

# Where Learning Meets Opportunity: Connecting Classrooms to Careers Through Real-World Learning



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## EDITOR'S NOTE

This Spotlight highlights a growing shift toward **career-connected learning**, which blends academic content with **real-world applications** to better prepare students for life after high school. From flying drones and exploring marine science to internships, semiconductor pathways, and AI-infused CTE courses, the articles highlight how hands-on, work-oriented learning **builds problem-solving skills, motivation, and career awareness**. Educators, employers, and students alike emphasize the need for programs that are aligned with future market demands, supported by school counselors, and responsive to students' interests. When schools provide meaningful, **authentic learning experiences and clear career pathways**, students gain not only technical skills but also a clearer sense of purpose, relevance, and opportunity in an evolving workforce.



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## Want Students to Become Better Problem Solvers? Then Teach Them to Fly Planes and Drones

By Kevin Bushweller

Rockville, Md. —

**P**airs of Magruder High School freshmen are gathered at the controls of eight Redbird flight simulators, high-tech machinery with foot pedals and control panels that are used to train private and professional pilots how to take off, land, and maneuver aircraft safely under normal and dangerous circumstances.

The students in the second-floor classroom—some wearing COVID masks and others choosing not to—are all getting a taste of the thrill and potential dangers of piloting an airplane. The computer keyboards for the FAA-approved simulators feature red, green, blue, orange, and brown function keys for activating experiences such as flying in zero visibility, with a failed engine, or on autopilot. One student is approaching an airport for a landing, but veers sideways across the runway. Another applies too much power when taking off, flying up at an awkward, problematic angle.

In the years ahead, these 9th graders will learn the principles of flying airplanes and drones; tackle mathematical and engineering analyses around concepts such as torque, force, weight, distance, and altitude; learn how dead or malfunctioning batteries can unleash “runaway” drones; and investigate the possible causes of an airplane crash and how it could have been prevented.

One 9th grader, Eleanor Kim, is not sure what career she eventually will choose as an adult, but she is seriously considering something in the aviation industry. “I want to try this out,” she said. “It gives us a great plan for the future and future job options.”

The free and relatively new curriculum—designed by the nonprofit Aircraft Owners and Pilots Association (AOPA) Foundation and used mostly in high school career and technical education programs—is spreading quickly across the country, growing from use in 29 schools in 17 states in 2017-18 to 322 schools in 44 states for the 2021-22 school year. Forty percent of the kids in the program are students of color and 21 percent are females.

The surge in interest is fueled largely by growing opportunities in the airline indus-



try, which faces massive shortages of pilots, mechanics, and other jobs due to retirements and the domestic and international expansion strategies of many airlines.

The industry is also struggling to build a roster of pilots that features more women and people of color. Currently, only about 5 percent of aircraft pilots and flight engineers are women, 4 percent are Black, 2 percent are Asian, and 6 percent are Hispanic, according to U.S. Bureau of Labor Statistics.

“Women and people of different ethnicities, they bring a different perspective, a different energy,” said Tammie Jo Shults, a former Navy and Southwest Airlines pilot and author of *Nerves of Steel*, which recounts the problem-solving skills she put into action to safely land a Boeing 737 when it blew an engine at 32,000 feet. “We are not needed in the industry because when you mix all those groups together, you get a higher IQ. You get better innovation.”

Brad Morrison, manager of pilot recruiting and development for American Airlines, said roughly half of his airline’s pilots are scheduled to retire within the next seven years and American needs to hire 2,400 pilots this year alone. There is also a big demand for airplane mechanics and other jobs, he added.

“What I tell kids now,” Morrison said, “is



**VIDEO:** Students across the country are learning problem-solving skills in a curriculum that prepares them for careers in the aviation industry.

this is how I wish the industry would have been 20 years ago” when he was thinking of pursuing a career as a pilot. There are way more opportunities now to enter the airline industry in a variety of careers and get promoted quickly, he said.

### Solving real-world problems: Investigating the cause of a plane crash

Ayman Bustillos, a Magruder senior who plans to study aerospace engineering at Embry-Riddle Aeronautical University in Daytona Beach, Fla., next year, has been in the AOPA program for four years. He said one of the most powerful and memorable problem-solving lessons he learned in high school happened when he was asked to investigate the cause of a catastrophic jet airplane crash. “That helped me in my decision to become an aerospace engineer,” he said.

The plane crash lesson—which is part of the curriculum—had Ayman and four other

students work as a team to investigate why the plane crashed as it approached the runway. Ayman’s responsibility was to investigate the specifications of the airplane, its engines and its age; a second team member had to evaluate the quality of communications between the pilots and the air traffic control operators; a third, the weather conditions during takeoff, in flight, and on the landing approach; a fourth was tasked with pulling together all the data from the aftermath of the crash; and the last team member had to review previous airplane crashes to determine if there were lessons learned from those accidents that could be applied to this one.

“The whole point of the exercise was to work on a team and combine each other’s strengths,” said Ayman, who noted that the team’s final conclusion was that pilot error caused the crash.

Victoria Wentt, a recent Magruder graduate who is now attending a local community college, is working toward earning her private pilot’s certificate and hopes to one day fly for one of the major commercial airlines. She too found the opportunity to tackle a real-world problem like a plane crash much more meaningful than what she learned in most of her other classes in high school.

“We were the problem solvers,” said Wentt, who would be among a tiny percentage of Black female commercial airline pilots if she achieves her professional goal. “We had to figure out what happened and why it happened. We all learn off of other people’s mistakes. But in a plane crash scenario, you do not want to be the one making the mistake yourself.”

Despite the largely positive experience Ayman and Wentt had in the program, he suggested there is room for improvement. “The biggest flaw of the program was the lack of direct instruction,” he said. “Most of the time, you can do your own thing.”

That works well for highly motivated students like him, he said. But without enough direct supervision, others don’t take the work “as seriously as they’re supposed to.”

Luke Moitoza and Byron Barksdale are very serious about flying.

On this April morning, in their second period AOPA class, the two sophomores use plastic parts, wood pieces, tape, and rubber bands to build a miniature helicopter—an exercise to teach them about torque (a twisting force that prompts rotation) and how the rotor system of a helicopter affects its motion.

But after putting the tiny flying machine together, they twist the rubber band too tightly. When they let it go to see if it will fly prop-

erly, it shoots up like a rocket and smashes into the high ceiling in the Magruder classroom, the helicopter crashing to the floor after leaving one of its key propeller components embedded in the ceiling.

Byron, a high school baseball player wearing his blue and gray Magruder team jersey that day, eyes a tennis ball on his table, holds it in his hand for a moment, then throws it underhand at the ceiling, hitting a spot perfectly to make the purple helicopter part pop out of the ceiling and drop down. Cheers and laughter follow.

Then the two are right back at it, trying to put the helicopter back together, focused and serious with Moitoza wearing a black COVID mask and Barksdale maskless.

“  
We had to figure out what happened and why it happened. We all learn off of other people’s mistakes.”

**VICTORIA WENTT**

Magruder High School graduate

Moitoza, a 16-year-old with a military short haircut, received a \$10,000 scholarship from AOPA to take flight lessons and is in the Civil Air Patrol. He plans to join the U.S. Air Force after college and hopes one day to fly B-21 bombers. Byron is thinking about entering the military to fly cargo planes.

In pursuit of his private pilot’s certificate, Moitoza did a solo flight in Winchester, Va., last fall, and a three-hour flight and night flight with an instructor. He is on track to get his pilot’s certificate when he turns 17.

### ‘The new frontier of flying’: Learning about drones

The AOPA curriculum has two tracks that students decide to take when they are juniors—the regular pilot pathway or the drone track. Because he has already learned a lot of the regular pilot skills on his own, Moitoza plans to enter the drone track because he wants to be licensed to fly both planes and drones. “That’s

the new frontier of flying,” he said.

In a little more than a year, the number of FAA-licensed drone pilots in the United States increased from about 206,000 to more than 273,000, according to Glenn Ponas, the AOPA Foundation’s director of high school outreach and a former aviation teacher and district administrator for the Pittsburgh public schools.

But one of the hurdles for the Magruder program is getting approval from the county government to fly drones—either in a protected area inside the school building or outside on school property. School officials are working on making that happen. What complicates matters is the school is located close to Washington, D.C., which has some of the most-restricted air space in the country to fly regular planes or drones.

Natalie Webb, a junior in the program’s drone pathway, says it has taught her important problem-solving skills such as collaboration that are often absent in her other academic classes. She said having the opportunity to fly drones under the supervision of teachers would make the program even better. She hopes the school gets that approval before she graduates next year.

A 16-year-old competitive swimmer, Webb does not want to be a professional pilot of planes or drones. But she is now seriously considering a business management career in aviation because of the industry’s expanding opportunities.

That is music to the ears of Erik Yates, the AOPA Foundation’s director of curriculum development and a former public and international school teacher and STEM supervisor for 25 years, given that some career and technical education programs are often criticized for funneling students into narrow career pathways with few options to move in other directions. “If you can imagine a job, it’s in the airline industry,” he said, rattling off a bunch of non-pilot careers such as human resource management.

### ‘Flying does involve certain risks’

On a cold, drizzly afternoon in April, Yates is in an airplane hangar at the Montgomery County Airpark in Maryland, giving a presentation about the aviation industry and the myths surrounding it to a group of sophomores, including Luke and Byron. He occasionally pauses his presentation to accommodate the roar of charter jets or prop airplanes taxiing for a takeoff or coming in after a landing, and some kids turn to watch the planes.

