. This is my 28th year. So, been here quite a long time. It's shocking to think of it like that!

Mike: It gives you a good perspective, Chuck. Cool.

Let me introduce our second guest: Kristine Christensen. Kristine, you're a Professor of Management Information Systems. But you're also involved with faculty professional development at the college, aren't you?

Kristine: Hi, Mike. First, I'd like to thank you for having us.

At the college I wear several hats. I was serving as Professor in the Computer Information Systems department as my primary role, where I teach Web Design, UI, UX Design, Networking for Business, Programming, and other technologies. Almost four years ago, I started working with Chuck on the Robotics and IoT curriculum in the Automation & Engineering Technology Department.

I get bored easily. So, I like the new challenge of getting to know and learn new subjects, and then teaching them! And so, it's been a lot of fun. Specifically, IoT, given its multidisciplinary nature. So, that's my teaching role.

And I also serve as Director of Faculty Development, where I oversee the professional development opportunities for our faculty and plan development days for all college employees.

Mike: Good, Kristine. Well, as all of us know, actually with faculty is WHERE these emerging technologies become incorporated into the curriculum. And that's what we want to talk about today. I know both of you have worked on integrating and incorporating skills and competencies. Kristine, let me start with you, if I can. First, how do you know what the IoT Skills and Competencies are? Before you start thinking about incorporating them, how do you know what they ARE?

Kristine: Mike, we've done our homework. We've done a lot of research from business and industry journals. We've looked at job postings, attended conferences, advisory meetings, talking with various individuals from both business and industry as well as academia across the country.

We also have the privilege to work with Dr. John Sands at the Center for Systems Security and Information Assurance (or what we call CASSIA). And they received an NSF grant to examine the workforce competencies and needs of the IoT industry. So, we know that this is a career field that is multidisciplinary in nature, is constantly evolving, and there's a lot of moving parts.

So, what the grant did is developed an IoT Coordination Network, and they gathered information about the workforce needs by partnering with representatives from industry, and manufacturing, and academia, and users of integrated smart devices. And through those relationships with the organizations, they were able to discover what the future local, regional, and national IoT workforce needs are. So, they examined the emerging technologies and explored new products and devices coming out related to IoT.

And the whole idea is to examine what business and industry are projecting needs are, so that we as educators can complement those needs and educate our students, so that they can be successful IoT integrators and technicians. And one thing that's important to note, this is how we kind of figured out what we wanted to teach in the IoT courses that we have established by leveraging our research and also using what the Coordination Network put together.

But soon the Network will publish two reports: one on the workforce competencies, which identify what companies are looking for from community colleges for teaching our students, and necessary competencies, capabilities, knowledge and skill sets related to IoT. And the second

report that's going to be coming out: what are schools doing nationally—with a canvass of all the schools. So, what types of courses, certificates, and full degrees are being offered. And that will help colleges and faculty know what their workforce needs are locally, but then also look at what other schools are doing to implement IoT into their curriculum.

Mike: Good, Kristine. I want to make sure that in the Show Notes we'll incorporate references to those resources that you've talked about. But let me ask you a question. I'm gonna ask both you and Chuck the same question: Where in the curriculum do you put Internet of Things (IoT)? I mean, it's a pretty broad topic. Some people think of it as "sensors and smart devices." Other people think of it as the "software and algorithms" that manage the data. So, it's such a broad field. Kristine, let me start with you. Where does it go in the curriculum? Does it go into CIS? Does it go into Advanced Manufacturing? Does it go into Engineering Technologies? What's your thoughts on that?

Kristine: For me, I think it's multidisciplinary in nature. And that's what makes it so difficult to place and house IoT at a college. So, maybe some colleges could take an approach where it may not have a permanent home, or they borrow from other areas.

And I guess it depends and is contingent on the workforce needs of the area that the community college or college is serving. Like you said, it could be housed in a Computer Information Systems, and using data analytics, or using the software tools to interpret the data that's being collected by those sensors. Or it could be Electrical Engineering. Or it could be Manufacturing. That's the difficult part. And because there are not that many programs that are fully born for IoT yet, I think other colleges and universities are having a difficult time determining where it's going to be housed, and how technical it's going to be. Is it going to be more of an Engineering focus? Or is it going to be an Applied Engineering focus? Is there going to be a CIS focus? It could even be a Math focus, where they crunch the numbers for the analytics.

So, I think that one way to really combat any confusion and to try to work together and partner across the college. I think that would be most strategic for colleges, and then have maybe one primary owner. But knowing that because of the multidisciplinary nature of this major is that those partnerships are really important.

