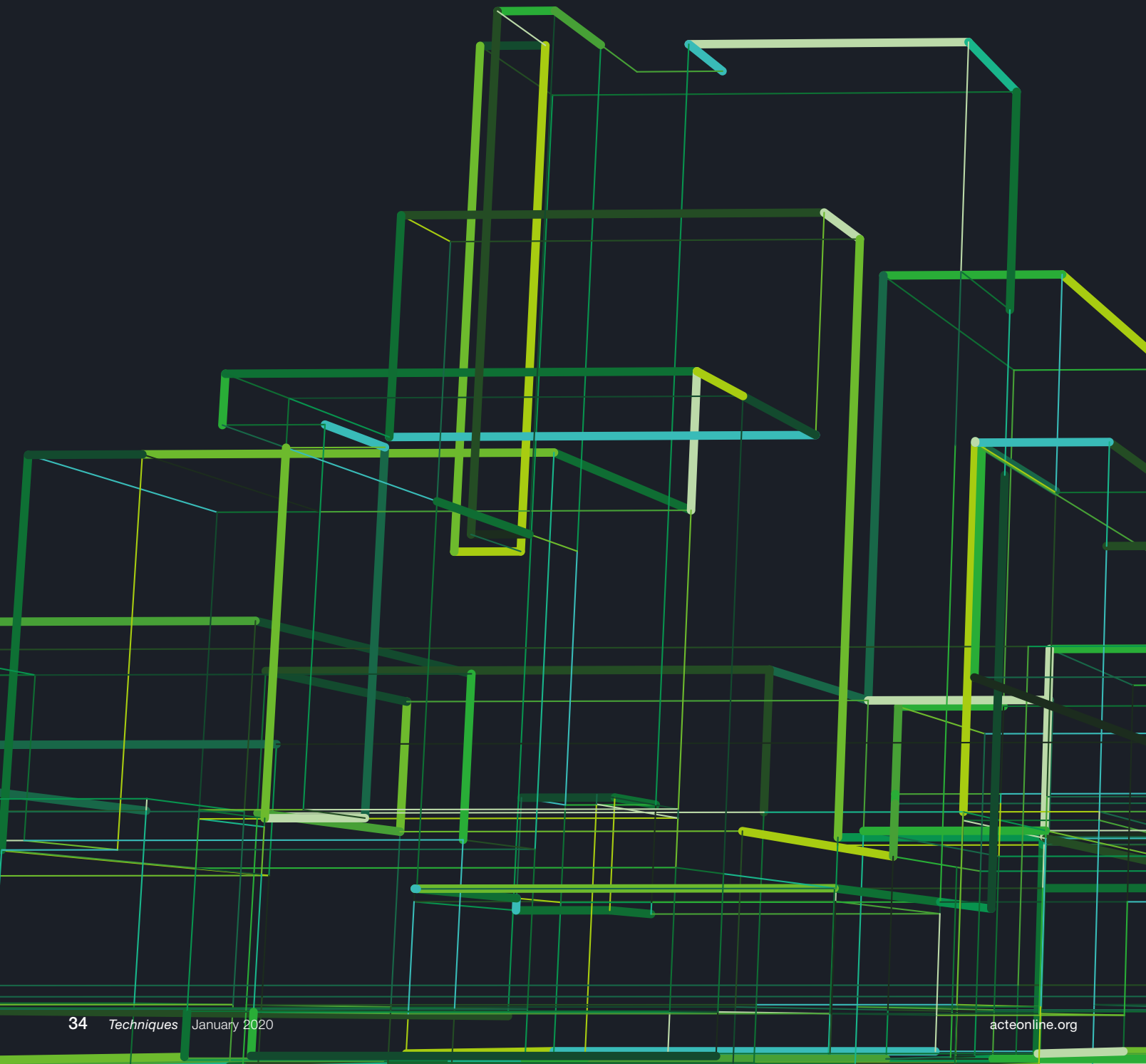
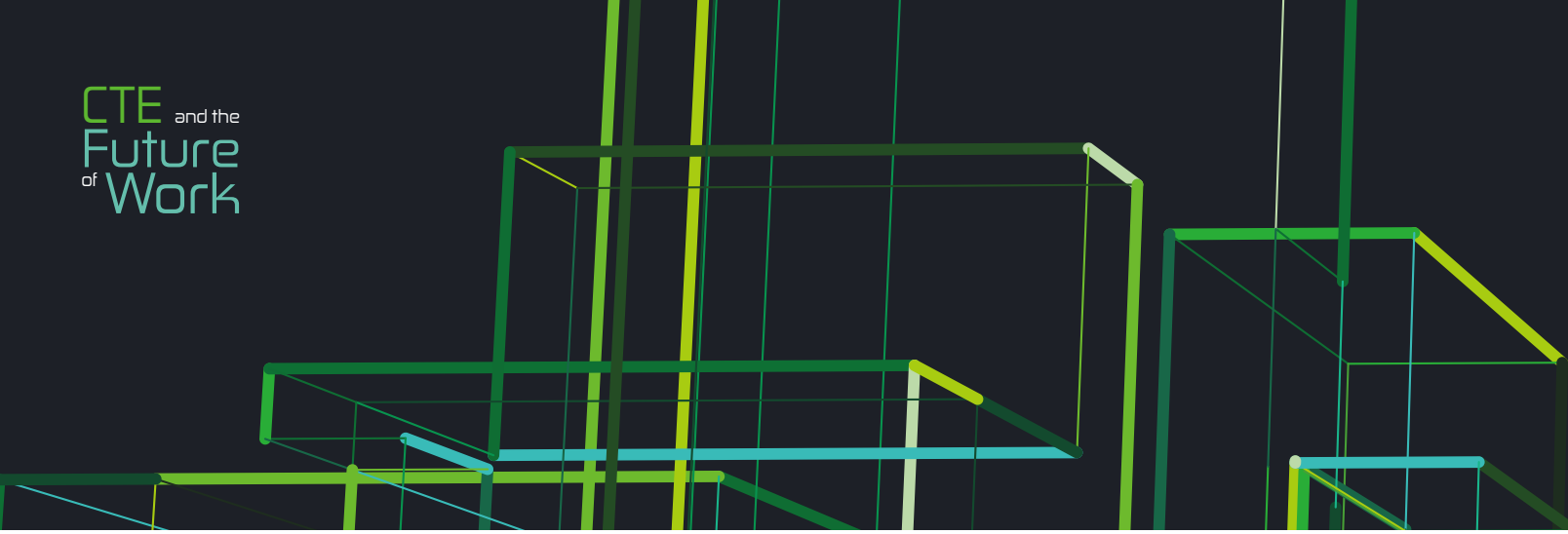