Earlier that morning, the students had the

opportunity to climb inside a charter jet and examine the cockpit, talk to current and retired airline pilots, and see how airplane mechanics work. The two mechanics working on this day are women.

When the din of the airplanes is far from the hangar, Yates talks to the students about US Airways Flight 1549, which hit a flock of birds after taking off on Jan. 15, 2009, from New York City's La Guardia Airport and then lost all engine power. Yates told the students that the jet airplane's captain, Chesley "Sully" Sullenberger, used problem-solving skills he had learned flying glider planes when he was younger to carefully guide the plane safely onto the Hudson River.

That story eventually led to a slide Yates showed on a large screen to the students about one of the myths about the airline industry: It is too dangerous. He pointed out that it is much safer to fly than to drive a car. (A few years ago, the National Safety Council compiled an odds-of-dying table, showing that the chances of dying in a motor vehicle accident to be 1 in 101 for a lifetime—for commercial airline flying and private flights, it concluded there were too few deaths to calculate lifetime odds.)

"We don't hide from the fact that flying does involve certain risks," he said in a follow-up interview. "But riding a horse involves certain risks, too."

Luke weighed those risks before he took his first solo flight. But once the plane left the runway and took off toward the sky, he looked out the window and saw a passenger jet flying high above him, and he remembers thinking: "I've got this. This is why I'm flying." ■

# More Than 2.1 Million U.S. Engineering and Manufacturing Jobs Could Go Unfilled by 2033

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## A Marine Science Program in a Surprising Place Shows Students New Career Options

A school system in a landlocked state has found a way to make a marine science program work

By Caitlynn Peetz Stephens

**F**or more than three decades, a high school marine sciences program has been making waves—in the middle of Iowa, a landlocked state more than 1,200 miles from the nearest ocean.

Hundreds of students have passed through the program in the Des Moines district, designed to introduce students to potential careers in aquarium science, marine biology, and related fields through its use of more than 150 different aquariums ranging in size from two to 2,400 gallons. The aquariums are home to about 150 different species—coral farms and clown fish, sting rays, octopuses, and more—all cared for and maintained almost exclusively by students who receive college course credit and, in some cases, scuba diving certifications, for their work.

“It’s definitely a unique experience,” said Gregory Barord, one of the program’s instructors.

It’s a particularly noteworthy program, especially given its location, as districts grapple with growing pressure to prepare students for both college and to enter the workforce, and to provide them with meaningful experiences in the process. Students say they want more education aimed at exposing them to potential careers, saying it helps them learn about job possibilities they didn’t know about previously and informs their post-high school plans.

But such specialized programs can be tough to pull off, especially when paired with teacher shortages, most notably in specialized subjects and career-prep tracks. In fact, 28 percent of school and district leaders said in a recent EdWeek Research Center survey that marine science is a STEM specialty subject they’d like to offer but can’t because they doubt they’d be able to find teachers for it. Marine science ranked third, behind cybersecurity and artificial intelligence.

The Des Moines school system found Barord by chance—a lucky connection made at a conference a decade ago. Barord was in graduate school then, and now is a well-



Rachel Mumme for Education Week

Nolden Grohe, 16, feeds exotic fish during Marine Biology class at Central Campus in Des Moines, Iowa. The Iowa school system has had a hands-on program for three decades that has introduced students to career possibilities in aquarium science, marine biology, and related fields.

established marine biologist by trade, who has discovered a new species of aquatic animal and spends his summers conducting research throughout the Pacific Ocean.

But from August to May, he’s working with Des Moines students, hoping to usher in the next generation of marine biologists. Or, at the very least, inspire a curiosity and appreciation for the ocean and its creatures.

“I’ve always wanted to get students involved in research at this age, because growing up, I hated science and I hated research,” Barord said. “But that’s obviously changed and I want to show the kids that it can be fun and it can be an option for them, too.”

### Participating students are interested in related careers, or are simply curious

The program has come a long way over the past three decades. It started as one might imagine—a few fish tanks on a bookshelf. Now, an entire facility in the district is dedicated to

the program. Instead of manually mixing salt and water in a bucket to maintain the proper levels in the tanks, all the student caretakers have to do is open a valve connected to the tanks to automatically fill the saltwater to the correct levels. On average, about 150 students annually participate in the program, which is broken up into two yearlong courses—marine biology and aquarium science.

“The students aren’t all necessarily interested in careers in the field. They might be interested in just the ocean or maybe just taking a different class,” Barord said. “So, the background, skill level, and interest ranges from nothing to, ‘I want to be a marine biologist for my career.’”

And sometimes those interest levels change over time.

Senior Addison Stone originally thought she wanted to study psychology in college, but her perspective has completely shifted after spending three years in the program. She became so invested that she does volunteer work for the lab in the summers and during holiday breaks, and even convinced her parents to let

her have a (much smaller) fish tank at home.

Now, she wants to study marine biology in college and pursue a career in the field.

“The more time that I spent in the lab, the more time that I worked and learned everything, I just knew that I couldn’t do anything else,” Stone said. “I’m not quite sure where I’m going yet with this, but I know that I want to stick with-in the community of marine biology.”

### Every day in the marine science program is full of opportunities

No two days are the same in the aquarium science program, because students are dealing with live animals who may become sick, die, or need special attention. On one summer day in late August, for example, a summer intern arrived for his four-hour shift and found two deceased fish, Barord said.

The group had noticed a parasitic outbreak in the preceding days and had to do special observations and monitoring of all the other fish in that tank to ensure it didn’t get out of hand. They also had to take special care to ensure they were washing their hands routinely and avoiding cross-contamination with other tanks as they prepared food and performed other care routines.

In situations where a fish is sick (or several), a local volunteer veterinarian comes in to do examinations and provide care, all while including students in the process.

When they’re not tending to the animals, some students also conduct research that, in some cases, are published in academic journals or elsewhere.

“To leave high school with a publication on your record is pretty rare, but a good opportunity for them,” Barord said.

Vianne Stroope-West, a junior, recently completed one of those research projects. She conditioned a lionfish to move to a “target” within the tank for feeding. The target was within a small bucket, and the goal was to make being in the bucket less stressful for the fish—important for when it has to be put inside one while staff clean the tank or transport it elsewhere.

“For me, my favorite things are the projects I get to work on, because that’s the kind of thing that can make a difference for the fish,” Stroope-West said. “The less stressed the lionfish is, the safer those activities are.”

### Students get hands-on experience on annual expeditions

Barord and his class routinely host experts in the field either in person or on Zoom for

talks and mentorship sessions.

The marquee event, though, is the annual “field studies expedition,” a weeklong trip to a location near an actual ocean—like Texas or Florida—where students get hands-on experience with researchers and other professionals. The 30 to 40 students who go attend seminars, visit universities and labs, and work with conservation groups to care for and learn about local species.

In April, the group will travel to Fiji—the program’s first international trip.

“It’s hard to really explain the value of the field studies expeditions,” Barord said, “but just getting to make those connections really means the world to these kids.” ■



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## CTE Is on the Rise. Here’s What Educators Say Would Make Programs Stronger

By Arianna Prothero

**T**here is a surge of interest in career and technical education programs at the secondary school level, fueled by concerns about the cost of college and opportunities to make good money in jobs that require technical skills, sometimes right out of high school.

But how well are those programs performing?

Most educators feel the overall quality of their CTE offerings is good, but still see room for improvement. That’s according to a nationally representative EdWeek Research Center survey that asked teachers, principals, and district leaders whose jobs include some CTE work to assign a letter grade to their CTE programs. Nearly half of them gave their CTE programs a B.

But what makes an A-rated CTE program? (Twenty-three percent of educators gave their programs an A rating.)

While many factors go into creating a high-quality CTE program, some of the key reasons cited by educators in the survey are good facilities, strong partnerships with local businesses, diverse course offerings, district- and state-level support, quality instructors, and high student enrollment numbers.

“We update our curriculum regularly, we

offer multiple concurrent enrollment courses, we market our programs extensively and we have highly motivated and engaging teachers,” a district-level CTE administrator in Connecticut shared in the survey.

“Our CTE program works very hard to accommodate students and gets them into the program that they request,” said another district-level administrator in Michigan. “Students earn a quality education while enjoying the hands-on learning. Students look forward to getting into CTE.”

Said a middle school teacher in Texas who rated their CTE program with an A: “I chose the selected [letter] grade because of my experience working as a CTE teacher. Our administrator totally supports our programs, students, and teachers and licensed instructors.”

### Educators identify big challenges for some CTE programs

Still, plenty of educators in the survey acknowledged that there was room for improvement. Some of the challenges top of mind among educators who rated their CTE offerings a B or lower included lack of funding for facilities and equipment, inadequate amount of space, not enough teachers, and a lack of rigor.

“We would have more programming if we had adequate space,” said a district-level

CTE administrator in Virginia. “Additionally, we need more teachers. It would be helpful if there were easier pathways for people to teach CTE courses, especially in the trades.”

A district administrator in South Dakota added: “We have teachers new to the profession. They need extra time to fully develop their classroom activities to the point where CTE classes/programs reflect the outside world.”

