



## Darius Melvin and Susan Witt

**Darius Melvin:** [00:00:00] But also, they recognize that, actually, my skills are gonna make a difference, immediate. And I think that that really, like, spoke to them. And they just gravitated toward that.

**Annalies Corbin:** [00:00:14] Welcome to Learning Unboxed, a conversation about teaching, learning, and the future of work. This is Annalies Corbin, Chief Goddess of the PAST Foundation and your host. We hear frequently that the global education system is broken. In fact, we spend billions of dollars trying to fix something that's actually not broken at all but, rather, irrelevant. It's obsolete. A hundred years ago it functioned fine. So, let's talk about how we re-imagine, rethink, and redesign our educational system.

**Annalies Corbin:** [00:00:49] This is Annalies Corbin. Welcome to the next episode of Learning Unboxed. We are on the road again today in the bustling city of Buffalo, New York. And we are very excited to be at the Buffalo Manufacturing Works. And today, we're gonna talk about manufacturing, modern manufacturing, in particular, and what that means in the world of K-12 education, post-secondary, and the future of work.

**Annalies Corbin:** [00:01:13] And joining me today are two wonderful guests from the Buffalo Manufacturing Works. We have with us Susan Witt, who is the STEM Lab Manager for Buffalo Manufacturing Works and who, for the past four years, has been developing and managing a program in a STEM Learning Lab that she's going to tell us all about. A mechanical engineer by trainer. We're really excited to have you. Thank you.

**Susan Witt:** [00:01:37] Thank you, Annalies.

**Annalies Corbin:** [00:01:39] And joining us, Susan, is Darius Melvin. And Darius is an educator who came to Buffalo Manufacturing Works to be the STEM Learning Lab Instructor, to do the hands-on, one-on-one work with all the kiddos and this amazing program. And he's going to talk to us about what the heck additive manufacturing and advanced automation is and how that works for K-12. So, thank you.

**Darius Melvin:** [00:02:03] Right. Thanks. Thanks for having us.

**Annalies Corbin:** [00:02:05] Yeah, I'm very excited today. So, Susan, I would like to start with you. So, first and foremost, help us understand what exactly is Buffalo Manufacturing Works, and why on earth with a program like Learning Unboxed be here?

**Susan Witt:** [00:02:19] Yeah, absolutely. So, Buffalo Manufacturing Works is actually operated by EWI, which is, as you know, out of Columbus, Ohio. So, we're EWI employees. But Buffalo Manufacturing Works is made up of EWI, our partners in academia, which is University of Buffalo, our local MEP, which is Insyte Consulting, and local importer/exporter experts World Trade Center. So, it's kind of, if you will, a one-stop shopping center

for local SMMs, small, medium-sized manufacturers to come in, get help with manufacturing needs, researching developments, and then implementation into industry.

**Annalies Corbin:** [00:03:04] And it's all around manufacturing. We are actually sitting overlooking the High Bay-

**Susan Witt:** [00:03:11] Yes.

**Annalies Corbin:** [00:03:11] ... which is my favorite part of this place. And I've been very fortunate to, sort of, get to come and go over the last 20 years. So, 18 months maybe. And just sort of see what's been going on with the program, but also a really huge move, a new building.

**Susan Witt:** [00:03:25] Yes.

**Annalies Corbin:** [00:03:26] So, Darius, you guys moved from your existing, where you started up, into this huge giant facility, which is also going to incorporate this educational, sort of, expertise. But there are other partners here. Tell us a little bit about the place where we are, Darius.

**Darius Melvin:** [00:03:41] So, we are at the Northland Corridor, which is basically a revitalization project on the east side of Buffalo. This building used to be Niagara Manufacturing for many, many years. But more recently in the recent decades, it sat abandoned. Almost like target practice sometimes over here.

**Annalies Corbin:** [00:04:03] Yeah.

**Darius Melvin:** [00:04:04] And a bunch of, you know, abandoned—and a bunch of abandoned factories that are just around this area. However, this site was identified as the perfect place to bring together a number of things that were needed to help grow manufacturing locally. So, the first tenant that was here is Workforce Training Center, where they train students locally to kind of move up in manufacturing. So, things I mechatronics, also welding. And they partner with local academic institutions here in Western New York to kind of bring those classes to those students.

**Darius Melvin:** [00:04:42] And then, also we moved here just in July. So, we've been here now for a few months, but it's been a two-year process of just construction and all kinds of different, like, manufacturing, just issues, and different things that were coming to the forefront that needed to be addressed. But Buffalo Manufacturing Works moved here in July. And so, we have we tripled our space and went from about 20,000 square-foot facility to about 60,000 square-foot facility. And as you mentioned, you know, very beautiful, huge space for us to be able to help grow the company, but also to have a number of different outreach opportunities happen here. And of course, we're excited to talk about the learning lab. But nonetheless, we're here.

**Darius Melvin:** [00:05:29] Another construction company also moved here next door. We also have Insyte Consulting here. So, there's a number of companies and different initiatives that are here within this corridor that, like I said, used to be an old manufacturing facility. It's now just being revitalized. It really helped change the face of the community here on the east side of Buffalo.

**Annalies Corbin:** [00:05:48] And we're really excited about that. It's one of the things that we're seeing happening all over the world that we know that it's positive impact on communities where business industry, and K-12, postsecondary, adult learning can kind of all come together inside of a community atmosphere and just really change the future of how we think about prepping workforce. So, it's really, really exciting to see that.

**Annalies Corbin:** [00:06:10] So, Susan, I want to talk a little bit about the origins of this program. So, you guys are now for almost five years in on this program around additive manufacturing and advanced automation. And so, talk to us a little bit about how you got started in this space, because it's not necessarily the typical career path for a mechanical engineer to suddenly find themselves building programming that's going to make a difference or change the lives of some pretty young folks. So, help us understand where this came from.