Mike: You know, Chuck, I think your partnership with Kristine sort of exemplifies what she's talking about! You're on the Engineering Technology side. That's sort of a standard home for IoT. Are you resentful (I'm joking, Chuck!) of other departments getting in on the game?

Chuck: Well, you're absolutely right. That's exactly why Kristine and I, I think, do such good work. I love the fact that she wears so many hats. Because I believe—and I witnessed this myself going through the traditional Mechanical Engineering programs at large state universities—that there is a siloing of disciplines and degree programs. That, while it may have been beneficial, and it may still be beneficial in some areas, there's the Fourth Industrial Revolution, which is really what we're in right now. And what we're talking about represents a huge convergence of technologies and ideas. And there has to be a bridging of these technologies that bring some of this together for our students and for industries. So, yeah. I think the way we have approached this course (or this program) kind of reflects that. We try to bring in a lot of the different disciplines that bear on IoT.

But at the same time, it was very important with both Kristine and myself from the very outset that we NOT teach it in the traditional manner of multidisciplinary courses and programs—where there's prerequisites. We wanted our students to be able to get in on the ground floor, so to speak, and not have hurdles and barriers to getting into this extremely relevant, very timely area. So that, if they're interested in it, then they could go further, but not having to go through all the prerequisites that normal classes like this would have. Normally we'd have a prerequisite of maybe a programming language or two. We'd have prerequisites of Digital Electronics or Introduction to Electronics. So, we've structured this class, and our whole idea with the program is to get students excited about it first, and then have them proceed according to their wishes and desires for more background.

Mike: Sure. Chuck, I'm really glad you brought up the "prereqs," because a number of our listeners are out there thinking, "Okay, what am I going to have to force my students to do before they can take a course like this?" But it sounds like you've lowered those barriers by minimizing prerequisites here. I think that's an important thing.

But let me ask you this. When you talk about a course, what course are you talking about? What is its name? Tell us briefly what this course is?

Chuck: Yes, we're talking about our IoT Fundamentals Course at Moraine Valley Community Colleges. It's "LAN-120." But it's essentially an IoT Fundamentals course. We teach embedded systems in that. And we do that, as I said earlier, and as Kristine and you mentioned, without prerequisites. Now, that's a challenge! And Kristine and I both took that challenge head on, and tried to kind of "break the mold" a little bit, I think, with some of our thinking for this. But we've had great success with it. So, it seems to have borne itself out.

Mike: Good, Chuck. That sounds good! Kristine, let me turn to you. All of us know that, for faculty to teach something or even to incorporate something, they have to be comfortable with it, right? Before they can bring it into their classroom. How do other faculty at Moraine Valley (or other colleges that you're aware of), how do they get comfortable with this knowledge, skills, and ability for IoT? How do they actually get ready to do this?

Kristine: Mike, this is my one passion: to help other faculty learn about a variety of methods or topics. One of the things I really love to do. So, being able to address any professional development or faculty is, again, this is something I'm very passionate about.

So, we thought about how can we teach the teachers? How can we get this information out? How can we get training out to the high schools, the colleges, and even the universities? And then, also help the faculty become confident and gain the skills necessary to teach this course.

So, we put together the IoT Educators Academy. Its focus is to help faculty wanting to gain skills in this area and abilities in IoT so that they can incorporate it within their curriculum. So, whether that be a lesson in a course, a full new course, a certificate, or a program, we felt

like faculty needed to get an opportunity in a fun way to learn more about IoT.

I don't have an Engineering background. I have a Business and Computer background. So, being able to have that experience of someone entering this field with "not an engineering background," I knew how to address any gaps for faculty that felt a little apprehensive about learning this.

In addition to teaching the skills to our faculty, the Academy is meant to provide an opportunity for the faculty to experience the curriculum as a student. So, they'll know where the potential "pain points" for their students will be.

It also was meant to create a network of educators who can then discuss IoT and where it might sit in the curriculum. And also share resources with one another across the country. We've run our IoT Educators Academy four or five times. And we've built nice relationships with everyone who's taken the class.

But one thing I think is "just to break the ice." It's to provide that opportunity for people to experience hands on, even if it's through Tinkercad (virtually). They're able to construct the same type of project that their students will.

And a big bonus, too, is that they can take anything that we provide them in our course freely and incorporate that into THEIR course. So, that hurdle of having to come up with your own content and then having to develop it—it's already been done for them! So, if they want to even just try it out in one course, just one concept... It's something that they can incorporate an IoT module in an existing class so that the students are introduced to the concepts of IoT, and then start to become excited about it.