A district administrator from Oregon who works in student services raised concerns about the rigor of the district’s CTE program: “We have students taking CTE pathway programs, but very few pursue careers in those areas after high school. Students are taking CTE classes because they are fun and easy rather than to prepare for the future.”

Others pointed out that their middle school CTE programs are not well connected with the ones in high school.

“Our district has many offerings and opportunities for students within CTE, but we lack alignment in terms of which students are enrolling,” said a middle school principal in California. “Despite having some CTE programs in middle schools, they do not connect to the more advanced programs at the high school, thus affecting enrollment and pathway completion.”

Despite the challenges, many educators in the survey reported that their CTE programs are growing. In fact, enrollment in K-12 CTE programs increased 10% between the 2022-23 and 2023-24 school years, from 7.8 million to 8.6 million students, according to the U.S. Department of Education.

It’s a trend likely fueled by both state policymakers investing more in CTE and students and parents increasingly questioning the payoff of traditional, four-year college degrees.

Six in 10 educators said in the EdWeek Research Center survey that their districts’ CTE offerings have grown in the past five years, compared with fewer than 1 in 10 who said their districts’ offerings have decreased. And 71% of educators said their students’ level of interest in CTE has increased either a little or a lot in the past five years.

Pathways related to digital technology, artificial intelligence, information technology, and cybersecurity have seen the greatest increase in interest, according to the survey. ■

**Additional Resource**   
View this article’s charts

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# Can School Counselors Support the Push Toward More Career Pathways?

By Lauraine Langreo

**M**any school districts are shifting away from a near-exclusive focus on college preparedness and are instead providing opportunities for students to explore and engage with a broad range of post-high school pathways.

The change comes as more students and families are questioning the trade-offs and return on investment of a traditional four-year college education. Policymakers and industry leaders are also working to ensure there is a pipeline for students to end up in high-demand jobs, such as nurse practitioners, data scientists, and clean energy technicians.

But are school counselors keeping up with this shift?

A nationally representative EdWeek Research Center survey of 472 teachers, school leaders, and district administrators with CTE connections, conducted between September and October, found that a plurality (46%) say their school counselors spend less time on CTE-related counseling than college counseling, while 41% say their counselors spend about the same amount of time on both.

The survey results show “that we have a long way to go” and that it’s “going to take a long time to change culture and to change minds,” said Chelle Travis, the executive director of SkillsUSA, a national career and technical student organization.

For decades, “college for all” has been the guiding principle for K-12 education, the nation’s education policies, and a multitude of school improvement efforts. At the same time, career and technical education had the reputation that it was just for students who don’t have the academic performance or financial resources to attend college.

Even though CTE programs are evolving to support new and emerging professions beyond the traditional skilled trades, such as those involving artificial intelligence and sustainability, the survey results show that many counselors still have the same mindset, Travis said.

For Ebonee Magee-Dorsey, a CTE counselor for the Lawrence County Technology &



Wesley Hitt for Education Week

Students in Bentonville public schools’ Ignite program, which offers career-pathway training, work on projects during class in Bentonville, Ark. As career and technical education evolves, new survey findings suggest many school counselors are still more focused on college.

Career Center in Monticello, Miss., the findings align with what she’s seen in the field.

“For so long, the CTE world has been on an island by itself,” Magee-Dorsey said. It makes sense that a high school counselor wouldn’t be knowledgeable about CTE because “they’re not directly working in that field. ... They’re doing the everyday work,” she added.

In Mississippi, many districts have a career center with a career counselor, Magee-Dorsey said. School counselors work with those CTE-specific counselors to provide resources to students who are interested in postsecondary options besides the four-year college education, she said.

But in districts that don’t have career counselors, it might be difficult for a school counselor to be able to provide those resources, Magee-Dorsey said. They might not have industry connections the way CTE-specific counselors do, she said.

School counselors also have a lot on their plates, experts say. They have to deal with students’ academic performance, their social-emotional and mental health, and other challenges. And their caseloads are huge. Nationally, schools had on average one counsel-

or for 385 students in the 2022–23 school year, according to an American School Counselor Association analysis.

As student demand and interest in CTE increases, school counselors need more resources and training to provide students with all the postsecondary options available to them, from apprenticeships and certifications to two-year or four-year college degrees, experts say.

Travis, however, is “encouraged” by the fact that 41% of educators with CTE connections say their counselors spend about the same amount of time on college and CTE-related counseling, she said.

“I don’t know that you could have said that 20 years ago,” she added.

The data point signals progress and that “many districts and schools are elevating CTE as a legitimate, respected postsecondary option,” Travis said. ■

**Additional Resource**   
View this article’s charts



Eric Davis for Education Week

Agnieszka Crownover explains how a surgical robot works to intern Lutrell Kirk, an 18-year-old high school senior, at Northwest Health in Valparaiso, Ind. Lutrell and other seniors are part of a program to give them hands-on experiences before graduation.

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## Students at This High School Do Internships. It's a Game Changer

By Elizabeth Heubeck

Chesterton, Ind.—

**D**isengaged students. Sky-high absenteeism. A disconnect between the typical high school's academic curriculum and post-graduation life.

These and related complaints about the American high school experience have been gathering steam for some time; the pandemic exacerbated them. State-level policymakers have taken note, and many are now trying to figure out how to give high school students access to a more relevant and engaging experience that prepares them for a future—whether it involves college or doesn't.

One of those states, Indiana, has begun to re-imagine high school graduation requirements—placing a greater emphasis on experiential, hands-on learning. But before the murmurings of change, Indiana's Chesterton High School had already begun moving in this direction.

The school, located in Porter County, Ind., serves approximately 2,000 students from three towns that make up what's known as the Duneland area. In 2019, just before the pandemic struck, the district's then-new superintendent, Chip Pettit, challenged the high

school to enroll 50 percent of its seniors in an experiential learning opportunity outside of the school building.

Adding an elective senior internship—lasting a semester or the entire school year, depending on student preference and schedule availability—to its preexisting traditional career and technical education and teacher cadet programs made the goal achievable.

After a slow start, the school's internship program has grown exponentially. In 2019-20, just five students completed internships, mainly due to the logistical challenges the pandemic presented. This past year, it grew to over 180 participating seniors, with more than 200 community organizations agreeing to accept interns.

Just a day before Chesterton seniors graduated from high school in June, Education Week caught up with five seniors to learn about their internship experiences, what they learned, and how the glimpse into the work world may shape their futures.

### Prepping animals for surgery

*Ark of the Dunes Animal Hospital*

It's a typical busy Wednesday morning at the Ark of the Dunes Animal Hospital in

Chesterton, Ind. Two leashed dogs bark loudly at another four-footed patient in the waiting room. But mere feet away, in the pre-op exam room, a sense of calm prevails.

Wearing scrubs, Alex Reed, an intern and senior at Chesterton High School, hovers over the patient before her, one hand resting gently on the dog's belly. She injects the saline solution that will sedate the dog during a spay operation, as another staff member looks on. Once the dog goes limp on the exam table, she shaves the site where the incision will be made and gently clips each of the dog's nails before hooking up the animal to a heart monitor.

Now the canine is ready to undergo its operation, thanks to Alex's efficient work.

Acting with a calm competence that belies her age, Alex begins to sound a bit more her age when asked about how she's enjoying the internship experience. "I love being here," she gushed. "I didn't think it would be so exciting."

Alex's family owns four cats and a chameleon, but it wasn't until the teen began spending time at the animal hospital as an intern—three days a week starting in September 2023—that she developed an appreciation for the various roles of staff members at the animal hospital. Prior to her internship, Alex considered studying herpetology (the branch of zoology related to amphibians and reptiles) in college. Now, she's leaning toward veterinary medicine.

She'll have plenty of time—and more hands-on experience—before solidifying her professional plans. The staff at the animal hospital asked Alex to work through the summer there as a paid full-time employee before heading to college in the fall, allowing her to spend even more time onsite than during her elective internship.

### Marketing the Indiana coast lifestyle brand

*Retail hub for The IN Coast*

In the heart of downtown Chesterton sits a tiny storefront, barely bigger than a garage. But some big brainstorming happens in that small space—the retail hub for The IN Coast, a lifestyle brand celebrating the northwest Indiana lake town. And during the 2023-24 school year, much of it came from Megan Wilcox and Lexi Wolf, Chesterton High School seniors who interned for the business.

Megan and Lexi, interested in marketing and fashion and inspired by the positive experience of a former Chesterton High School in-

tern at The IN Coast, approached owner Jenny Soffin as soon as they learned that she would again be accepting marketing interns from the school. Soffin rewarded their assertiveness with a spot as interns for the school year.

What started as an internship scheduled for 10 to 15 hours per week during their senior year became an all-consuming experience in which no task was too big or too small. Megan and Lexi have done everything from tagging incoming merchandise and welcoming customers to the store to creating a new design for the brand's shorts/sweatshirt set and participating in marketing brainstorm sessions with the leadership team.

Lexi said that she and Megan initially assumed this would be limited to school hours. The reality has proved far different: They don't leave work at the shop when they lock the door for the day.

"Even on the weekends, we're texting Jen ideas. It's become a part of our lives," Megan said.

The interns marveled at the process of seeing their creative ideas come to fruition, from crafting a design to tagging the final product—a T-shirt with the unique pattern screen-printed onto it.

Lexi and Megan are headed to college in the fall, where both planned to take marketing courses. They'll have an advantage over many of their classmates.