**Susan Witt:** [00:06:43] Yeah. So, yes, I have my mechanical engineering degree. And out of college, I did work as a design engineer for many years. And then, I took some time off, and I did consultancy work as I stayed home to raise my kids. So, I think as some of your listeners right now, it's sometimes hard to work full time, especially in a male-dominated role and have young kids at home. So, I stayed home and did consulting work in the mechanical engineering field. And then, when my kids got a little bit older, I decided to go back into the workforce. And I did a little bit of a pivot, and I got more into the workforce environment.

**Susan Witt:** [00:07:25] And this great opportunity came up with a great initiative called "Dream It. Do It." And it's local—it's a national initiative through NAM, National Association of Manufacturers. And it was—it engages and educates K-12 in manufacturing and engineering opportunities in the local community. So, I did that for a couple of years and it was great. I went out, I did presentations, I took students on tours, I talked out about engineering, and I was very passionate about it.

**Susan Witt:** [00:07:56] And through there, I met—I made some great connections and I met my co-worker, Nadine. And she came here to Buffalo Manufacturing Works. So, she brought me over here because one of the founder council members, Praxair, wanted to do something in education here at Buffalo Manufacturing Works. So, they brought me in to kind of figure out what that would look like because no one here had any expertise. And so, I—they brought me in to kind of talk about, "Well, what should we do?" And we kind of just sat down and started brainstorming. And I came in as a consultant role at that time.

**Susan Witt:** [00:08:28] And that was really the birth of the additive learning lab. Praxair hadn't really believed in additive manufacturing. And, obviously, we believe in additive manufacturing. So, the birth of the additive manufacturing learning lab came about. And then, she was like, "Why don't you just stay on it for now?" And that-

**Annalies Corbin:** [00:08:52] Probably, it's always worked out.

**Susan Witt:** [00:08:54] Yeah.

**Annalies Corbin:** [00:08:54] Yeah, yeah. Absolutely.

**Susan Witt:** [00:08:54] And that was five years ago. We had no idea where we would be in five years. It's been an amazing, amazing journey.

**Annalies Corbin:** [00:09:00] And it's pretty cool.

**Susan Witt:** [00:09:01] It is, yeah. Yeah. You know, being an engineer was very fulfilling. And I had some—I had worked on some great projects, but doing what we do every day and seeing the difference we make in these kids' lives-.

**Annalies Corbin:** [00:09:12] It's awesome.

**Susan Witt:** [00:09:14] Yeah. You know, when we see these students. And our first cohort, now, are just start graduating college.

**Annalies Corbin:** [00:09:23] Wow!

**Susan Witt:** [00:09:23] Yeah.

**Annalies Corbin:** [00:09:23] It's exciting.

**Susan Witt:** [00:09:24] Yeah, it's exciting to see.

**Annalies Corbin:** [00:09:24] Yeah, it is.

**Susan Witt:** [00:09:24] And to have them come back to us and say that—you know, that what they learned here at Buffalo Manufacturing Works and the programs that we have here helps them through college.

**Annalies Corbin:** [00:09:36] Very rewarding.

**Susan Witt:** [00:09:36] It's a whole different kind of reward-

**Annalies Corbin:** [00:09:37] Yeah, it is.

**Susan Witt:** [00:09:39] ... than what I did in engineering.

**Annalies Corbin:** [00:09:39] Yeah, it is. Absolutely. So, Darius, help our listeners who don't know anything about additive manufacturing or advanced automation, what the heck is that?

**Darius Melvin:** [00:09:49] Right.

**Annalies Corbin:** [00:09:49] Before we get into nuts and bolts on the program. So, as a teacher, you came into this.

**Darius Melvin:** [00:09:54] Right.

**Annalies Corbin:** [00:09:55] And all of this wonderful STEM focus. So, I want you to explain to us, what is additive manufacturing and advance automation?

**Darius Melvin:** [00:10:02] Sure. You know what? Like when I first came and worked here, I had no idea what it was either. Even as I applied, and you know, in the interview and adding me, I still have to figure that out myself.

**Annalies Corbin:** [00:10:17] I think that makes you perfect for the job.

**Susan Witt:** [00:10:19] You may fit pretty well.

**Darius Melvin:** [00:10:21] Yes. So, additive manufacturing, an easy way to remember is the first three letters, add, right? It means you're adding layer by layer and building up a product. So, additive manufacturing can also just be known as 3D printing.

**Annalies Corbin:** [00:10:36] Right.

**Darius Melvin:** [00:10:37] Right?

**Annalies Corbin:** [00:10:37] Right.

**Darius Melvin:** [00:10:37] So—and that can take on a number of different styles, and a number of materials, a number of different machines, and different things like that. But additive manufacturing, at the end of the day, is 3D printing, right? Advanced automation is, right, auto, meaning that it's done for you automatically, right? So, advanced automation, another word for that is robotics.

**Annalies Corbin:** [00:10:59] Right.

**Darius Melvin:** [00:11:00] So, those are the two things we focus on. That's the way I usually like to break it down to students, right?

**Annalies Corbin:** [00:11:06] 3D printing and robots.

**Darius Melvin:** [00:11:07] And robotics, right. And then—and that-

**Annalies Corbin:** [00:11:09] I get that.

**Darius Melvin:** [00:11:09] Right. That, usually, at least, reaches everybody's kind of basic knowledge of, "Okay, I've seen a 3D printer, or I've, at least, heard of this before."

