THE PROBLEM WITH ROBOTICS EDUCATION

and 7 Ways We Can Improve It

READY ROBOTICS

Introduction

A story that illustrates the problem with robotics education and why the skills gap is so difficult to overcome in the manufacturing industry is told by Larry Flatt, Executive Director of the Advanced Robotics program at Motlow State Community College. The story begins with a call from Bryan who is looking to secure a better future for himself. Larry says there is never a week that goes by where he doesn't get one of these calls. Bryan has heard that manufacturing and robotics skills are in demand, and that getting training in these skills is a path forward for a higher paying job in manufacturing. Larry takes the call and they start by discussing what good career options there are in advanced manufacturing. Larry then asks Bryan a question, ***"Who do you want to work for, Bryan?"***

Bryan is confused, he is looking for skills that will allow him to apply to a wide range of employers and he responds,
"I don't know, I'm just looking to get the advanced manufacturing skills I need to get hired."

But it is not that easy, there is no single robotic programming skill that works across employers. Larry says to Bryan
"Well if you want to work at the local automotive company, you need to learn FANUC, the wood product manufacturer uses ABB, and the plastics manufacturer uses Yaskawa".

Bryan thanks Larry for this time and says he will think about it. The story unfortunately concludes here, Larry never hears from Bryan again as there is no clear path for someone like him to invest their time and money in a vendor specific skill.

We are upset with the state of industrial robotics education. We want to be clear though that we are not upset with the educators trying to develop the curriculum to teach students robotics. What we are upset with is a stubborn industry, where every OEM wants to create its own walled garden, with its own robot programming language and associated interfaces, that makes it very difficult to teach the full set of skills students need to deploy automation when they get to their new jobs. In addition, robotics and automation are very often taught as their own discipline. However, we think robotics and automation should be made so easy that nearly anyone can apply the tools to automate whatever manufacturing process they manage!

In the middle of US coal country, Kathy Walker, CEO and founder of the eKentucky Advanced Manufacturing Institute (eKAMI), has built a model for the future of Advanced Manufacturing. “We are reskilling the region’s people for jobs in Advanced Manufacturing. This community needs it, and US manufacturing needs it.” says Walker. Proof that the Advanced Manufacturing skills eKAMI is teaching are in high demand: eKAMI has trained over 100 students with a 100% job placement rate.

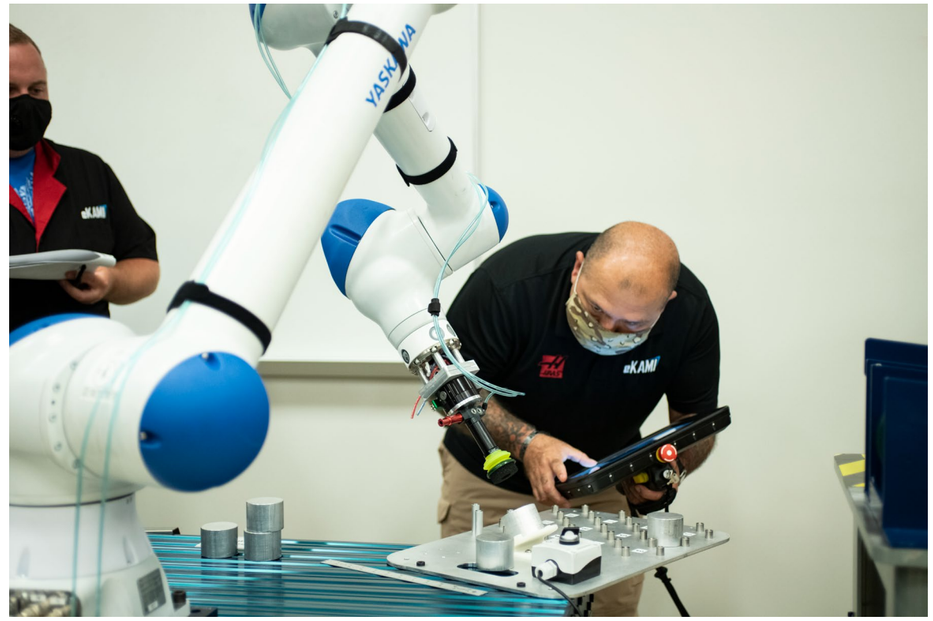
The students who graduate from eKAMI are very proficient on almost any CNC lathe or mill. In addition, they know how to approach a machining job, decompose it, program the machine, and then perform the quality assurance checks with metrology tools. They also learn G-Code, a standard language used to control CNC machines since the 1950s. Because of the standardization, even though eKAMI is a Haas Technical Education Center with Haas CNC machines, the students can be up and running in a manufacturing facility running other brands of CNC controllers in no time. Unfortunately, for robot programming education, this is not the same story, since there are no standards for robotic programming. Not in the user interface or the programming language. Each of the 70+ robotic programming languages is completely unique, with very little in common with any of the other programming languages.