"I feel like nothing compares to the impact of hands-on learning," Megan said. "No matter how many classes we would have taken, nothing compares to being in the business and seeing how it works every day."

### A student witnesses the inner workings of a hospital up close

#### *Northwest Health*

Lutrell Kirk says he got lost all the time when he started his internship at Northwest Health, a local hospital in Valparaiso, Ind. It's no wonder, as he was dispatched to 10 to 15 departments throughout the experience. "Now, I know the hospital like the back of my hand," he said.

He also learned several invaluable lessons about working in the hospital setting—lessons not easily taught in a high school classroom.

Observing employees in a dozen or so settings, Lutrell realized two things: Hospitals offer many types of employment opportunities, and every one matters. "From security to surgeons, they all have to do their part to make the hospital run smoothly," said Lutrell, whose tasks ranged from transporting pa-

tients through the hospital to delivering blood-work to laboratories.

During his internship, Lutrell witnessed firsthand how some of the most prestigious medical professions also come with the greatest responsibility. He described standing in an operating room, impressed by how much respect the staff members showed for the surgeon, and, in turn, the air of authority the surgeon displayed. "Everyone's eyes went straight to him when he walked into the operating room. The nurses put on his smock. And then he just got to work," said Lutrell. "I was like, 'I want to be like him when I grow up.' But there's a lot of pressure on that guy."

An experience later in his internship drove that lesson home. Lutrell was with a security department staff member when an emergency call came through. An incoming patient had been shot, and they needed to head to the front doors of the emergency department to await his arrival. Police and emergency department personnel crowded the area, and Lutrell watched as the bleeding patient was whisked into an operating room.

"It got real, fast. In just 30 minutes, everything happened and the staff had to be prepared," said Lutrell, who described the coordinated efforts as a beautiful thing to witness. "This is a real job. People's lives are on the line."

As Lutrell pursues studies in biochemistry at Indiana's Valparaiso University over the next four years, he'll have time to reflect on his dynamic internship experience and consider how it might shape his future. "There are so many pathways in the hospital," he said.

### An intern-mentor relationship drives the success of a real estate internship

#### *McColly Real Estate*

Ever since he was a young kid, Alex Hurlbert loved driving through neighborhoods and admiring houses with unique architecture and attractive landscaping. So he jumped at the chance to intern at a residential real estate company.

Unsure of what to expect, Alex enjoyed a front-row view of the multi-tiered process that starts with a vacant lot, ends with the sale of a new house on that formerly empty lot, and requires several steps along the way to make it happen. The relationship between Alex and his internship supervisor, Paul Boyter, a managing broker at McColly Real Estate, proved key to the success of the experience.

Alex demonstrated a genuine eagerness

to learn and, in turn, Boyter openly shared what he knew. Alex learned the ins and outs of the various online systems associated with the industry and tagged along with Boyter on appointments—whether to the home of a prospective client or to an open house for a home on the market.

"We would go to people's homes, hear their stories. Alex was right there with me. It's real-life stuff," Boyter said. "I didn't change a thing. I did what I do every day and just incorporated Alex into it."

Eventually Boyter began entrusting Alex with certain responsibilities in his absence, like researching and providing estimates for the cost of an upcoming home listing and posting new listings online.

The internship taught Alex more than how residential real estate operates. He also picked up on how powerful networking is in the industry to developing a client list and a reputation for high-quality service. "I'm proud that I made all these connections," Alex said. "Paul's going to be somebody I talk to in my future, definitely."

In turn, Paul taught Boyter a valuable lesson, too.

"When I see kids like this, it gives me hope for the future that we're going to be OK," the real estate agent said. "That's what I've learned from Alex."

### Designing construction site plans

#### *Duneland Group, Inc.*

Nine months into her internship at Duneland Group, Inc., an engineering and surveying firm a few miles from her high school campus, Abby Ailes reflects on her first few days there.

"I sat at my computer and all I saw were a million lines on a computer. I had no idea what they meant. I freaked out at first," Abby said.

Then she gave herself a pep talk. "I was like, I'm here for a year, let's put my mind to it."

Eventually, those lines on the computer screen started making sense, as did the industry jargon that engineers in the office used. "You hear talking, you just kind of pick up on it," she said.

It helped that Abby spent two to three days in the office for the entire school year—and that she resolved early in her experience to persevere in spite of her lack of experience. Prior to her internship, Abby's only exposure to the industry was an introductory engineering class in her junior year. "We worked on making blocks in class, and cubes. Here, we make real things," she said of the company,

which provides land development and municipal and civil engineering services.

Since the early days of her internship, Abby has learned that those “lines” on her computer screen represent elements of construction site plans. She’s even been tasked with contributing to and manipulating them.

“I put the house on the lot with the correct building codes and dimensions. To be able to put a house in a subdivision like that, it blows my mind,” said Abby.

It must have impressed her employer, too. The firm asked her to stay on past her internship as a full-time employee until she departed for college in the fall. She’s leaning toward studying engineering, primarily because of her internship experience. ■



Adriana Zehbrauskas for Education Week

Alina Kiselev, 17, works on a Wheatstone bridge circuit during a class on semiconductor manufacturing at Hamilton High School in Chandler, Ariz. The school launched a two-year semiconductor program this academic year to help meet the demand for trained employees in sector.

Published December 04, 2025

## In ‘Silicon Desert,’ a School Prepares Students to Join the Semiconductor Boom

By Elizabeth Heubeck

Chandler, Ariz.—

It’s a typical balmy fall afternoon here, as about 15 high school students file into class. Most wear the de-facto teen uniform of sweat-shirts, comfortable pants, and sneakers and, in elevated voices, they joke among themselves as they make their way to their seats at group tables.

The periphery of the otherwise typical-looking classroom contains electrical devices and thin, unassuming wafer-like objects that can form the building blocks of semiconductors, which power just about all our modern-day electronic devices—from smartphones to satellites.

While these high schoolers may act and look like typical teens, what they’re learning is not typically found in the traditional high school curriculum. Studying the inner-workings of semiconductors is generally reserved for college students studying STEM-related disciplines or employees in the industry receiving hands-on training.

Yet when Hamilton High School began

offering a cutting-edge career and technical education (CTE) semiconductor program this school year, students like senior Alina Kiselev wanted in on it. She doesn’t have enough time to complete the two-year, 18-credit program. But she enrolled in the introductory course anyway, “just for fun.”

A self-described lover of all things physics and electronics, Alina’s natural curiosity piqued her interest in learning about semiconductors. She also admits to wanting to know more about the conversations she’s been overhearing from the back seat of the family car all these years when her parents, both technicians at Intel, drove her to school on their way to work.

“I used to think [the semiconductor industry] was all about the people in the bunny suits working with the wafers, but it’s so much more than that,” Alina said

Bunny suits? Wafers? Just months into the course, Alina and her classmates toss around these and other industry-associated terms as though they’re typical of teen vernacular. (Bunny suits refer to protective garments worn by workers in semiconductor hubs. Wafers are disc-like silicon substances that

make up the building blocks that eventually power electronics.)

That’s intentional, as building industry vocabulary is an essential piece to the CTE program’s overarching goal of exposing students to the booming semiconductor industry’s manufacturing process, from the principles to the processes and the tools that underpin it.

This exposure can’t come soon enough for students in a state that has emerged as a leader in the semiconductor industry. In the last five years, Arizona has secured more than \$210 billion in semiconductor-related investments, some of it tied to the CHIPS Act of 2022.

That federal law allocated approximately \$50 billion over five years to drive the United States’ semiconductor manufacturing industry and reverse a decades-long decline in the nation’s global presence in the sector. In 1990, 37% of all semiconductor manufacturing occurred in the U.S.; today, it’s closer to 12%.

The Chandler Unified school system’s creation of the program is “absolutely appropriate now, given the scale of investment and anticipated workforce needs,” said Steven Zylstra, CEO and president of the Arizona Technical Council, a trade association for the state’s science and technology companies. “The semiconductor industry has matured to the point that workforce shortages are becoming a bottleneck.”

But the program—funded through state and federal grants—required a lot of groundwork from the Chandler Unified school district. From tapping local higher education experts to drumming up support from local and global companies to raising awareness and interest among staff, students, and parents, each step in the process started with efforts initiated from inside the district.

### How Chandler went from a sleepy agrarian town to the ‘Silicon Desert’

A confluence of factors aligned to transform Chandler from a sleepy agrarian outpost of Phoenix to what some have nicknamed “Silicon Desert.” Business experts point to the suburb’s vast amount of land, close access to an international airport, a business-friendly environment (based on its tax structure), and higher education institutions like University of Arizona and Arizona State University dedicated to innovative research in tech-heavy industries.

In 1980, Intel opened its first manufacturing plant in Chandler. Fast forward to 2022, when the CHIPS Act led to a \$7.9 billion investment for the growth of the company’s

U.S.-based semiconductor manufacturing facilities, including one in Chandler. The forthcoming semiconductor projects at four U.S. facilities are part of Intel’s plan to invest more than \$100 billion to expand chip production capacity and capabilities in the country, according to a company spokesperson.

TSMC Arizona, another key player in the industry, has made a \$65 billion investment to fund three semiconductor fabrication plants in its nearby Phoenix location following the passage of the CHIPS Act. Overall, the state’s investment in semiconductor expansions related to the federal law represents 13,000 potential jobs, according to the Arizona Commerce Authority.