**Annalies Corbin:** [00:11:18] Right, right.

**Darius Melvin:** [00:11:18] I've seen a robot before, right, being able to do things on its own after you program it. That's all additive manufacturing and advanced automation is. But, yeah, we're excited to be able to teach that and break that down. And that's one of the things I really enjoy about the learning lab is that most of our kids who come into it have no background in additive manufacturing, have no background in advanced automation. And that's the way we like it because, then, they all start the same level, and it kind of builds on whatever academic knowledge they have, their background knowledge, and then brings them to a level where through hands-on learning, they can then understand how this works, understand—and then, also see in front of them the impact of this kind of technology on the way we make things and the way we do things in manufacturing

**Annalies Corbin:** [00:12:07] Yeah. Kids get excited when they can figure out what the heck it has to do with them, right?

**Darius Melvin:** [00:12:10] Right.

**Annalies Corbin:** [00:12:10] And so, that's part of the—it's both the mystery and the joy in all of this, right?

**Darius Melvin:** [00:12:15] Right.

**Annalies Corbin:** [00:12:16] And definitely, you know, additive manufacturing and the robotics components, kids are—they're interested, but they don't understand how complex it is, which is some of the beauty of the program.

**Darius Melvin:** [00:12:27] Exactly.

**Annalies Corbin:** [00:12:27] So, Susan, the program in its current form. So, talk us just a little bit through it. So, you launched the program. You got your first grant in. But it's in three components. And we'll dig into each of the three components, but give us sort of the overview of what does the program look like today.

**Susan Witt:** [00:12:44] Okay, yeah. So, today, we actually have three classes. We have a 10th, 11th, and 12th grade, 10th grade, we bring students in for exploratory, what we call exploratory classes. Each student comes in—that comes in, they have their own workstation. And their workstation has a laptop with state-of-the-art industry 3D modeling software and a tabletop FGM printer. So, we bring them in, and they just really focus on learning 3D modeling software and learning the FGM printer. And they just really get used to 3D printing.

**Susan Witt:** [00:13:20] In 11th grade, they come in, and it's a more rigorous class. I mean, they learn about all seven AM technologies.

**Annalies Corbin:** [00:13:27] So, AM technology, you've got to help with that.

**Darius Melvin:** [00:13:28] right.

**Annalies Corbin:** [00:13:28] Congrats on your acronym.

**Darius Melvin:** [00:13:27] Exactly.

**Susan Witt:** [00:13:31] I know. Sorry. All seven additive manufacturing technologies. So, in the world of additive, it's split into seven technology, core technologies, which is material extrusion, binder jetting, material jetting, directed energy deposition, powder bed fusion, sheet lamination, and Vat polymerisation.

**Annalies Corbin:** [00:13:57] And the kids learn all of that.

**Susan Witt:** [00:13:59] Yes.

**Darius Melvin:** [00:13:59] Yes.

**Annalies Corbin:** [00:13:59] Because those are a lot of really giant big words-

**Darius Melvin:** [00:14:01] Yeah.

**Susan Witt:** [00:14:01] Right.

**Annalies Corbin:** [00:14:01] .. that you would think most kids-

**Darius Melvin:** [00:14:03] Right.

**Annalies Corbin:** [00:14:03] ... would be to be terrified at.

**Susan Witt:** [00:14:04] Exactly. So, we break it down with them. We are fortunate enough that we have three out of the seven technologies in the lab that the students are able to receive hands-on time with. They actually

get to play with the printers, see how they work, see how the technology works, see how the prints come off the printers. There is a huge misconception, thanks to TV and movies-

**Annalies Corbin:** [00:14:29] Right, yeah.

**Susan Witt:** [00:14:29] ... that something prints, and you just take it off, and it's ready to be used, right? And that is not the case.

**Darius Melvin:** [00:14:37] Right.

**Susan Witt:** [00:14:37] There is a-

**Annalies Corbin:** [00:14:38] Special finishing work they have [crosstalk].

**Darius Melvin:** [00:14:39] Yeah, exactly.

**Susan Witt:** [00:14:39] There are a lot of polish process.

**Annalies Corbin:** [00:14:41] They don't show that on TV though, right?

**Susan Witt:** [00:14:43] Right, yeah. There is a lot of post-process that goes into these parts. And there's a lot of that goes in beforehand, even material selection, how you put it on the bag, how you set up the printer. So, we go through all of that in the 11th grade class, right? And, again, we're very fortunate that we have three of those technologies in the room that the students can play with. And then, again, very fortunate that we have another three out on our High Bay tour that the students are exposed to and can see running. And our engineers can talk to them and show the kids how they work.

**Susan Witt:** [00:15:21] And then, at the end of the 11th grade class, the students actually sit for the SME Additive Manufacturing Fundamentals Exam. So, that's a Society of Manufacturing Engineers Additive Manufacturing Fundamentals Exam. And it's an industry standard certificate. And currently, I'm really proud to say that we have a 94% pass rate with our students.

**Annalies Corbin:** [00:15:43] Which is amazing, yeah.

**Susan Witt:** [00:15:45] Yeah, we're really—we work really hard with our students on that. We've developed a great curriculum, and we've worked with it. And I was really happy to bring Darius in, and he's really helped us refine that curriculum. And the students who come in and work on that do really well on that certificate, on that exam.

**Susan Witt:** [00:16:06] And then, senior year, when they come back to us, they have a program that's called Industry-Sponsored Projects. So, our students actually work with engineers on real-world projects. So, there are projects that engineers need to have done but just don't have the bandwidth to do or time to do. So, the engineers haven't given them the problems. They give and the parameters to work around. And our students design, 3D-model design, and print solutions. And then, they work with the engineers to tweak our solutions. And then, they bounce back to our final projects. And then, those projects are actually implemented on course.

**Annalies Corbin:** [00:16:43] It's amazing, yeah.

**Susan Witt:** [00:16:43] But it's not just the design. We work with the students to do engineering reports and presentations. So, those students are not only working on their engineering skills, but they're working on their communication skills, and their presentation skills, and their team building skills. And so, when they leave the program, they're leaving with a lot of real-world experience, and they're leaving being a more well-rounded student. So, those are the three forces that we've been able to develop over the five years that we've been here.