CTE and the Future of Work

By Joyce Malyn-Smith, Jessica Juliuson & Sarah MacGillivray

A major transformation is taking place in America's workplaces. The National Science Foundation calls it the Future of Work at the Human-Technology Frontier (Mervis, 2016) — a future that is driven by combinations of machine learning, artificial intelligence, the "internet of things" and robotics. Today's students will need new sets of skills, knowledge and dispositions to succeed in workplaces where technologies are partners with humans in the problem-solving process. The career and technical education (CTE) community is already giving students a head start in preparing for the future of work. But one key challenge involves predicting the multiple directions in which the workplace is heading and reconfiguring CTE to keep pace. In this article, we provide a glimpse of the changing world of work shared by industry specialists in high-tech fields, and we spotlight strategies the CTE community can use to prepare students to thrive in that world.



> "What does work look like at the human-technology frontier and what skills, knowledge and dispositions do you look for in employees?"

Students travel to participate in a Ford STEM challenge.

The Shifting Landscape

At Education Development Center (EDC), researchers and practitioners are exploring what it will take for our students to succeed in work at the human-technology frontier. To better understand the future of work and the intersection between humans and technology, we asked experts in high-tech firms, national defense, aeronautical engineering and space travel, "What does work look like at the human-technology frontier and what skills, knowledge and dispositions do you look for in employees?"

These specialists shared the following characteristics of workplaces at the human-technology frontier (Malyn-Smith, Blustein, Pillai, Parker, Gutowski, & Diamonti, 2017):

1. Convergence of technologies and disciplines will bring about a predominance of dynamic, interdisciplinary teams, with members contributing deep content knowledge, technical skills and synthesis while people move fluidly in and out of projects.
2. Artificial intelligence (AI) and machine learning will enable machines to "understand" complexities more quickly than humans. AI will touch every aspect of our lives. At work, AI will become part of every major project.
3. Continuous streams of data between and among humans and machines will require skills in synthesis, analysis and interpretation of relationships among data sets. Data publicly available within minutes of capture will accelerate the pace of innovation and change.
4. Design and systems thinking will provide a common language and process

> "As the pace of change increases and new technological innovations disrupt and evolve the workplace, it is clear that the fundamental ways schools approach student learning must change."

for engineers and team members from other disciplines to define a problem and develop pathways toward a solution, with an understanding of the context and interactive components of a challenge.