For these graduates to be competitive on a global level they should be able to multiply their output through the use of automation. Aaron Prather, R&D Evangelist at FedEx Express, says it best. “We can upskill our workers and create a superhuman workforce with skills that make them orders of magnitude more productive than they otherwise would have been. I believe this has the potential to both increase manufacturing output and create tens of thousands of high quality jobs!”

The problem is, robotics training is not a part of every CNC programming class being taught. Walker saw that and knew she needed to give her students an added advantage, and robotics training is how she’d accomplish it. She wants eKAMI to prepare these students for any scenario in the field, not just a wish that they’d land a job with a company using one of the robots they happened to be trained on.

How we can improve robotics education

Here are the seven ways we believe robotics education can be dramatically improved to aid not just learning centers like eKAMI, but any educational institution training Advanced Manufacturing skills:



1 Focus on the skills to automate, rather than just the nuances of a robot programming language

- Robot programming is too difficult, and it takes up a disproportionate amount of training in a robotics course. By simplifying the programming, and eliminating the differences between brands, and also the differences between collaborative and industrial robots, students can spend more time learning automation skills. The key is to use a standard robot programming interface so the students can be more capable by learning other key skills such as safety, machine interfacing, gripper design, fixturing, and automated production operations - which are all critical components of successful automation projects.
- There are a wide variety of applications that can be automated using robotics. While programming the robot may be a common thread, learning what to automate can be more important than knowing how to automate. That may seem like a surprising statement, but through our application assessments where we walk through factories, we regularly see poor automation choices. There needs to be a greater emphasis on automation design.

2 Train on real robots

There are suppliers in the education industry who use robots that don't remotely match the capabilities of real industrial robots. This lack of realism causes a few issues for students:

- Students are likely to be demotivated since they realize the hardware used for training is more of a toy than something that could be used in a real-world setting.
- Students don't learn any real-world tasks. They perform small scale simulations and don't learn the hard lessons about automating systems in the real world, such as tending a lathe or performing a palletizing task.
- The students don't learn what robots can and cannot automate. For example, most robotic arms have 6 joints, giving the robot 6 degrees of freedom (DOF). However, the most popular educational package on the market only has 4 joints. This lack of realism limits the overall skills development.

3 Enable educational institutions to purchase robots competitively

By removing brand specific programming barriers, we can enable institutions to put out to bid the robots used in a class. The ability to choose robots on price or capability has three significant benefits:

- The ability to purchase real robots used throughout industry, at a lower cost through competitive bidding.
- A wider range of robots for students to learn from. No single robot OEM has over 20% of the industrial robot market.
- The ability to train on real-world applications since real robots rather than models made only for education can be used.

4 Create content for students, not content to create robot OEM specific developers

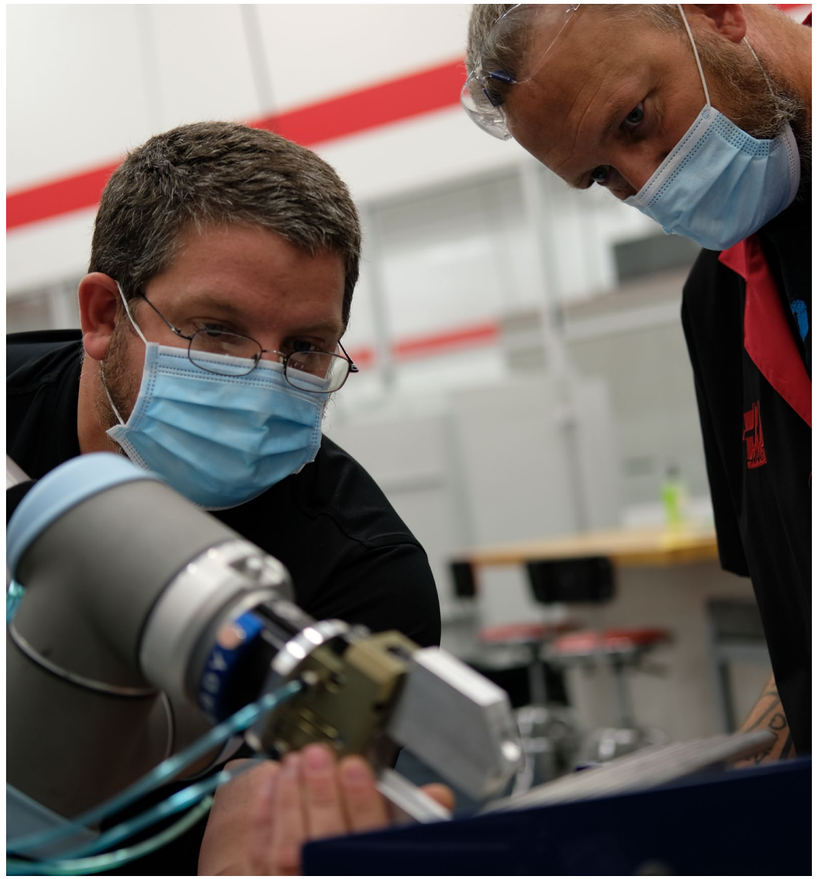
Advanced Manufacturing students should be learning the mental models that enable them to work with any robot on the market. Instead, they are forced to spend far too much time on robot-specific nuances within vendor-led training. Many students learning robot programming may be programming for the first time. The current course guides spell out the prerequisites, such as, “Helpful to have had prior programming experience in another programming language like “C” or PASCAL.” However, when reskilling or upskilling existing workers, it is unreasonable to expect them to know C or PASCAL. Furthermore, one robot OEM in their curriculum guide says that after 72 hours of training the student is just ready to, “develop simple application programs.” In our experience, students can be ready to program a complete lights out task in that period of time, on 3 robot brands or more, if given the proper learning environment.