Hamilton High’s new program—which adds to the district’s cadre of 20 other CTE programs—is the district’s attempt to respond to the growing semiconductor workforce demands in its own backyard. Its goal is for the program to be relevant, universal, and flexible.

Hamilton High School, in the heart of the affluent and sprawling suburb of Chandler, serves about 3,300 students from diverse racial/ethnic backgrounds: 37% of its student body is white, 25% is Hispanic, 18% is Asian, and 9% is African American. While 39% of public school students across Arizona are eligible to receive free lunch, just 14% of students at Hamilton High are.

The school’s students are also well-positioned to continue their education after high school graduation: 83% of its graduates attend a two- or four-year college, compared to a national rate of approximately 62%, and students score higher in both the math and the evidence-based reading and writing portions of the SAT than students nationally, averaging 669 versus 508 (math); and 651 versus 520 (reading and writing), respectively.

“Some of the kids [in my class] are very academic; they probably have a direct path to college,” said the semiconductor instructor, Omar Muñoz, whose engineering degree preceded his nearly 30-year career in the semiconductor industry, most recently at Intel in Phoenix. The 53-year-old last year took an early retirement and pivoted to teaching; the timing worked well for him and Hamilton High.

As for Muñoz’s students, he says even those who choose not to go to college but who complete the two-year semiconductor CTE program could possibly be hired immediately at a company in an entry-level manufacturing position. Plus, a partnership with Rio Salado College, a community college in neighboring city Tempe, allows Hamilton students the opportunity to earn college credits for the coursework associated with the program.

tion to earn college credits for the coursework associated with the program.

### A search for industry and academic partners reaps results

When Chandler Unified’s administration in 2023 approached Janet Hartkopf, the school’s emerging technology coordinator and a former cybersecurity instructor, about spearheading a new CTE program focusing on the semiconductor industry, she knew she’d be starting from scratch.

“There is nothing out there. There’s no high school curriculum. The best we have right now is advanced manufacturing, and that is different,” Hartkopf recalls thinking, as planning for the program was just getting started. “We wanted to be very intentional in its design. ... We wanted to make it modular, flexible, so that any district can scaffold it to what they need.”

But first, she’d need to find the right experts to guide the program’s development.

Hartkopf found a strong partner in the University of Arizona, where she welcomed the expertise of staff led by Liesl Folks, a professor of electrical and computer engineering and the founding director of the university’s Center for Semiconductor Manufacturing.

The university was in the process of ramping up its efforts to support the semiconductor industry by establishing and strengthening industry and academic partnerships. As part of that effort, the university entered into a memorandum of understanding with the Chandler Unified school district’s governing board to establish Hamilton High’s program in semiconductor manufacturing.

With the University of Arizona providing research expertise and the training know-how, Hartkopf began seeking industry support for the program. “I visited over 50 companies, just in Chandler alone,” Hartkopf said.

In response, she received support from 25 companies, both local and global. Arm, the largest semiconductor company in the United Kingdom, agreed to sponsor a semiconductor summer camp run jointly by University of Arizona and Chandler Unified. A U.S.-based Samsung employee shared a draft of the school’s curriculum with colleagues at the company’s corporate headquarters in South Korea for review.

Representatives of locally-based semiconductor companies have made classroom visits to explain what their organizations do, and the roles their employees play. Alina and her class-

mates have gotten to interview them about their jobs, learning about what it’s like to be an engineer, a mechanic, a production associate, and a member of a manufacturer’s emergency response team.

Additionally, company representatives have made guest appearances at professional development sessions to help district staff increase their knowledge of the semiconductor industry. Other companies have contributed classroom equipment such as small electronics and sanitized data samples for use during in-class projects.

Earlier in the fall, the students got a free pass to skip class and attend SEMICON West, a premier microelectronics exhibition. Normally held in technology hub San Francisco, this year it was in Phoenix. There, Alina said she met people who design and sell critical components of semiconductors to major companies like TSMC and Intel.

The industry’s role is also evident in the school curriculum, which was shaped in large part by University of Arizona instructional designers.

“I am 100% confident of what we built, because we built it with industry, for industry, from the start,” Hartkopf said. She added that the entire two-year curriculum, slated for completion in the spring of 2027, will evolve as the industry does.

“Technology changes so much,” she said. “You cannot afford to say ‘we’re done.’”

### Getting the word out to students and staff

As the school’s curriculum started to come together, the district turned its attention to marketing the program. In partnership with the University of Arizona’s Center for Semiconductor Manufacturing, it decided to launch an annual weeklong semiconductor summer camp, starting in the summer of 2024, to gauge, and hopefully pique, student interest in the subject.

The “chips and wafers” camp, for rising 9th and 10th graders, promised participants the opportunity to meet with University of Arizona semiconductor experts, tour Chandler-based semiconductor companies, and participate in hands-on activities.

It proved popular. In the camp’s first year, within 36 hours of opening registration, 96 students attempted to register for 40 slots, Faulks said. Thirty-three percent of campers later enrolled in Hamilton High’s semiconductor program.

Hartkopf continually works at finding ways to keep the student pipeline growing. Some of her work involves educating the school's staff members on the industry and its merits, so they can, in turn, encourage their students to consider the program.

This involves explaining what a semiconductor wafer is and even having her adult audience simulate making them out of Play-Doh. She talks about the different careers involved in the industry, and tells them about the locally-based companies in the industry.

"They get this holistic, broad overview of what the semiconductor industry is," she said.

### Schools across the country consider how to meet workforce demands

As the demand grows for trained future employees in fields related to emerging technology—such as semiconductor manufacturing, cybersecurity, aviation, or advanced manufacturing, or other burgeoning industries—more school districts across the country may be seeking out industry and educational partners to build CTE programs like the one in Hamilton High.

Already, Hartkopf has fielded calls about the program from districts as far-reaching as Wisconsin and California, and she will be attending an upcoming national CTE conference to spread the word.

Other related classes and programs have begun to crop up elsewhere. The Princeton Independent school system in Texas this year added a class in electrical engineering technology for seniors that it says will prepare graduates for employment with Texas Instruments, a large semiconductor manufacturer; it plans to expand to a two-year program in the future.

The Taylor Independent school district, also in Texas, recently launched an electronics technology program that includes but doesn't focus exclusively on the semiconductor industry. Samsung Austin Semiconductor donated \$1 million to fund the program's laboratory and equipment.

Some of the momentum for supporting training programs for the semiconductor industry is occurring at the college level. The Association for Career and Technical Education identified three programs focused on the sector: in Florida, Illinois, and Arizona's Maricopa County, where Chandler is located.

Community college-based CTE programs in emerging technology areas can be more specialized, evolve faster, and often provide students with a set of skills closer to the

labor market than high schools, said Alisha Hyslop, chief policy, research, and content officer for the association. Plus, they can offer dual-enrollment credit to students in related high school-based programs.

But finding knowledgeable instructors to teach at either the high school or college level is a challenge. Pay is a big stumbling block.

"In cybersecurity, semiconductor, or other emerging tech jobs, an individual could make three or four times more than teaching," Hyslop said.

### Positioning students for success

In Chandler Unified, Muñoz teaches all three sections of the semiconductor classes, working with a total of 48 students. Toward the end of his nearly 30-year career, Muñoz managed employees at Intel, a job he says isn't too different than "managing" a classroom of high school students.

He sees the benefit in introducing students early to the many facets of the semiconductor arena. "We're gonna try to expose them as much to the whole industry, so they can make better choices" when choosing a major or career path, he said.

As for Alina, the senior at Hamilton High School, she seems to have a strong grasp of her next moves after graduation.

"I want to work at Intel for a few years," she said. "I don't know if I'll stay in the semiconductor industry, but I'll definitely stay in the tech industry," which means having to know "the basic stuff that it's comprised of."

Eventually, Alina said, she figures she'll get a degree in engineering of some sort, maybe manufacturing or mechanical engineering, after being in the workforce for a few years—or possibly while in it.

Alina observes that she'll likely be the first person in her family to get a bachelor's degree. Maybe, she says, even a Ph.D.

"My parents, they're technicians. It's surprising how far they've gotten with such little education," Alina said. "It shows that experience goes a long way, right?" ■

# The Impact of Manufacturing Workforce Development in Rural America

Over the past few years, manufacturing in the U.S. has accelerated dramatically. Between 2020 and 2024, annual construction spending on manufacturing facilities surpassed \$150 billion—a record-breaking, nearly threefold increase according to McKinsey.

These shifts toward technology-driven careers could boost wages by \$34 billion a year. McKinsey indicates that three groups stand to benefit most: local K–12 graduates, existing manufacturing workers, and those who earn indirect or induced wages spurred by industry investments.

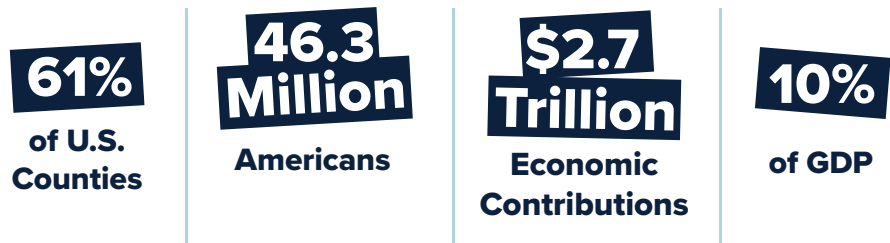
## Rural Schools Are Critical—But They Need the Right Tools

As advanced manufacturing moves closer to rural students, educators have a chance to create locally relevant pathways to careers that evolve alongside innovation. McKinsey identifies two essential levers in PreK–12 education: strong foundational skills and evidence-based, relevant learning.