And most faculty have received the course really well. We've had faculty complete the course, and even take the certification exam when they're done. And they emailed us saying, "I got it! I got it! I got it done!" So, we try to build excitement. And again, our IoT Educators Academy is a fine Academy where faculty not only learn, but they build relationships with other faculty across the country.

Mike: Kristine, I'm going to make sure we link to that in the Show Notes so people can potentially take advantage of that opportunity in the future. And here's one thing I know for sure: faculty learn from each other, don't they? And I think you've set the stage for that.

Kristine: Oh, absolutely. The thing that I really like is that a cadre a faculty—that they can learn and share from. And, you know, we're not all experts! Because of the multidisciplinary nature of IoT, we have faculty that are cybersecurity experts, electronics experts, programming experts. In their field they're the subject matter experts, but not all of them. So, when we're collectively together, we really "bring it." So, it's really kind of fun because you hear the different aspects and the different perspectives of each discipline coming out through their voices.

Mike: Sure. Chuck, I want to follow up with you on something that Kristine just said. There's an option for not necessarily doing this as a whole new course? Can I bring in modules or individual learning activities? Is that possible, Chuck?

Chuck: Yeah, absolutely. That was part of what Kristine and I...how we developed our IoT Educators Academy. That is also part of our work peripherally to the Educators Academy with the IoT grant. So, definitely in our IoT course that we share with instructors. That could be deconstructed, and different modules, different content can be introduced to students in existing classes to kind of augment or bring them into different areas. We also have our IoT Workbook, which is separate from our IoT class. And like I said, kind of tangential to the IoT Educators Academy, but we also share that freely. And in that we have two volumes of that right now, and we hope to develop a third volume.

Mike: Kristine, a little bit different topic: What if students take this course? Do they think, "Oh, this is the best thing that has ever happened to me?" Do they appreciate the problem-based approach? What sort of student reactions have you had, Kristine?

Kristine: For the most part, Mike, our students have received this class really well. Because of the lack of prerequisites that we require for this course, students that would never be exposed to electronics ARE. They never realized that they would like it. It exposes students to a

variety of topics that they might not have ever considered even pursuing additional coursework in.

And they really, really like the concept of doing things "hands on" and seeing what they've done actually function and perform and work as it should. So, it's not just theoretical. Our students can do their homework with Tinkercad. But they also are required to get a kit where they physically build these projects—and they can see them work! We have students record the functionality of each project. And some students walk us through it, and explain how it works, what reinforces their learning. Some actually have their siblings around them, and they're educating their siblings. And, for the most part, our students have been really excited about this. And one of the most common comments that we receive is that "I didn't realize that I would like electronics!" (If they're a programming student, or a LAN student.) Or "I didn't know I'd like programming!" So, it opens their eyes to different curriculums, which is one of the best things—they would have never thought to even pursue. So, they have really liked the learning activities—especially the hands-on portion and being able to see what they've done at the end of each project.

Mike: That's a good observation, Kristine. You can see their enthusiasm from what you've described. Let me turn back to Chuck. Chuck, give me a short answer: What's your industry partners take on this course? Do they say, "This is just what they need?" What's your industry member's response here?

Chuck: Our industry members think that this is just what is needed. I think they were surprised at our attempt with no prerequisites. So, I think that they were pleasantly surprised and pleased with that. But yeah, we've received very good reviews from industry. Especially because we have fit in the Arduino certification. It's always good for our students when we can add some professional certifications with that.

Mike: I'm glad you mentioned the certification. That'll be sort of our wrap-up point for today. Kristine, back to you. If you were in charge of everything, Kristine, what advice would you give to someone who's out there thinking (let's suppose they were a faculty member), "I really ought to be incorporating IoT concepts into my curriculum." Where do they start? What's the best starting point for them?

Kristine: Mike, if I was in charge of everything, I would tell them to take the IoT Educator Academy course—because it's gonna kinda "break the ice."

And I would also say "start small," if they're apprehensive. Just incorporate an assignment about "what IoT is," and then maybe even turn to Tinkercad. They have some projects where students can build. There's not much of an investment financially for a school—it's just a web browser. And have students start building. Just start small, and then work your way up.

We do have that community of learners and educators that you can always leverage.

And the IoT Educators Academy is here.

And also, we have those workbooks. So, I just encourage them to check it out.