**Annalies Corbin:** [00:17:13] And that's pretty awesome. And so far, about 60 kids in various stages of the program at this point.

**Susan Witt:** [00:17:21] Right, yeah, yeah. So, we have 25 workstations.

**Darius Melvin:** [00:17:24] Yeah.

**Susan Witt:** [00:17:25] Yeah.

**Darius Melvin:** [00:17:26] That's right.

**Susan Witt:** [00:17:26] So—and we recruit about 20 students for each class. So, 20 11th grader, 20 12th graders. And we have, on average, about an 86% retention rate every year. And then, I would say we have about a 73% year over year.

**Annalies Corbin:** [00:17:45] Right.

**Susan Witt:** [00:17:45] So, we start in 10th grade. They come back for 11th grade.

**Annalies Corbin:** [00:17:47] Right.

**Susan Witt:** [00:17:48] You know, Darius will teach a little bit and show the kids a little bit of how things work and what they need for the exam. And then, it's all hands-on.

**Annalies Corbin:** [00:17:56] Yeah.

**Susan Witt:** [00:17:56] They do a lot of projects-based—I don't know their teacher terms. I'm sorry.

**Darius Melvin:** [00:18:01] No, it's okay.

**Annalies Corbin:** [00:18:01] No, no, it's all good.

**Darius Melvin:** [00:18:01] Yeah.

**Susan Witt:** [00:18:03] But yeah. So—and then—so—and that's how they learn.

**Darius Melvin:** [00:18:07] Yeah. So, the pedagogical approaches we usually take in the class.

**Annalies Corbin:** [00:18:10] Yeah.

**Darius Melvin:** [00:18:11] Obviously, you walk in, and there's 25 workstations. Immediately, kids want to get to working on those. So, we usually like to—that's one of the ways we engage is to have-

**Annalies Corbin:** [00:18:22] Yeah.

**Darius Melvin:** [00:18:23] ... experiential learning, hands-on learning. And then, because all the students are working at different levels, right, that kind of satisfies a differentiating instruction model too. And then, we also like to use a lot of cooperative learning as well, where students are working together, the different teams, but also working on various different things because when they get out to the real world, right, one of the things we like—roles we like to give students, one is a design engineer, one is a project manager, one is a support specialist. Each of those different roles have different responsibilities tied to it. But it's realistic to the way the world works, right? Especially the manufacturing world, each of them have a different job, and then each of them being able to deliver on those jobs, right?

**Darius Melvin:** [00:19:06] And so, that's that's really helpful for our students just to be engaged and just define their work as actually meaningful. So, bringing those medium for opportunities to the lab is just obviously, you know, something that we use to engage students each time they come in.

**Annalies Corbin:** [00:19:22] Yeah.

**Darius Melvin:** [00:19:22] But it's something that we're like that photo improvization, kids' eyes might glaze over. But when they see it in action, right, and they are able to work in teams, utilize all those different instructional strategies when they're doing it, that ultimately helps students really stay engaged with what we're doing.

**Annalies Corbin:** [00:19:38] Yeah. And the kids want to be involved. It's just by nature, they always do.

**Darius Melvin:** [00:19:42] Yeah.

**Annalies Corbin:** [00:19:42] So, it's pretty, pretty exciting. So, tell me a little bit about that because I want to dig a little bit into sort of the nuts and bolts of each of the three, sort of, opportunities that kids have as they progress to the grade level. So, let's talk a little bit about the 10th grade exploratory course. And so, share with us a little bit, Susan, about the two projects the students actually get to work on. And you varied it a little bit. And so, I don't know if this is a Susan question or a Darius question.

**Darius Melvin:** [00:20:10] Yeah.

**Susan Witt:** [00:20:10] Yeah.

**Annalies Corbin:** [00:20:10] So, either one of you guys jump in on that, but I find it intriguing the way you've crafted the actual project piece for that first year-

**Susan Witt:** [00:20:19] Yeah.

**Annalies Corbin:** [00:20:19] .. because that's a critical because that's your hook.

**Susan Witt:** [00:20:22] Yeah.

**Darius Melvin:** [00:20:22] Right.

**Susan Witt:** [00:20:22] So, I—Darius actually did the Give a Print, right? So, that was one of his first projects, And I think I'm going to let him speak to that because I think that's a phenomenal project that he came up with. So, I'll let you speak to that. And then, I'll speak to the other one.

**Darius Melvin:** [00:20:36] Yeah. So, last year, it was my first year in the learning lab. One of the things I like to do whenever I teach—this is my fifth year teaching overall.

**Annalies Corbin:** [00:20:45] Okay.

**Darius Melvin:** [00:20:45] And so, whatever I like to teach, I like to have some sort of connection to the kids' world. And one of the ways we do that is, how do we find a meaningful opportunity for them to utilize these skills? And one of the things I like to do is, "Okay, what issue do you guys see around your community that you feel like could be addressed?" And maybe they first think that it's not—something that they can't do, right?

**Annalies Corbin:** [00:21:12] Right, right.

**Darius Melvin:** [00:21:12] I can't help this other student who's for game—you know, toys or gifts for the Christmas season because I don't have the money to help them, right? But you do have a printer-

**Annalies Corbin:** [00:21:27] Right.

**Darius Melvin:** [00:21:27] ... and you do have design skills, right?

**Annalies Corbin:** [00:21:30] Right.

**Darius Melvin:** [00:21:30] So, one of the things that we came up with last year, actually, on Giving Tuesday last year, we introduced this project called Give a Print, which we titled it, where, basically, students come up with designs and prints that they, then, give to a local charity. So, last year, our local charity was the Children's Hospital here. And so, one of the things they did was, you know, did research. Okay, what What can we make for a student, for kids at Children's Hospital? What can't we make? Okay, this is something that I like to do so—that I'm familiar with. So, I really—I'm passionate about making a Connect Four game. So, I want to make a Connect Four game, right? And then, they basically came up with that on their own, and they designed everything on their own. So, one of the rules I always have as you cannot just go to open source sites and just download it.