To be successful, students need to develop core skills—literacy, math, and critical thinking—that are applicable across roles and professions. They should also be immersed in relevant learning that’s tailored to local, industry needs. Students can then put their knowledge and skills into practice through career and technical education (CTE) courses, dual enrollment opportunities, apprenticeships, and career academies.



## Rural America by the Numbers



Source: U.S. Bureau of Labor Statistics

**Learn more about our Advanced Manufacturing course**

[go.pltw.org/adv-manufacturing](https://go.pltw.org/adv-manufacturing)

### Build Partnerships that Support High School Advanced Manufacturing Programs

Strategic collaborations can help schools fund and upgrade CTE programs as industries evolve, ensuring classroom learning reflects real workforce experiences and future career opportunities. By creating mutually beneficial partnerships, school districts can bring students and community together in a variety of ways.

Start by building a local advisory committee of community and business members who will serve as competition judges or provide feedback on projects. It's an easy on-ramp to deeper engagement such as facility tours, work-based learning, and resource sharing.

Next, give students access to realistic work experiences that build their understanding of the modern manufacturing workplace and provide clarity on future job

preferences. Start small by setting up site visits and classroom visits with area professionals. Then, collaborate with business owners to develop work-based learning options such as internships, job shadowing, youth apprenticeships, mentorships, and capstone projects.

For schools with budgetary challenges, equipment and training partnerships may be an option. Explore shared equipment, donations, or training collaborations that benefit both students and professionals. And as always, connecting with economic development groups, workforce boards, and STEM-focused organizations that invest in rural innovation and talent pipelines can spur educational investments.

### Prepare Your Students for Future in Advanced Manufacturing

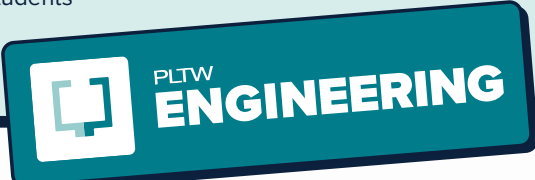
McKinsey's analysis paints a compelling scenario: rural communities revitalized by advanced manufacturing. But it's only possible when schools and businesses work together to equip students for high-value careers close to home.

By implementing an industry-backed advanced manufacturing course, rural districts don't merely adapt; they seize the opportunity to empower students, fuel local economies, and enable purposeful career journeys. ■



## PLTW High School Courses that Explore 30+ Careers

- EES** Engineering Essentials – Introduction to engineering concepts and problem-solving
- AE** Aerospace Engineering – Aerodynamics, propulsion, flight systems
- IED** Introduction to Engineering Design – 3D modeling, CAD, and design process
- ES** Environmental Sustainability – Green design and renewable energy
- POE** Principles of Engineering – Mechanisms, materials, and systems thinking
- CSP** Computer Science Principles – Broad exploration of computing, data analysis, and algorithmic thinking (AP-aligned)
- DE** Digital Electronics – Circuits, automation, and electronic design
- ADM** Advanced Manufacturing (New, Fall 2026) – Advanced robotics and smart manufacturing
- CIM** Computer Integrated Manufacturing – Robotics and manufacturing processes
- PLTW CAPSTONE** PLTW Capstone – Culminating open-ended research experience for all PLTW high school students
- CEA** Civil Engineering & Architecture – Structural design and urban planning



# Get a Glimpse into PLTW Advanced Manufacturing

## Lesson 1: Introduction to Industry 4.0

The course begins by immersing students in the world of Industry 4.0 through active exploration and real-world applications. Students explore a product through reverse engineering and simulate an assembly line to gain hands-on experience with manufacturing processes. Students begin by learning Python programming, then apply their skills to control a six-axis robotic arm, troubleshoot real-world systems, and experiment with AI assisted code generation. As they master the fundamentals, they use their skills to solve increasingly complex challenges.

Students conclude the unit by applying their understanding of robotic arms, programming, AI, semiconductor fabrication, and optimization to solve an industry-based challenge. Interwoven throughout the unit, students explore key concepts such as supply chain management, automation, and process optimization—all anchored in the context of semiconductor fabrication.

### Lesson 1.1 Robotics in Manufacturing

Students begin their journey into Industry 4.0 by reverse engineering a product and rebuild it as an assembly line to understand the foundations of manufacturing processes. Building on their foundational knowledge of Industry 4.0 and manufacturing processes, students engage directly with a six-axis robotic arm. They program the robot using Python coding, troubleshoot real-time issues, and explore the power of AI-assisted code generation. Along the way, students investigate key robotics concepts such as absolute vs. relative movement, object manipulation, and human–robot collaboration.

Throughout the lesson, students will explore key topics such as supply chain management, automation, and process optimization, and draw practical connections to semiconductor fabrication. This ongoing comparison serves as a reference point, helping students understand how advanced manufacturing principles are applied in one of the most complex and high precision industries. The lesson also introduces AI prompt engineering, lean manufacturing, and essential tools and processes that power today's factories.

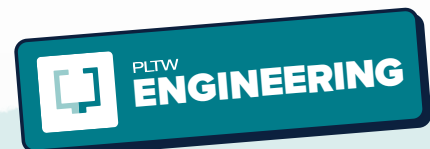
### Lesson 1.2 Application of Automation

Students continue developing their robotic systems by applying a deeper understanding of Cartesian coordinates in the context of field-based tasks. As they begin to recognize the limitations of working with a robotic arm in isolation, they uncover the need for additional tools and technologies introduced in the next unit. Through experimentation and iteration, students explore machine learning and optimize their processes to design an efficient manufacturing workflow that mirrors industrial practices.

### Lesson 1.3 Real-World Robotics

Students apply their knowledge of robotics, programming, AI, semiconductor fabrication, and process optimization to solve authentic, contextualized challenges. By integrating these skills, they design and refine solutions that reflect the complexity, precision, and interconnectivity of digitally integrated manufacturing systems.

# PLTW



Get the full course outline

[go.pltw.org/adv-manufacturing](https://go.pltw.org/adv-manufacturing)

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## Classroom View: How AI Is Influencing Teacher Approaches To Career and Technical Ed.

By Arianna Prothero

**L**eah Ferguson faced a huge learning curve when she left a job in marketing to teach graphic design and digital media in a career and technical education program at The Dalles High School in Oregon. The previous teacher didn't leave her any materials or guidance, and she had to build an entire curriculum from scratch.

Ferguson came into the role with deep understanding of graphic design and digital media when she started the teaching job four years ago, but she struggled to impart that knowledge to teenagers.

She turned to artificial intelligence for help—specifically, the public version of ChatGPT after it was released. With the help of AI, she's been able to organize her subject matter more effectively, map out future lessons, and ensure the curriculum she is using is aligned to district, state, and industry standards.

"I spent more than 10 years working in marketing, in design and technology," she said. "Having to write scope and sequences and lesson plans and all those things, it's a lot for somebody who did not get a master's in education. Being able to use AI has been a huge help."

At the same time, it is a challenge for Ferguson to stay on top of all the changes AI is bringing to K-12 education. She had to scramble recently to update her curriculum on teaching the Adobe suite of online tools after the company added new AI features to all of its programs.

Ferguson's experience highlights both the opportunities and challenges AI presents for career and technical education teachers. Many have had to integrate the technology into their lessons to fulfill their missions to ensure their students are career-ready and prepared to utilize artificial intelligence skills for jobs in fields such as welding, auto mechanics, health care, construction, cybersecurity, airlines—and even AI itself.

That said, there are still plenty of CTE teachers who are resisting the integration of AI into their instruction. They're concerned that the technology might hurt, rather than



Wesley Hitt for Education Week

Students in the digital media pathway at Bentonville public schools' Ignite program work on a group project during class in Bentonville, Ark. The program—which integrates lessons about AI into its curriculum—offers career-pathway training for juniors and seniors in the district.

help, skill development, according to CTE educators and experts.

Even Ferguson, who has embraced AI in her work, sees the potential downsides of the technology. "It's a constant battle, because what you don't want to do is get lazy and complacent, which AI can make you, because it can do a lot of your thinking for you," she said. "It's important to recognize that AI is an assistant, not a replacement."

Education Week reached out to six educators who work in career and technical education to hear how they are using AI in their classes. Their responses—which have been organized below into four main themes—shed light on how AI is altering their field and how the technology can help schools tackle common problems in CTE.

One big challenge is recruiting and retaining teachers as demand for CTE classes rises. In a recent EdWeek Research Center survey of educators working in career and technical education, 61% said that their school's or district's CTE offerings had increased in the past five years, driven largely by rising student demand. Survey respondents indicated

that having enough teachers was crucial to the success of their programs.

### AI can be a lifeline for new CTE teachers

Many CTE teachers come straight from jobs in other fields, entering the classroom through an alternative certification program. Helping those teachers get up to speed on the pedagogical part of teaching takes up a lot of J.J. Ayers's time as the CTE coordinator for the Little Elm Independent School District in Texas. But AI has greatly shortened that learning curve, he said.