By trying to cater to many robot OEMs, the educational centers also offer multiple courses that teach the same topic, but based on specific robot programming languages. The impact of these duplicate courses is there is less room for other, more important skills. Instead of having these three courses on the curriculum such as:

101 - Basic Robot Programming for FANUC
102 - Basic Robot Programming for ABB
103 - Basic Robot Programming for Universal Robots

The training centers could have these three courses and a much more capable student for the same amount of time:

101 - Robot Programming (Industrial AND collaborative robots)
102 - Basics of automated work cell design
103 - Lights out machine operation



5 Add robotics as a mandatory component of other skills training, such as CNC machining

It is time that robotics isn't a separate curriculum in all cases. Quite simply, for US manufacturing to remain competitive on a global scale, we must make automation ubiquitous. It is important that students learn the basic skills to understand automation as a tool, an extension of their own capabilities, to leverage themselves to do more. Walker finds this particular point very critical and emphasizes, "We need to stick with providing a solid foundation in Advanced Manufacturing skills. It is the foundational skills in Advanced Manufacturing that the students can then leverage to do anything." The companies that hire these students will increase their revenue per employee and out compete manufacturers without the same commitment to automation.

Reduce the ongoing costs needed to keep educational centers current

Vendor specific hardware drives a lot of the capital budget necessary for training centers to equip themselves. Unfortunately, to stay current with industry needs, the education centers must buy equipment from each brand. Christopher Wyant, Program Director of Robotics and Industrial Maintenance at Wichita State University Tech, says why these purchases are required:

> “Since each OEM is requiring their own walled garden of skills and processes, educational centers are left trying to host multiple types of robots and training programs, which is very costly in dollars, and also limiting since nearly the same course content is duplicated amongst the brands. In the end, we try to be a lot of things to a lot of people and do none of them justice. A student may be trained on three to four different platforms, but still encounter something different when they get out into industry.”

Training centers would be in a much better place if they could use their current asset base and simply update the software and UI to match evolving industry standards. Instead of having the high costs from constantly having to add to their fleet of training robots, by just updating the software they can stay on the leading edge of robotics in industry. The result is lower costs, and the ability to keep up with a much faster innovation cycle driven by a software approach.

7 Reduce the complexity within the industry by reducing the number of disparate vendor skills required to be taught

Many industry partners already have robots or equipment in place to automate, but lack the skills or trained personnel to maintain them. One outcome of that is StaRS (Stationary Robot Syndrome). StaRS happens when robots are installed, and then ei ther the task changes or someone knowledgeable in robot programming leaves, and it's too costly to bring in an integrator, or there is no time or money to send the current staff to training, to update the task. In these all-too-common situations, perfectly functional robots end up sitting idle.

By reducing the complexity of robotic interfaces and by making them more standard, we can better leverage the skills being taught at the educational centers. Wyant says, "The greatest contribution from our students in the next 5-10 years will be to help our current manufacturing environment adapt to the next stage of manufacturing by demonstrating a good ROI for each automation process they install." A good ROI will be driven by lower cost implementations, more easily maintained systems, and leveraging the skills of students who've been taught to automate the processes they've been educated in.

Conclusion

In conclusion, we believe our approach at READY Robotics to simplify and standardize robot programming, and eliminate the need for robot OEM-specific coursework, will enable a large expansion in the adoption of robotic automation. We are frequently asked, “Why can’t industry standards solve this problem?” That is a great question, but each robot vendor is more focused on protecting the skills necessary to maintain their current install base and is limited by the hardware capabilities of their existing robot platforms. We need a fresh approach, a software-driven approach, to develop an open platform that not only makes the programming easier, but enables a rich ecosystem that is not driven by any single robot OEM.

By using READY Robotics curriculum, and easy-to-use, cross-brand robot programming software Forge/OS, eKAMI has proven that they can train every one of their students in robotics. A testament to the power of a cross-brand robot programming platform like Forge/OS, the eKAMI students were programming Yaskawa, FANUC and UR robots in one day, and able to program a lights out manufacturing task in just 2.5 weeks – when none had ever touched a robot before, and now they are “superhuman!”

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