**Annalies Corbin:** [00:22:19] Download it. You have to do it yourself.

**Darius Melvin:** [00:22:23] You have to design it yourself, right?

**Annalies Corbin:** [00:22:24] Yeah, yeah, exactly. Perfect, perfect, yeah.

**Darius Melvin:** [00:22:24] So, yes. So, they utilized their skills to create these different toys that we were able to give, I think it was about 20 different sets of gifts to Children's Hospital last year.

**Annalies Corbin:** [00:22:37] That's phenomenal. I mean, that is truly, truly-

**Susan Witt:** [00:22:39] Yeah.

**Annalies Corbin:** [00:22:39] ... inspirational and phenomenal, right?

**Susan Witt:** [00:22:39] It was amazing, yeah.

**Darius Melvin:** [00:22:39] Yeah.

**Annalies Corbin:** [00:22:39] And that is so cool. Good on you.

**Darius Melvin:** [00:22:42] And I was amazed that just how passionate they were by it.

**Annalies Corbin:** [00:22:47] Yeah.

**Darius Melvin:** [00:22:47] Whenever you're a teacher, sometimes, you've got to give kids budges.

**Annalies Corbin:** [00:22:51] Yeah.

**Darius Melvin:** [00:22:52] With this one, they just came in and ran with it.

**Annalies Corbin:** [00:22:54] That's awesome.

**Darius Melvin:** [00:22:55] And I think that the compassion was developed there.

**Annalies Corbin:** [00:22:58] Empathy.

**Darius Melvin:** [00:22:59] The empathy was there for them.

**Annalies Corbin:** [00:23:02] Yeah.

**Darius Melvin:** [00:23:02] But also, they recognized that, actually, my skills are going to make a difference-

**Annalies Corbin:** [00:23:08] Yeah.

**Darius Melvin:** [00:23:08] ... immediately. And I think that that really, like, spoke to them. And they just gravitated toward that. So, that was the first initiative. And the first initiative we're doing this year with the 10th grade class as well.

**Annalies Corbin:** [00:23:20] That's awesome. I'm glad you guys are continuing it. That's great.

**Darius Melvin:** [00:23:23] Yeah, yeah, true.

**Susan Witt:** [00:23:23] Yeah, yeah, yeah.

**Annalies Corbin:** [00:23:24] Yeah.

**Susan Witt:** [00:23:24] Yeah, it was an amaze—and to see them donate-

**Darius Melvin:** [00:23:27] Yeah.

**Susan Witt:** [00:23:28] ... them, you know, [crosstalk] a class out of it, and they walked down because we were still at our old facility-

**Annalies Corbin:** [00:23:35] Right, right.

**Susan Witt:** [00:23:35] So, we could walk back to the local hospital and donate. It was just great. It was a great project all around.

**Darius Melvin:** [00:23:41] Yeah, for sure.

**Susan Witt:** [00:23:43] So, we're really proud of that one, yeah.

**Darius Melvin:** [00:23:43] Yeah.

**Annalies Corbin:** [00:23:46] And Susan, the second project of the students here in 10th grade, tell us about that one.

**Susan Witt:** [00:23:52] Yeah. So, they actually designed bridges. So, we give them parameters. You know, it has to expand X amount of length, they can't exceed X amount of filaments, and some other parameters. And then, they actually have to design and 3D print their own bridge. We partnered with UB, you know, our partners in academia, the University of Buffalo Arts Department. And they have mentors come in, and students, and faculty, and kind of guide students through. But they go on their 3D modeling software. They do research on different prototypes, they 3D model, and then 3D print. We do testing on the way. And then, the last pass, we actually test the bridges to see who can hold them all the way off where it breaks.

