JULY 2019

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+

BUILDING AI

WHEN STUDENT CREATORS MEET ARTIFICIAL INTELLIGENCE, SPARKS FLY

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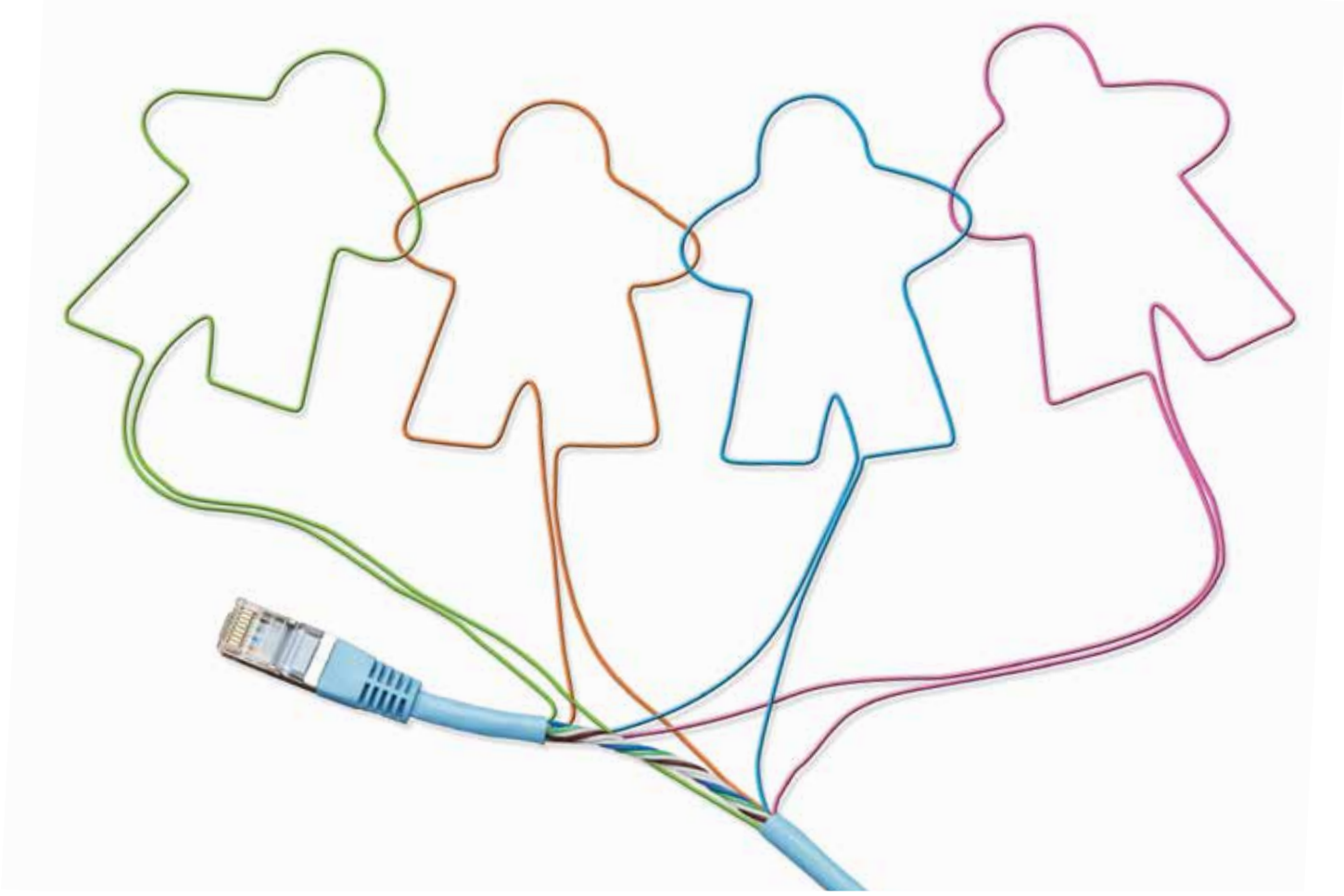