5. As both humans and machines evolve, the boundaries between what machines do best and what humans do best will continue to blur. Machines will become partners with humans in the problem-solving process, not merely tools to be used to solve problems.
6. With the power of technology at our fingertips and machines as partners in problem solving, "computational thinking" (Wing, 2006) — thinking like a computer scientist — will predominate the workplace.

In addition to these characteristics, experts highlighted the importance of cybersecurity, education and training emphasis on solving authentic real-world problems, an ongoing focus on lifelong learning and learning to learn, and the importance of ethics in understanding unintended consequences. The shared expectation is that the highest-growth occupations and industries will be STEM-focused, or at minimum require dispositions and skills that can be put to use in a STEM context.

Strategies to Prepare Students for the Human-technology Frontier

Very few, if any, of today's students are ready for the workplaces that industry specialists describe. Developing the dispositions and skills required to succeed in the future is no small task for districts working within a system that has been designed for the industrial era, rather than an era defined by AI and machine learning. As the pace of change increases and new technological innovations disrupt and evolve the workplace, it is clear that the fundamental ways schools approach student learning must change. Federal and state education and workforce development organizations will need to get out in front of the wave and anticipate what students will need to know and be able to do three, five or 10 years from now to be empowered and successful adults.

Our EDC team interviewed CTE educators and leaders to identify the actions they are taking to reshape education to prepare students for the future of work. They shared strategies used to build students' skills and dispositions in key areas described by the industry specialists:

- Interdisciplinary teamwork
- Design and systems thinking
- Lifelong learning
- Real-world problem solving

Many of the strategies build students' skills in multiple areas simultaneously.

Interdisciplinary Teamwork

At Florida's Spruce Creek High School, the Academy of Information Technology and Robotics' (AITR) project-based curriculum offers an example of how schools might prepare students for a workforce that calls for interdisciplinary teamwork — demanding versatility, flexibility and collaboration. Partnering with Teledyne Marine, an underwater telecommunications manufacturer, teams of students work to develop improved manufacturing processes.

Teacher Janet Cunningham said, "This type of curriculum fosters teamwork and collaboration to build employability skills while also providing the necessary core subject state standards in an environment where students see true connections between subject areas. While students are researching, taking notes, writing reports and creating presentations about various elements of the cabling, their work is meeting English standards. Doing the same work, they are also meeting standards in science, engineering and math."

Elk Grove Unified School District Program Specialist Sue Hubbard noted, "We try to have educators working together to see across disciplines; [students] don't go into work as an English person or a history person. Education puts content in one discipline or another, but in the real world we don't work in one discipline."

Design and Systems Thinking

Elk Grove's Innovative Design Engineering Academy uses Ford Next Generation Learning's (Ford NGL) Community Connected Learning framework, developed in partnership with EDC, to teach students how to use design thinking, systems thinking and project management to unpack and develop solutions to challenges from business partners like Sacramento Municipal Utilities Development.

"These skills are key," said Hubbard. "Students have to practice empathy, do environmental scans, determine who stakeholders are, what the environmental impact is. They have to look at data and develop a potential solution that might address the problem. That's how innovation happens. They will be fine wherever they go, because in industry

AITR students have a block schedule with dedicated time for technology use.

they will be the people others go to — they will be the 'idea person'."

"We are training our students for jobs that don't even exist yet," observed Tammy Epperson, assistant principal at Central Florida Aerospace Academy. "We are training them in content areas, but also training them to be problem solvers, to think, to learn, to approach new situations and work through problems that come up."

Lifelong Learning

In the face of changing markets and economic demands, Jay Steele, president of the National Career Academy Coalition (NCAC), strongly advocates for the development of graduates capable of lifelong learning, flexibility and adaptability.

"It doesn't help students to prepare them for a career in which there is no future," said Steele. "Districts have to be prepared to make changes in response to workforce trends, and students have to have the skills to learn how to learn — how to apply skills they have learned in new situations."