In one case this school year, Ayers said, a newly hired CTE teacher has made the same kind of professional progress in four months that would typically take a year and half to achieve without the help of AI.

"The problem is, when you know everything about something, you don't necessarily know where to start," said Ayers. But AI can help with that, he said, by asking a chatbot to break down complex concepts into chunks.

"You can put yourself in your student's

shoes and go, ‘is this basic enough?’ Or ‘do I need to break it down even further?’”

Because CTE teachers typically are subject-matter experts, they know when a generative AI tool is giving them bad information, Ayers said. That level of subject-matter expertise helps them avoid some of the pitfalls of using a technology that generates a lot of inaccurate information, so-called AI “hallucinations.”

In Minnesota, new and veteran CTE teachers have been eager to adopt AI, said Lavyne Rada, the associate director of teacher recruitment and retention for the Lakes Country Service Cooperative, an education-support nonprofit that serves school districts in the region. As part of her organization’s CTE teacher induction program, they encourage new teachers to take what they know about a particular topic and use ChatGPT or Perplexity to plan backwards from there. Teachers are also encouraged to type the same prompt into different AI generative chatbot tools to see which one works best for them, Rada said.

“When do I teach safety, and when do I teach this one skill? And how do I best teach this other skill?” she said. “That has been the shift I’ve seen in the last year: Our teachers coming from industry are asking less questions about ‘what do I teach?’ and are shifting to ‘how do I best teach this skill?’ It’s much more student-focused instead of survival focused.”

### Rapid advances in AI can be hard to keep up with

CTE teachers face a double whammy when it comes to the evolution of AI: not only do they have to keep up with rapid advances in AI, they also have to stay abreast of how AI is changing the skills they need to teach students.

As a measure of how quickly AI is changing her job, Ferguson said her introductory courses are sometimes out-of-date within a year or two, putting students in a difficult spot when they move into more advanced courses.

“I have kids right now who are juniors ... and they’re like, ‘we didn’t cover this in my intro course.’ And I’m like, ‘they didn’t have it back when you were a freshman two years ago,’” she said. “It is definitely uniquely challenging because I almost have to spend two or three weeks reviewing for my intermediary and advanced courses because there’s been so many changes even since last year.”

However, CTE teachers are also uniquely positioned to adapt to those changes. Most teachers or programs in those subjects have advisory boards made up of industry profession-

als and community members to help teachers stay current while they’re in the classroom.

Diane Waite, a business and marketing educator in Mounds View Public Schools in Minnesota, has been leaning on her advisory board for guidance on how she should incorporate AI into her instruction.

After one of her advisory board members who is an executive at General Mills—and a former student of Waite’s—came to her with concerns that local high school students weren’t learning enough about AI in school, they worked together to develop an introduction to AI series.

The series, which Waite embeds in all of her classes, goes over the ethical use and crediting of AI, the limitations created by the data AI tools are trained on, and the basics of writing prompts.

“We showed them how to add onto a prompt. We showed them how to really narrow down and get data from a prompt. We showed them how to do advanced prompts, and how to put tone into a prompt,” she said. “We learned that students weren’t as versed about how to use AI not only effectively, but ethically.”

### AI helps CTE teachers stay agile

While AI can create challenges, it’s also a powerful tool to help CTE teachers remain adaptable and current, said Rada.

“If a teacher doesn’t have that exact skill set of this new industry that’s coming into town, they can use AI to figure out, what are the skills that are needed and how could they teach that to students,” she said. “It really helps with that flexibility in addressing the local community need. Instead of trying to find a textbook that maybe talks about it but was published 10 years ago—and how much of it is still relevant?”

As is the case for their colleagues who teach traditional academic subjects, generative AI tools can help CTE teachers brainstorm, differentiate instruction, create grading rubrics, plan lessons, write emails, do paperwork, create classroom content, and draft letters of recommendation—that last task being one that CTE teachers have to do often.

The technology can even help teachers simulate job interviews for their students.

Jason Van Nus runs the work-based learning program for the Lowndes County Schools in Georgia. While he uses AI to create content and help with assessments, he’s found it most helpful in conducting mock interviews with students.

Using SchoolAI, Van Nus creates custom-

ized generative AI chatbots that give students questions based on their area of focus—whether it’s welding, accounting, engineering, or another pathway. Instead of arranging for students to do mock interviews with members of the community, Van Nus said, he can focus on recruiting industry partners to come to the job fairs he organizes.

“That’s how I use it with students, and it’s been super, super effective for me,” he said.

### Many CTE teachers say using AI to do their jobs better is no longer an option

Simply put, for students to be ready to take on technical jobs after high school, they need more than just industry certifications—they need a familiarity with how to use AI in their respective fields.

By the nature of their jobs, CTE teachers have had to be early adopters—and even advocates—for using the technology in schools, said Rada. That sometimes puts them at odds with other educators and even school policies—thrown together quickly in reaction to rapidly growing use of AI—that banned students from using the technology in school.

“I saw a lot of CTE teachers in their districts taking the lead on using these tools so [students] are ready for the workforce,” she said.

Some educators are skeptical of AI’s place in career and technical school settings. Much like teachers of traditional academic subjects, they have concerns that the technology could be used inappropriately and in ways that water down or undercut knowledge and skill development.

Van Nus, for one, said there’s definitely an array of different views toward the technology among his district’s CTE teachers. But the way he sees it, AI isn’t just a handy personal assistant for overworked educators, it’s now a critical component of CTE instruction.

“If they’re using AI in the professional world, I’m doing [students] a disservice if I’m not embracing it and teaching them how to use it ethically,” he said. “I can’t say my kids are career-ready when they leave my program if I haven’t taught them how to use AI.” ■

**Additional Resource**   
View this article’s charts

Published December 17, 2025

# The Kinds of CTE Courses Students are Demanding From Their Schools

By Alyson Klein

Students are increasingly interested in focusing on digital technology, information technology, artificial intelligence, and cybersecurity in their career and technical education courses, according to a survey of educators whose jobs include some CTE work.

In fact, the survey found that nearly a third—31%—of CTE educators at schools that don’t already have a career pathway in digital technology, information technology, and cybersecurity expect that one will be introduced in the next five years. That’s a higher percentage than any other CTE subject area.

By contrast, nearly 20% of CTE educators expect their districts will add a construction pathway, which could include architecture and civil engineering, in the next five years.

The same percentage of educators predict that their districts will establish an advanced manufacturing pathway, which could include an engineering focus. And about 1 in 6 CTE educators—17%—envision a potential education career pathway for students interested in becoming teachers.

Careers that involve deep technical or computer science expertise—including data scientist, computer and information research scientist, and information security analyst—were among the fastest growing jobs in 2025, according to data from the U.S. Department of Labor.

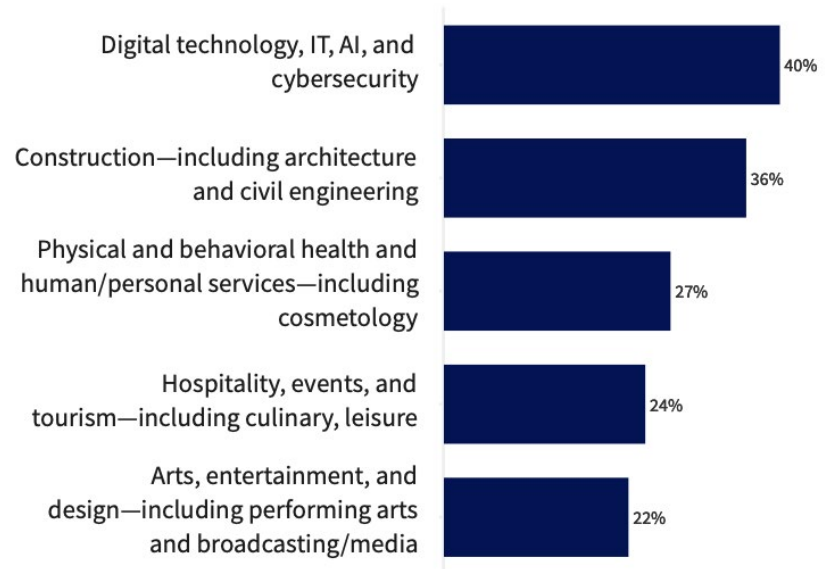
That’s likely a big part of the reason CTE educators see big growth potential for coursework and on-the-job experiences in technology, said Pat Yongpradit, the chief academic officer for Code.org and a leader of TeachAI, an initiative to support schools in using and teaching about AI.

The “CTE world is all about preparing kids for immediate jobs, not an amorphous future,” Yongpradit said. “They’re going to be on top of [career] trends a lot faster than the non-vocational academic tracks in the [same] school system.”

Jaycie Homer, a middle school CTE teacher in New Mexico, believes that AI career pathways are destined to grow in popularity. AI

**Select all that apply. They might or might not be the most popular yet, but, increasingly, our students are interested in CTE offerings related to:**

Top 5 answers



NOTE: Results show responses from teachers, school leaders, and district leaders.

DATA SOURCE: EdWeek Research Center nationally representative September-October 2025 survey of 114 district leaders with Career and Technical Education (CTE) responsibilities, 144 school leaders in a school offering CTE, 113 educators with other CTE connections, and 101 CTE teachers.



skills are “transferable across multiple sectors,” she said.