**Annalies Corbin:** [00:24:42] It's just awesome.

**Susan Witt:** [00:24:42] Yeah.

**Annalies Corbin:** [00:24:43] Always fun, yeah.

**Susan Witt:** [00:24:43] Yeah.

**Darius Melvin:** [00:24:44] Yeah, that's right.

**Susan Witt:** [00:24:44] It's—yeah. It's one of the best days. They got-

**Darius Melvin:** [00:24:46] Yeah.

**Susan Witt:** [00:24:46] .. all the engineers actually coming and watch this, yeah.

**Annalies Corbin:** [00:24:49] Everybody likes to see stuff being destroyed, right?

**Susan Witt:** [00:24:52] Yes.

**Darius Melvin:** [00:24:52] That's true.

**Annalies Corbin:** [00:24:52] You know, there's something about watching, you know, those physical manifestations-

**Susan Witt:** [00:24:58] Right.

**Annalies Corbin:** [00:24:58] ... of failure, right?

**Susan Witt:** [00:25:00] Right, yeah. Because we do non-destructive evaluation here.

**Annalies Corbin:** [00:25:03] Yeah.

**Darius Melvin:** [00:25:04] Right.

**Susan Witt:** [00:25:04] So, to do destructive evaluation-

**Annalies Corbin:** [00:25:06] Yeah, yeah.

**Darius Melvin:** [00:25:06] Yeah.

**Susan Witt:** [00:25:07] ... is kind of fun. Yeah. So—and the kids loved it. And I hope the winner-

**Darius Melvin:** [00:25:11] So, yeah, the winner, his bridge held 112 pounds.

**Annalies Corbin:** [00:25:16] Awesome, wow!

**Darius Melvin:** [00:25:16] Right? We're talking about a bridge that had to be-

**Annalies Corbin:** [00:25:20] 20?

**Darius Melvin:** [00:25:20] ... 5 inches long.

**Annalies Corbin:** [00:25:22] Right.

**Susan Witt:** [00:25:24] 40 grams?

**Darius Melvin:** [00:25:24] Yes. No, 60 grams of filament-

**Susan Witt:** [00:25:28] 60 grams

**Annalies Corbin:** [00:25:28] Okay.

**Darius Melvin:** [00:25:28] ... of plastic being able to hold a 114 pounds.

**Annalies Corbin:** [00:25:30] That is-

**Darius Melvin:** [00:25:31] That was pretty impressed. I was impressed.

**Susan Witt:** [00:25:33] Yeah.

**Annalies Corbin:** [00:25:33] A lot of learning took play.

**Darius Melvin:** [00:25:34] Yeah, exactly.

**Annalies Corbin:** [00:25:35] No question whatsoever.

**Susan Witt:** [00:25:36] Yeah.

**Darius Melvin:** [00:25:36] Right.

**Annalies Corbin:** [00:25:37] Yeah, yeah, yeah.

**Darius Melvin:** [00:25:39] Absolutely.

**Annalies Corbin:** [00:25:39] That's awesome.

**Darius Melvin:** [00:25:39] Yeah. So, it was-

**Annalies Corbin:** [00:25:39] That's awesome.

**Darius Melvin:** [00:25:39] So, it was a different take on, you know, that traditional, you know, popsicle stick bridge that we've done in technology class.

**Annalies Corbin:** [00:25:47] Yeah.

**Susan Witt:** [00:25:48] Yeah. But, now, again, we're taking that skill that they learned with the [indiscernible] in technology class, and we're bringing that into 3D modeling, and we're taking those skills, and giving them the skills to think in 3D. It was huge.

**Annalies Corbin:** [00:26:03] And you're setting them up then for the next course, which is to take those same skills and actually earn an industry certification, which, you know—and there's a lot of back and forth and debate around the sort of industry search space and the role that K-12 should or should not be taking in that.

**Darius Melvin:** [00:26:19] Right.

**Annalies Corbin:** [00:26:19] And, you know, I certainly—in PAST, the work that we do, we absolutely advocate for any and every place you could possibly add an industry-recognized cert into something that students are doing. You make it real for them.

**Susan Witt:** [00:26:33] Right, exactly.

**Annalies Corbin:** [00:26:33] It's tangible. So, I applaud the fact that you guys have taken this on to be able to have the students do that. And a 94% pass rate is huge. So, kudos for that.

**Susan Witt:** [00:26:44] Thank you.

**Annalies Corbin:** [00:26:45] So—but they get set up in that 10th grade experience. And so, they opt in as the 11th grader going through the different seven components of additive manufacturing. And so, as the students progress, are they working on seven different small projects then, or what does that look like? How did they actually get to the end to be ready to sit for that cert?

**Darius Melvin:** [00:27:04] Yeah. So, we do give a print as well with the 11th grade class. And one of the things we do as they're doing it is we build in teaching some of those technologies, right?

**Annalies Corbin:** [00:27:18] Okay, okay.

**Darius Melvin:** [00:27:18] So, they start on the FDM. Of course, they all know that, and that's the most popular type of 3D printing. But like Susan mentioned, we have material jetting in our lab. So, we show them that. And also, we have that photopolymerization in our lab too. We show them that. And-

**Annalies Corbin:** [00:27:34] I'm really jealous because we don't have that one at PAST.

**Darius Melvin:** [00:27:37] Yeah?

**Annalies Corbin:** [00:27:37] Yeah. I need that machine.

**Darius Melvin:** [00:27:38] Yeah, I know. It's cool to see. It really is. And it really is to see like all the lasers working together.

**Annalies Corbin:** [00:27:44] Yeah, yeah, I guess.

**Darius Melvin:** [00:27:44] But nonetheless, since those are in the lab, and they're doing Give a Print, right, maybe it's better to use a different type of material or a different color.

**Annalies Corbin:** [00:27:53] And they wouldn't necessarily have been exposed to that technology in that year one class. They will see it-

**Darius Melvin:** [00:28:01] Right.

**Susan Witt:** [00:28:01] Right.

**Annalies Corbin:** [00:28:01] ... but they would not have programmed and worked with it. And so, they get ready to come into the second level core.

**Darius Melvin:** [00:28:07] Exactly.

**Susan Witt:** [00:28:07] Correct.

**Annalies Corbin:** [00:28:07] Okay.

**Darius Melvin:** [00:28:07] Exactly.

**Susan Witt:** [00:28:08] Yeah.

**Darius Melvin:** [00:28:09] So, last year, our students were able to print items that they made themselves on the material jetting and that photopolymerization-

**Annalies Corbin:** [00:28:18] Okay, wow!

**Darius Melvin:** [00:28:18] ... technologies. But in the process, of course, hands-on, they're learning the process of those technologies, right? So, that first half of the year is just focused on those three in the lab. How can we utilize this to make better products for Give a Print.

**Annalies Corbin:** [00:28:32] Okay, okay.

**Darius Melvin:** [00:28:33] Then, going into the next part of the year, we, then, almost set them up for the industry sponsor course-

**Annalies Corbin:** [00:28:41] Right.

**Darius Melvin:** [00:28:41] ... by introducing them to some of our project engineers who, then, walked them through the different technologies that they work on each day. So, the direct energy deposition, the binder jetting, the powder bed fusion technologies that we have here in-house. We have our engineers come in and speak with the 11th grade class, "This is what I do. This is the process of it." And students are always so engaged with, one, somebody who is not me speaking.