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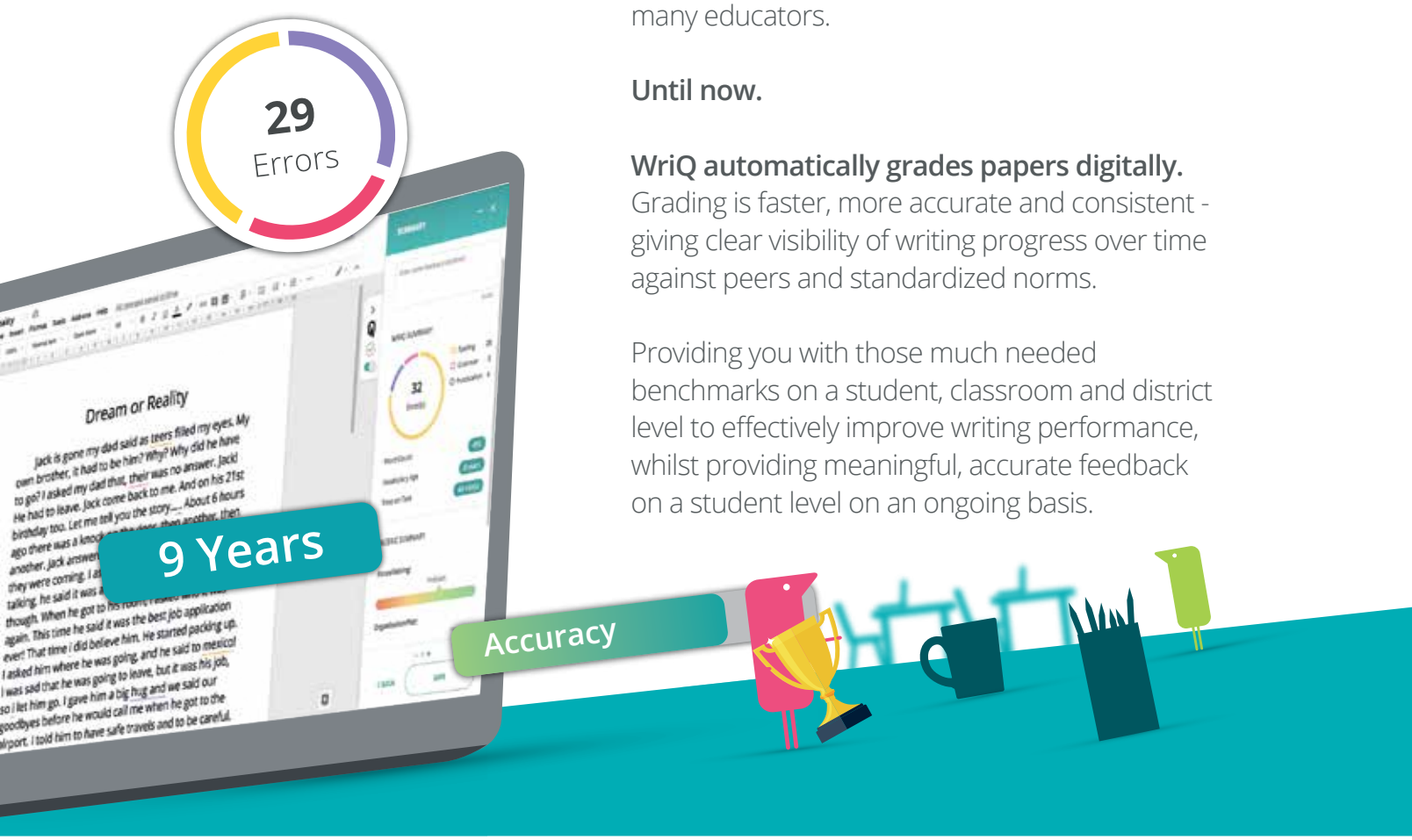

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EMPOWERED LEARNER

July 2019
Volume three Issue one
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EMPOWERED LEARNER

ISTE
Connected learning.Connected world.

The International Society for Technology in Education (ISTE) is a nonprofit organization that works with the global education community to accelerate the use of technology to solve tough problems and inspire innovation. Our worldwide network believes in the potential technology holds to transform teaching and learning.

ISTE sets a bold vision for education transformation through the ISTE Standards, a framework for students, educators, administrators, coaches and computer science educators to rethink education and create innovative learning environments. ISTE hosts the annual ISTE Conference & Expo, one of the world's most influential edtech events. The organization's professional learning offerings include online courses, professional networks, year-round academies, peer-reviewed journals and other publications. ISTE is also the leading publisher of books focused on technology in education. For more information or to become an ISTE member, visit iste.org. Subscribe to ISTE's YouTube channel and connect with ISTE on Twitter, Facebook and LinkedIn.