“AI is being used in the health care industry, in the construction industry, in the oil and gas industry,” Homer said. Students “could work in almost any sector and be able to reference those skills.” ■

**Additional Resource**   
View this article's charts

Published December 05, 2025

## Give Students Meaningful, Work-Oriented Learning, U.S. Executives Say

By Jennifer Vilcarino

**S**chools are making moves to provide more career and technical education courses that offer work-oriented learning experiences as student demand for those opportunities continues to rise.

A recent EdWeek Research Center survey found that 75% of teachers, principals, and district leaders said their schools or districts plan to offer more work-based learning and internship opportunities in the next five years.

But one big challenge for schools will be to establish meaningful, work-oriented learning experiences that help students develop skills that are transferable across almost any field. What should that look like? And how can schools make it happen in and outside of classrooms?

To address those types of questions, Education Week reached out to senior executives of American companies from a variety of industries. We asked them: What types of career learning experiences for K-12 students in school and actual workplaces do you think would help?

(In a related question, we asked senior executives from those companies to identify the specific skills students need to develop while they are in school to succeed later when they enter the workforce. See the responses to that question here.)

The following are the responses to the work-oriented learning experiences question. They have been edited for length and clarity.

### Bryan Quick

*Director of Talent Acquisition at Abbott, a global health care company*

There's no replacement for hands-on learning or the chance to obtain advice, training, and knowledge from those doing the work on a daily basis, whether they're in the lab, the office, or out in the field. Offering high school students the chance to see how a company operates, what a workday looks like, and what different jobs entail can open their eyes to a wide array of careers and pathways to success. It helps them envision the future.



Internships like the ones Abbott offers also provide students with an awareness of the skills and experiences required for certain jobs. And by providing students with on-the-job experiences alongside seasoned professionals, they can obtain a greater understanding of what they'll need to succeed in the future in a much different way than they ever could in the classroom.

### Brandee McHale

*Head of Community Investing and Development at Citi and President of the Citi Foundation*

Technical and vocational training, work-based learning, digital literacy up-skilling and financial education are all key to unlocking opportunity for younger workers. That's why Citi colleagues dedicate their time and talents year-round to providing financial education programming to K-12 students. Furthermore, through the Citi Foundation's 2025 Global Innovation Challenge, we are supporting many nonprofits in their efforts to deliver these kinds of experiences. For example, by equipping young adults from low-income communities in California and New York with AI training, professional development, and social support, one grantee is helping increase access to high-quality technology careers and economic mobility.

Another is helping youth in Puerto Rico gain access to careers in the aerospace industry by connecting them to technical trainings and employers, as well as providing job placement assistance, mentorship, and access to continued education. With hands-on experiences like these, combined with access to trainings, networks, and mentors, I am confident that we can help close skills gaps and support resilient economic futures for the next generation.

### Laura Slover

*Managing Director of Skills for the Future at ETS, a global education and talent solutions organization*

To close the growing gap in workplace readiness, we need to rethink high school offerings. Experiences that center around solving real-world problems encourage students to ask, "What is the problem and what do I need to know to solve it?" That mindset builds curiosity, technical knowledge, critical thinking, and adaptability. Community-based learning and apprenticeships also give students direct exposure to professional environments, while innovative programs like Big Picture Learning and High Tech High show how personalized, project-driven education can foster collaboration and resilience. And equally importantly, we need to create space for failure. Learning

happens when things don't go as planned—that's where creativity, grit, and growth truly emerge. Shifting assessment approaches in K-12 and using tools like the Mastery Transcript provide students the opportunity to reflect on their own learning and build bodies of evidence about their capabilities. One of the most critical skills for the future will be the ability to keep adapting and developing over the course of one's life. Learning is a journey.

### Melonia da Gama

*Director of Training Programs at Fortinet, a cybersecurity company*

For students in high school, introducing technical courses and fundamental certifications is beneficial to prepare for post-secondary education programs and higher-level technical certifications to supplement degrees and diplomas. Additionally, it is essential for students to develop personal competencies and workplace-readiness skills to be fully prepared for a career as a cybersecurity professional. These competencies—such as collaboration, critical thinking, and communication—can start being developed at an early age and grow into essential tools in the workplace.

That is what we need right now: more interest in a career within cybersecurity. Research shows that the global cyber workforce is short by more than 4.7 million professionals. Providing students with hands-on experience in “capture the flag” cybersecurity competitions, internships, training sessions with seasoned professionals, certification programs, and age-appropriate resources are important tactics to drive more interest in the field. Coordinating guest lecturers or arranging field trips to local technology companies or cybersecurity training facilities could help drive interest in the industry and ultimately prepare interested students for rewarding careers in cybersecurity or information technology.

### Maureen Heymans

*Vice President of Learning and General Manager for LearnX at Google*

To help prepare young students for the future world of work, we need to design active learning experiences. This means moving away from the arm's length approach of shadowing someone toward hands-on experiences that can teach K-12 students how to solve problems, interact more effectively with technology like AI, and build something from scratch.

Here are three types of learning experiences that can help:

*Vibecoding [a practice that uses natural language to prompt AI]:* Students take a passion project and turn it into something tangible. Think football, gaming, or baking, where instead of a blank canvas, they could vibe-code interactive versions to create a fitness tracker, a retro version of a game, or a recipe app. This helps them build knowledge of AI technologies, [and understand] their strengths and weaknesses.

*Structured AI Co-Creation and Critique Sprints:* These sprints could tackle real-world problems and teach AI literacy skills. First, brainstorm alone without AI. Then use AI like Gemini to expand and refine those ideas. The most crucial step is critically evaluating the AI's output, identifying any biases or ethical blind spots. This teaches students to treat AI as a brainstorming partner and not a replacement for original thought.

*The Notebook LMRsearch & Synthesis Challenge:* Give a team a messy folder of conflicting reports and data. Their mission [is to] use a tool like NotebookLM to make sense of the chaos. They must find the contradictions, synthesize key arguments, and propose a path forward. This simulates the high-level research and critical thinking required in a job like engineering and moves them from passive consumers to active explorers, helping them manage cognitive load and manage multiple perspectives—a vital skill in today's workplace.

### Lydia Logan

*Vice President of Education and Workforce Development at IBM*

Closing these gaps requires connecting learning with real-world experience. Education and industry must collaborate to give students early, authentic exposure to workplaces and emerging fields.

By equipping educators and community partners to guide students toward in-demand skills—and fostering partnerships across business, higher education, and workforce systems—we can build a more resilient, future-ready talent pipeline.

### Dave Zasada

*Vice President of Education and Corporate Responsibility at Intuit, a global financial technology platform*

Since launching in 2023, nearly 4 million students across the United States have in-

teracted with Intuit for Education's free financial literacy curriculum. Over the course of that time, we've seen the importance of combining real-life training with virtual and classroom-based learning, and have launched several initiatives to help fill those gaps and meet students where they are, including the Intuit for Education Food Truck Program.

The Food Truck Program equips underserved and underrepresented Career and Technical Education (CTE) high school students with everything they need to run their own food truck—from financial and business management tools to culinary training and startup grants. Throughout the program, students learn everything from entrepreneurial finance and point-of-sale systems to designing a menu and sourcing food locally and seasonally. This free, work-based technical and entrepreneurial program provides school districts with fully operational food trucks, equipped with commercial-grade kitchens, and a curriculum to teach high school students how to operate a business using Intuit's financial tools, like an internship on wheels. The program has now had close to 10,000 students participate, and is currently active at schools in Dallas, Denver, Los Angeles, Nashville, Nevada, San Diego, and other places.

By combining classroom learning with true on-the-job experience, we can transform financial literacy from a passive learning experience into an active, engaging journey that immerses students in real-world simulations that mirror everyday financial decisions. That way, students don't just learn about personal finance; they practice it and bring those lessons with them into the real world.

### Duwain Pinder

*Partner at McKinsey & Company, a global management consulting firm*

Our research suggests a link between Career and Technical Education (CTE) and performance. High school students who take CTE courses have higher graduation rates and greater employability, especially students from low-income backgrounds, than those who do not. To accomplish this, we see an opportunity for industries and schools to collaborate more closely to reimagine career-connected learning and adopt evidence-based models to design more effective programs. Youth apprenticeships and dual-enrollment programs also offer students an opportunity to gain hands-on experience outside of traditional learning models, enabling a more rounded education and a broader resume of experiences.

## Deirdre Quarnstrom

*Vice President of Education at Microsoft*

Real-world experience is essential. Integrating AI into the classroom with guidance from educators is helping provide students with digital and creative problem-solving skills that will help them thrive in future careers.

But it starts with building strong fundamentals and providing access to age-appropriate experiences. For example, Reading Coach, part of Microsoft's Learning Accelerators, helps students strengthen literacy and reading skills through personalized practice and feedback. These tools—along with others focused on math and critical thinking—create a foundation for more advanced technologies and ensure students are confident learners. We also see enthusiasm for AI literacy in Minecraft Education and Hour of AI, where learners of all ages explore how AI works, practice digital literacy, and reflect on safe and responsible use through hands-on activities.

That kind of early exposure is very beneficial. When students can experiment with the same AI tools in the classroom that professionals use in the workplace, they start building both technical understanding and confidence.

In short, if we give K-12 students opportunities to use AI responsibly in school, we're essentially giving them a head start on skills that today's workplaces demand. It's about turning classroom experiences into a springboard for the next generation of creators, inventors, and leaders. ■

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