And reach out to Chuck and I, because we're always happy to help our colleagues across the country.

Mike: I know you are! I'll make sure that we put links to those resources and to mechanisms to contact you.

Chuck, let me ask you a somewhat different question as we conclude for today. Sometimes faculty get in silos, right? They're just focused on teaching their courses. But it's clear that you and Kristine have broken down these cross disciplinary silos (let's call them). What's your advice? How do you do that? Do you just simply brazen about and pick up the phone and call a faculty member you've never met before on your own campus, in another division, or...? How do you get started in making a partnership like this?

Chuck: Well, that's a good way to start. That's kind of how Kristine and I got together. Kristine was brave enough to step across the aisle, so to speak, and get involved when she saw that I was starting a Robotics program at the college. So, yeah, just being brave.

But also, there's so many opportunities nowadays for educating yourself, for kind of teaching yourself, or at least exploring different options tangential to your background. So, as long as there's a desire and an interest in some of these fantastically cool, neat things that are so important nowadays, so topical, and so relevant, I think, "where there's a will there's a way." There's so many opportunities, in addition to just reaching across the

campus and saying, "Hey! What are you doing? Let's get involved in some new technologies!"

Kristine: I have to say that Chuck was brave enough to take me on—and with open arms! [laughing] Because I didn't have a background like his. And he was always willing to take me under his wing and educate me on things that I might not have been confident with. So, having that partnership has really, really helped and made a huge difference for me.

Chuck: That's a really good point that Kristine and I constantly try to get across to our students as well. There's a lot of student thinking that, "I have to be good at something in order to go into that field." But sometimes you can develop that "goodness." Sometimes just through interest. Maybe mostly through interest. That can be "the spark that lights the fire." And so, maybe just through our presence, maybe through Kristine's presence in our classes, students see that it's not intimidating. You can jump right in. There's plenty of people around.

I kind of liken it to (and I've told Kristine this) learning how to swim. You can learn how to swim in a kiddie pool—splashing around. But it's not real. Maybe the best way to learn how to swim is being thrown into a pool, as long as you have those people next to you that are going to help you. And so, that's kind of the way I see Kristine and myself in our classes with the students that we're going to "throw you in the deep end." But we're going to be right there to help you, to show you how to swim, and how to get through all this. And it's not really as bad as you think.

Mike: I like that "jump right in" idea, Chuck. That's a good one. Both you and Kristine sort of embody this whole thing, right? You've embraced this cross-disciplinary approach to incorporating new and emerging technologies like Internet of Things into your curriculum. And I think it's a great model for us to maybe mimic or adapt for ourselves. I really do like it. And so, thank you both for all the enthusiasm that you bring to this.

Today, you really addressed the challenges of not only the technology itself, but working across these disciplines. And you've provided resources in that academy that Kristine mentioned, as a starting point for faculty. I think that's just been great.

I want to thank you on behalf of our listeners for the work that you've done, and also for being with us today: telling

us your story, showing us the model of what has worked for both of you. So, Kristine, thank you very much. Chuck, thank you very much.

Kristine: Thanks for the opportunity, Mike. We appreciate it.

Chuck: Yeah, thanks very much, Mike.

Mike: Listeners today, it was all about the Internet of Things. Now, given the multi-disciplinary nature of that topic, and the need to bridge all of the technologies involved, it's a challenge to bring that into your courses, into your curriculum, into your programs. But Kristine and Chuck provide a good model to follow to do that. Your action today is to look at their Fundamentals of IoT course, and to consider the opportunity of joining their Educators Academy. I'll put links to all of those things in the Show Notes. So, thank you!

Now I want to acknowledge that our podcast is produced by John Chamberlain at CORD. John, thank you for all of your excellent work. Our project is led by Principal Investigator Ann Claire Anderson, also at CORD. Thank you, Ann Claire.

You can find out more about our project and links to all of our podcasts at "preparingtechnicians" (all one word) dot "org". You can also access this podcast on Google Play or Apple Podcasts. A rating and review is always appreciated. If you do access this podcast through the website, right next to the Show Notes, you'll see a link that says Feedback Survey. Take just a moment to give us some information to help make these podcasts better.

And finally, thank you, our listeners, for ***Preparing Technicians for the Future of Work***.

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Lesiecki, Michael (Host). Preparing Technicians for the Future of Work Podcast: Episode 37, *Incorporating Internet of Things* (audio podcast, transcript). Center for Occupational Research and Development, Waco, TX. 2022. Retrieved from http://www.preparingtechnicians.org/