Our vision. ISTE's vision is that all educators are empowered to harness technology to accelerate innovation in teaching and learning, and inspire learners to reach their greatest potential.

Our mission. ISTE inspires educators worldwide to use technology to innovate teaching and learning, accelerate good practice and solve tough problems in education by providing community, knowledge and the ISTE Standards, a framework for rethinking education and empowering learners.

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PHOTO BY STEVE SMITH

We're in it together: Serving the best interests of students

By Bill Bass
President, ISTE Board of Directors

I often think about how much school has changed since I started teaching almost 20 years ago. I didn't have a computer, mobile phones were large and bulky, and the information I could use to teach my students was limited to what was in the library, our textbook or what I could copy on a handout. Even with these limitations, I always felt a great responsibility to carefully select the most effective learning materials for my students.

In today's digital classroom, the access to information and resources is seemingly infinite. Whether it's a virtual reality field trip or a database that helps streamline our ability to find and vet information, there's no shortage of resources that could be amazing in the classroom. So more than ever before, the responsibility we have as educators to curate the very best learning resources for our students remains one of the few constants.

Every single opportunity our students have to interact with a specific tool or content should be an *intentional* decision on our part, based on what we want them to learn. That means we have to think about everything from the learning goals for a lesson to terms of service, and how a specific website or provider is approaching student data privacy. It means we have to keep in mind that all content is not created equal, and that we must choose wisely in order for our students to have the experiences and conversations that will help them become critical consumers themselves. And it means we must be strategic about what we use so that we provide students enough experiences that they'll be able to make their own choices.

The ISTE Standards for Students (iste.org/standards) are an extraordinary guide that has shifted the conversation from what we want students to do to who we want them to be. By the same token, the Educator Standards and Leader Standards can serve as a guide for the work we do every day to support students.

Our daily realities are rife with decisions that must be made in the best interest of our students. The same is true for ISTE as we think about the role we have in education and the contributions we make to the greater educational community. We continue to look ahead and recognize that we, too, share a similar responsibility to support and lead, and we look forward to continuing on this journey.

Please don't hesitate to connect with the board using #ISTEBoard or by emailing us at board@iste.org. And when you see us at events, please share your thoughts on ISTE and how we can continue to support you in all your efforts!

Joseph South gives an update on ISTE Certification for Educators.

PHOTO BY STEVE SMITH

ISTE Certification helping create a critical mass of change agents

By Joseph South
ISTE Chief Learning Officer

A year ago, I made a bold promise at the ISTE conference. I said I'd buy a Philly cheesesteak at ISTE19 for every ISTE Certified Educator there if we reached 1,000 ISTE Certified Educators in a year's time. I thought I had about a 50-50 chance of having to pony up the cheesesteaks. Turns out, I was a little off. And by a little, I mean a lot!

Just one year after the launch of ISTE Certification for Educators, over 1,500 educators, school and district leaders, edtech coaches, PD professionals, school librarians and media specialists, and even higher education faculty have enrolled in the program. To meet the accelerating demand, we've partnered with 13 Certification Authorized Providers (CAPs) that are offering training in all 50 states and the Asia-Pacific region, with more international CAPs coming soon.

We're pleased by the interest in the program, of course. But what's really exciting is the feedback we're hearing from participants.

Many say they're learning more about reimagining pedagogy with the innovative use of technology than they have from any other source. That ISTE Certification is making them stand out among their peers in their schools for their knowledge and expertise. That the process gave them insight into themselves as an educator and a person.

So what's the draw of this competency-based, vendor-neutral certification? It's about change.

Some participants tell us they want to earn ISTE Certification as part of their personal growth trajectory or to prepare for future leadership roles. Some come as leaders who are dedicated to making second-order change across a school or district. Some districts are signing up entire cohorts to take the certification as a team so they can create a critical mass of forward-leaning influencers prepared to shepherd change with colleagues.

We think there's another appeal to ISTE Certification for Educators. The recognition that if we want to make real change in education, if we truly want to transform our schools, we need to set a bar for what every educator needs to know about teaching and learning with technology. While the ISTE Standards have provided a vision for what that should be, there hasn't been a program that could fully fulfill that vision. Until now.