**Annalies Corbin:** [00:29:07] Right.

**Darius Melvin:** [00:29:07] Right?

**Annalies Corbin:** [00:29:08] Right, right, right.

**Darius Melvin:** [00:29:08] Who is a professional.

**Annalies Corbin:** [00:29:09] Right.

**Darius Melvin:** [00:29:10] But then, also, being able to see those different technologies in action, and seeing it right in front of them. It really makes that technology come to life for them. And then, we go back to the classroom and just kind of do like a quick reflection of, "Okay, what was this process? How is this different from the process that you learned before? What are some of the advantages of this? What are some disadvantages of this? And then, what are kind of like the process of applications of this, right? What would be the best kind of product to make? Sure, I can make a cup, a plastic cup on a FDM machine, but what's something that I can make on a powder bed fusion machine that probably would be better made on that than on the FDM, right? So, you're building on their knowledge from those three.

**Annalies Corbin:** [00:29:55] Right, right.

**Darius Melvin:** [00:29:56] And then, adding those other three in. And then, that last one, sheet lamination is really cool because it adds both additive and subtractive manufacturing together. And then, it's cool to talk about that together as well, along with already knowing the other six because it's just like a brand new kind of process to them. So, that covers the seven over, you know, the first five months or so of our program. And then, those last couple of months, we just go into some of the test prep, and reviewing, and studying, and how to do, you know, best strategies-

**Annalies Corbin:** [00:30:32] Sure, sure, to be successful, yeah.

**Darius Melvin:** [00:30:32] ... if you're going to be successful. And then, they take the exam-

**Annalies Corbin:** [00:30:35] Yeah.

**Darius Melvin:** [00:30:35] ... towards the end of a year.

**Annalies Corbin:** [00:30:37] Yeah, which is very exciting for them. So, Susan, talk to me a little bit about that 12th grade experience then since the industry-sponsored component. And now, these kids are not just sitting in a classroom, they're actually involved in real projects. This is—you know, this is with industry. This is a for-profit endeavor in that sense, right? This is very—it's commercial. So, a couple of things. One, A, how do the students specifically get involved? And more importantly, Susan, what's the conversation with the industry folks, or is there one? Do they even realize it's happening?

**Annalies Corbin:** [00:31:12] That's a real question I get asked all the time, right? So, for example, you know, EWI in Columbus, we can't put kids at EWI from our lab and place them directly, for example, what's going on in some of those spaces because there are IP, there's been full issues. There's always issues. There's a whole host of stuff. But there are lots of ways that students can be actively engaged in what's happening in an environment like this. So, explain it to us a little bit.

**Susan Witt:** [00:31:38] So, currently, our students have only worked with our engineers here at Buffalo Manufacturing Works. We have had discussions with other industry partners who wanted to bring equipment in and work with our students in here. And we're still exploring those options. So, it'd be a little different, right? Like there are-

**Annalies Corbin:** [00:31:57] Right, right.

**Susan Witt:** [00:31:59] There are a host of issues with trying to bring students out on the shop floors.

**Annalies Corbin:** [00:32:04] Yeah.

**Susan Witt:** [00:32:05] Especially, it's one thing to do a tour, it's another thing to bring a student out on a shop floor to do measurements and do actual work. Here, we've worked with our engineers to pick—to choose projects in safe environments to know that they're not going to get hurt and to know to work on machines when they're down. We work very closely with our safety manager and our facilities manager. Last year, they worked on a project, on a machine, that was nowhere near any other machine. It was very isolated. And we had enough—we knew the days that the students were gonna be in there, so we could take care of all the IP and make sure of everything. And again, we have a rule that any time one student is out there, he's always supported by either an engineer, Darius, or myself. And we only let two students out the floor at one time, right?

**Annalies Corbin:** [00:33:00] Okay.

**Susan Witt:** [00:33:00] So, it's not like you have a whole—we're not letting the whole class of 20 go out with one person, right? And then—because that's when people start to wander, things start to happen, it starts with interest. So, we've gone through, and we've really thoughtfully tried to figure out like how to do this. We also take steps that we collect a lot of the data beforehand, right, to make sure the kids have a lot of what they need beforehand to start working on a project, right? So, we'll introduce them.

**Susan Witt:** [00:33:36] Last year, they worked on a project to create an adapter from one piece of equipment to another. Our engineers did a great job at doing a lot of the measurements, of precise measurements, of pieces of equipment that we didn't want the students to have access to. So, we identified those pieces of equipment. We identified what might be not safe. But on the flip side, we identified what would be okay to give them that real-world experience.

**Annalies Corbin:** [00:34:11] Right.

**Darius Melvin:** [00:34:11] So, it is a labor of love. It's not easy. You do really have to sit down and weigh the benefits and the risks. And that's why we're still working internally with our own engineers, and we haven't gone outside.

**Annalies Corbin:** [00:34:24] Right, right. Yeah, yeah.

**Susan Witt:** [00:34:26] Yeah. So, it's been a little difficult-

**Annalies Corbin:** [00:34:29] But the students-

**Darius Melvin:** [00:34:29] ... but it's very rewarding for students.

**Annalies Corbin:** [00:34:31] Yeah. I was going to say, and I would imagine for the engineers as well, for those who truly want to engage. And so, you actually brought up a really good point. I always like to close this program recognizing there are folks out there that are hearing this and going, "Oh, my gosh, you know, what's happening in Buffalo is absolutely amazing. You know, would it be possible do something similar, whether it was around manufacturing or a completely different industry? Does it make any difference?".

**Annalies Corbin:** [00:34:58] But, you know, as folks are wrestling with creating new, and better, more engaging programs for students, really rethinking the way we look at what is teaching, learning, and work in today's world as opposed to the way we've always done it, I suppose. And so, it's hard.

**Darius Melvin:** [00:35:17] Yeah.

**Annalies Corbin:** [00:35:18] This is not easy. What you guys have gone is not easy by any stretch of the imagination. But that said, it's obviously fulfilling and worthwhile.