Grand Island Public Schools, an NCAC partner school, has an innovative approach to preparing their students for a lifetime of learning. Beginning with a reflection on the technological changes they have witnessed in the past 10 years, students in their freshman academy develop a learning plan for the next 10 years.

Director of Innovation for College and Career Readiness Daniel Phillips explained, "Their learning doesn't stop with us, after they finish with us, or after a two- or four-year degree. The plan they build is a living document. As they go through different job shadows, guest speakers and industry certifications, they can document and

reflect on those experiences... It's a central component of their portfolio."

Real-world Problem Solving

Several of the leaders we spoke with sustain strong collaborations with community and industry partners to provide students with opportunities to tackle real-world problems. These partnerships also help educators stay current with the evolving skills, training and competencies that students need to succeed in the workplace. Elk Grove Unified School District and the Academy of Information Technology and Robotics are both Ford NGL communities, in which employers and community partners work with districts to develop and maintain strategic plans that embed workforce development and real-world experiences through authentic problem solving.

"We have formed partnerships with organizations such as Teledyne and the Volusia Manufacturers Association. Students complete internships on site that solve real-world problems with assistance from business professionals," continued Cunningham. "Our teacher team has the opportunity to participate in business externships that foster the connection of our students and business partners. Our administrative team supports our efforts by providing us with flexible scheduling, which allows us to bring real-world problems from our business partners to the classroom. They also allow us to bring in business professionals to work with our students during the school day."

Taking local connections to the next level, Central Florida Aerospace Academy's access to the aerospace industry is due in part to their location on an airport property. In partnership with industry experts, students can hear directly what these industries need and are given opportunities to practice the latest technologies.

"People and businesses on the airport campus, all the way up to the director of the airport himself, embrace the students," shared Epperson. "The dynamic between the adults and the kids is fascinating... Students feel they are a part of it."

Grand Island Public Schools learns about trends in workforce preparation from their business partners. Daniel Phillips said, "We meet on a regular basis; we have [career] pathway level advisory committees as well as academy advisories." When partners notify them of updates, they have the ability to "change on the fly," with support from the teachers. "Everything we do is for the potential growth and improvement of the community; [teachers] embrace and cherish the responsibility, and they work their tails off to make sure they are doing everything they can do to ensure our students are prepared."

Looking Ahead, Staying Flexible

While all of these promising strategies can help schools start to prepare students for the human-technology frontier, the leaders that we interviewed remain realistic about their ability to predict the future. Hubbard noted that a crucial part of the role of the CTE educator is to prepare students for whatever they may face.

She said, "Students can learn skills and train for jobs, but if they haven't learned flexible and transferable competencies, they won't be able to navigate in the future. We don't know what we don't know. We — and they — have to stay flexible." ■

Joyce Malyn-Smith, Ed.D., is a distinguished scholar at Education Development Center and is a national expert on STEM career development and workforce education. She leads a body of work that explores how to enhance learning and support people in using their STEM skills, knowledge, and dispositions to pursue productive and rewarding careers. Email her at jmsmith@edc.org.

Jessica Juliuson is an EDC senior training and technical assistance associate. She cultivates strategic partnerships among schools, communities, and industry to enhance outcomes for youth. Drawing on her background in whole school change, Juliuson leads innovative initiatives focused on career and technical education, instructional design and teacher development. Email her at jjuliuson@edc.org.

Sarah MacGillivray is a project associate at EDC, where she specializes in providing technical assistance and communications support to a variety of projects that focus on equity, workforce development and broadening participation in STEM. Email her at smacgillivray@edc.org.

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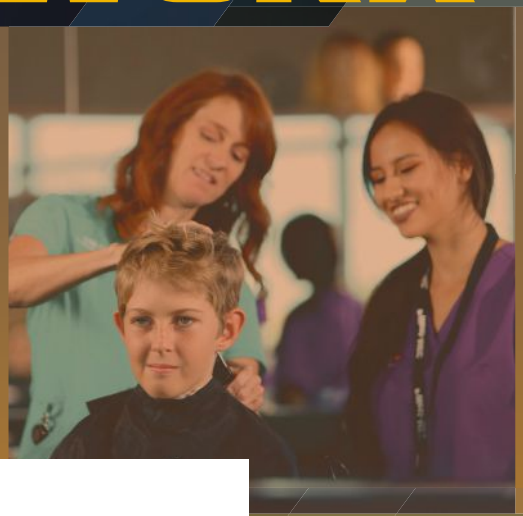

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