We want to be clear that ISTE Certification isn't tech training. Training on how to use a particular set of technology tools is helpful, but it isn't enough. Our professional development focuses on key pedagogical approaches to strategically using technology for learning. It's about the learning, not the tools.

Best of all, when you jump in, the ISTE Certification process comes with a community to support your professional development, provide mentorship and collaborate in making real change in education, whether that's in your classroom or across an entire organization.

At its core, ISTE Certification helps PK-12 educators rethink and redesign learning activities with technology to engage students in real-world, authentic, active learning.

It's hands-on PD that's for educators who want to learn, change and perhaps become systems change agents as well.

And that's resonating.

I guess it wasn't about the cheesesteaks after all ...

Learn more at iste.org/Certification

ISTE Certification

Get the certification
that transforms teacher practice

Become an ISTE Certified Educator

ISTE Certification for Educators is a competency-based, vendor-neutral certification for ambitious educators who want to progress from general technology integration to becoming digital learning catalysts.

This certification recognizes educators who are using technology to transform learning in meaningful ways.

Check out our expanded list of ISTE Certification Authorized Providers **– now serving all 50 states!**

iste.org/certification

Nikki D Robertson explains how centers allow innovative student-directed learning.

PHOTO BY STEVE SMITH

Empowering students to be masters of their own learning

By Nikki D Robertson

During my first stint as an elementary school librarian in the mid-1990s, I stumbled upon the magic of learning centers. Centers, which allow students to choose from a variety of learning activities, empower students to be masters of their own learning in a small-group setting while you take on the role of a facilitator.

Flash forward to 2016 when Future Ready Librarians launched a bold initiative calling on librarians to empower students as creators. Librarians were encouraged to help students to create digital products that engage them in critical thinking, collaboration and authentic real-world problem-solving.

One way to do this is by implementing and building makerspaces in our school libraries. While stand-alone makerspaces in a flexible library space is ideal, makerspaces incorporated into a fixed library schedule through learning centers is a manageable approach. Creating centers requires quite a bit of front loading, but all that up-front work pays off fast, resulting in a smooth running, well-oiled machine of a library.

When creating centers, you need to consider the curricular purpose behind each center, the skills you want addressed, the supplies you'll need, the procedure for student access and the relevant ISTE Standards to highlight.

Here are a few themes to get you started:

Set up a coding area

It goes without saying that coding is a necessary skill for students today. There already are far more computing jobs than qualified workers to fill them.

The possibilities for librarians to collaborate with teachers in all subject areas using code are wide open and exciting. Tynker's Homophones STEM Kit (bit.ly/2A2yEnS) empowers students to make a fun storytelling game where the player has to choose the correct homophone to advance the story.

The Scratch website (scratch.mit.edu) allows students to create interactive games to demonstrate knowledge of historical figures, events, science, literature and more. Or students can use this Codesters Hour of Code activity (bit.ly/2FO28WK) to explore all four quadrants of the coordinate plane.

Some coding sites and apps I have used with my K-5 students include:

- Code.org Hour of Code Activities (hourofcode.com)
- Scratch (scratch.mit.edu)
- Scratch Jr. (scratchjr.org)
- Made with Code (madewithcode.com)
- Khan Academy Hour of Code (khanacademy.org/hourofcode)
- Tynker Hour of Code (tynker.com/hour-of-code)
- OSMO Coding Family (playosmo.com/en/coding-family)

Offer green screen activities

A green screen center is surprisingly easy and relatively inexpensive to set up. All you need is a green plastic tablecloth from your local discount store and a green screen kit with lights that you can find online.

Here are a few of the green screen activities that I've done in the library that were a big hit:

READ posters. Have students in grades K-5 create their own READ posters based on the American Library Association's celebrity posters (bit.ly/2YDoq5T).

Proportion lessons. Teach students about proportions with this "Honey, I Shrunk the Kids" activity using a green screen. Students find images and use a two-step process to shrink their own image (bit.ly/2HTqxO5). It's fun to see where a child's imagination will take them – swallowed by a great white shark, playing soccer with their favorite LEGO characters or riding on the back of an eagle.

Parent night. Take family pictures in the green screen room with a backdrop image made to correspond with the schoolwide event. This activity gets parents into the library and imprints a positive image of the library in their minds. They can even share the photo on social media. And once you get them into the library, let students show them how to use the green screen and other technologies. That way parents are more likely to support and advocate for edtech.