**Darius Melvin:** [00:35:25] Right.

**Annalies Corbin:** [00:35:26] So, I guess my question, so, Darius, as a teacher, for teachers listening out there-

**Darius Melvin:** [00:35:31] Yes.

**Annalies Corbin:** [00:35:31] ... who are saying, "Gosh, maybe I should try this," you know, what is your giveaway to them? The one thing that, you know, you wish that you had known coming here. And maybe that's unfair because you came in on partway. But what would you say that is?

**Darius Melvin:** [00:35:45] As far as?

**Annalies Corbin:** [00:35:48] You know, what's your recommendation if someone says to you, "Hey, Darius, should I do this?" What do they need to know?

**Darius Melvin:** [00:35:54] Yeah. I would say the recipe has to be just right. I mean, when we think about the learning lab, it's within this new innovative organization that's operated by one that's been established, had been a leader in its field for a while. That alone is already very rare to find. But then, also, having a dedicated space to that. And everybody on board saying, "Yes, we want to have this happen," and having it happen

within the organization where what you're teaching is actually in place and in practice every day is part of what drives revenue here at our company.

**Annalies Corbin:** [00:36:38] Right, right, right.

**Darius Melvin:** [00:36:38] Right? That's a lot of elements that have to be in like—it's almost like the perfect storm for all of these things to happen. And then, on top of that, we still had to have grant funding, and we still had to have a lot of support from government as well to make this happen. So, it's not something, as you mentioned, that is just easily done. Not to say that somebody can't just go out and start it, but it would just be very difficult to sustain, especially as a teacher.

**Darius Melvin:** [00:37:08] I know most teachers are in, you know, their public or private school settings, and it's just difficult outside of 7:00 a.m. to 3:00 p.m. And then on top of that, having to plan. And then, on top of that having to grade homework and test. And then, on top of that, having to do with, you know, parent conferences and outreach, right? That's a lot of draws on the time. And I think that this sort of initiative takes a lot of time and just investment by a lot of different parties to come together. So, not to say it's not impossible, but I would say that you just have to have the right partners who are all on the same page. So, to summarize all of that, I think the one thing I would say is having all the right partners and resources together on the same page is critical for something like this to get off the ground.

**Annalies Corbin:** [00:38:00] Yeah, absolutely. Certainly at this scale. Susan, you know, as the founder of this endeavor, right? So, I mean, as that blank white piece of paper when someone said, "Yeah, let's do this thing," right, to the point where, now, you're in a new facility, you have dedicated space, and you're contemplating, you know, A, the program when we have, how do we amplify and scale, and do we start contemplating new programming and all that sort of stuff, what is your piece of advice for folks out there thinking about this that you would add to what Darius has suggested?

**Darius Melvin:** [00:38:31] Did I take all?

**Susan Witt:** [00:38:34] You did. He said it so eloquently.

**Annalies Corbin:** [00:38:37] But from an industry standpoint, right?

**Darius Melvin:** [00:38:40] Right.

**Susan Witt:** [00:38:40] Right.

**Annalies Corbin:** [00:38:40] Because industry's thinking about this very differently than folks in K12.

**Susan Witt:** [00:38:45] Right.

**Annalies Corbin:** [00:38:45] So-

**Darius Melvin:** [00:38:46] Exactly, yeah.

**Annalies Corbin:** [00:38:46] What is that sort of thought?

**Darius Melvin:** [00:38:49] Yeah. I think, we—I think educate. Coming from industry, right, I think education needs to engage with industry, and I think industry needs to engage with education.

**Annalies Corbin:** [00:38:59] Yeah.

**Susan Witt:** [00:39:00] There's such a misconnect there.

**Darius Melvin:** [00:39:02] Yeah.

**Susan Witt:** [00:39:02] And now that I've been on both sides-

**Annalies Corbin:** [00:39:04] Right.

**Susan Witt:** [00:39:04] ... I can see why, right? I can see both sides now. And then, my advice to education is just take a deep breath, and really keep reaching out, and find that industry partner who is willing to work with you because they are out there. And once you find one, just continue to work with them and continue to build that relationship because it's only going to strengthen the pipeline.

**Darius Melvin:** [00:39:31] Yeah.

**Susan Witt:** [00:39:31] And then, on the flip side, industry, industry really needs to start listening and start coming to the table with open ears, and start being more open to suggestions, and start being more—having open doors and open arms to education. It's not always—it can't be business as usual for industry anymore. We need to change. And I say that we—being like an engineering coming from industry, the industry lens. So, like persistence, and just, you know, keep at it, and you will find someone to partner with eventually, I think, is the best, you know, because we finally eventually did it in Praxair. And I know, you know, once you get your foot in your door, and you get started, and you start doing good things, you always find more and more partners out there. I think we've found that in the lab as we move forward.

**Annalies Corbin:** [00:40:25] And then, it's amazing community asset and not only a lot of work but huge, huge impact. So, thank you both for taking time out of your day to share your story with us and keep at it.

**Susan Witt:** [00:40:36] Yeah.

**Annalies Corbin:** [00:40:36] Thank you.

**Susan Witt:** [00:40:36] Thank you.

**Darius Melvin:** [00:40:36] Thanks for having us.

**Annalies Corbin:** [00:40:38] Yeah.

**Darius Melvin:** [00:40:38] Yeah, absolutely.

**Annalies Corbin:** [00:40:38] Yeah, thank you so much.

**Annalies Corbin:** [00:40:39] Absolutely.

**Annalies Corbin:** [00:40:43] Thank you for joining us for Learning Unboxed, a conversation about teaching, learning, and the future of work. I want to thank my guests and encourage you all to be part of the

conversation. Meet me on social media, @annaliescorbin. And join me next time as we stand up, step back, and lean in to reimagine education.