Need more ideas connected to the Future Ready Librarians framework? Try some of these:

Augmented and virtual reality center. Help students bring constellations to life, visualize 3D geometry, explore animal habitats or learn about the plight of refugees by visiting a Syrian camp using augmented and virtual reality apps.

Reading/ebook center. Introduce students to a variety of print and ebook resources so they'll always know how to find a good book.

Game center. Allow free play or introduce structured games to teach a particular set of skills.

Google center. Demonstrate how to use Google Tools, Apps and Experiments, such as Slides, Spreadsheets, Drawing, Chrome Music Lab, BookTrack Classroom and more.

Research center. Introduce students to district databases and teach media literacy and basic research skills.

Engineering center. Use KEVA Planks, LEGOs, cardboard, duct tape and other building materials that incorporate the basic engineering concepts of gears, levers, pulleys and stress and strain of structures.

NIKKI D ROBERTSON IS A VETERAN EDUCATOR, SCHOOL LIBRARIAN, INSTRUCTIONAL TECHNOLOGY FACILITATOR, AUTHOR OF *CONNECTED LIBRARIANS: TAP SOCIAL MEDIA TO ENHANCE PROFESSIONAL DEVELOPMENT AND STUDENT LEARNING*, AND ISTE LIBRARIANS NETWORK PRESIDENT. READ HER BLOG, "THE INCREDIBLY TRUE ADVENTURES OF AN EDTECH TRAILBLAZER," AND FOLLOW HER ON TWITTER @ NIKKIDROBERTSON.

"When creating centers, you need to consider the curricular purpose behind each center, the skills you want addressed, the supplies you'll need, the procedure for student access and the relevant ISTE Standards to highlight."

Mike Walsh weighs in on what the future holds for today's students and how educators can prepare them.

MIKE WALSH

CEO, FUTURIST, AUTHOR DISCUSSES AI, 5G NETWORKS AND OUR PERSONAL RELATIONSHIPS WITH TECH

By Julie Phillips Randles

When you want to know what the future holds for your students, Mike Walsh is the go-to guy.

Walsh is the CEO of the very appropriately named consultancy Tomorrow, but his description of his role is more glamorous: global nomad, speaker and consumer trend scout. It's a big assignment – and his focus on tackling it is laser-sharp.

But his bigger mission is to make sure the world is ready for these changes. "For all this talk of technology and disruption, it's the human perspective that's missing," he told an audience in 2016. "We are profoundly changing our behavior." And there won't be an industry that isn't impacted by this change.

The good news: Educators have "ringside seats" to what's coming, he asserts.

For instance, the students in your classroom will think it's normal when toys have conversations with them (and send a report on the data straight to adults) and wireless headphones are essentially (disturbingly) permanent implantable devices. They'll expect their "smart" tennis shoes to buzz in metropolitan cities when something interesting is happening nearby. And before you ever see them in the classroom, their own bathroom mirrors will have advised them on exactly why they look so good today.

In other words, the relationship with technology will be personal, and educators will need to adjust to teach that way as well. It starts with concentrating on problem-solving skills, which will be most in demand, according to Walsh. "Our ability to understand people's experiences will be key to the future of our companies," Walsh said. "[Students] need to think big, think new, but most importantly think quick."

Mike Walsh says our challenge, both as educators and students ourselves, is to adopt an intentional approach to the role of technology in augmenting our capabilities and allowing us to solve more complex problems.

“Rather than remembering facts, the real skill in the 21st century will be asking questions about facts, like: What is the source of this information? Who collected the data and for what purpose? Is this hidden bias and was the sample representative?

And this means that agile thinkers who can briskly embrace change will be in demand in the job market. Walsh himself lives this example. He graduated from the University of New South Wales in 1999 with a degree in commercial and media law. He was ranked fifth in the world in the XVIII World Debating Championships. Immediately following graduation, he launched internet.com in Australia, creating a leading local technology news and events media network during that web boom.

Since that success, he travels 300 days a year to suss out data and make sense of how it will impact countries. His clients include many of the global Fortune 500; he previously founded Jupiter Research in Australia and has also held senior strategy roles at News Corporation in the Asia Pacific Region. He’s also the author of the bestselling books *The Dictionary of Dangerous Ideas* and *Futuretainment*. His latest book is *The Algorithmic Leader: How to Be Smart When Machines Are Smarter Than You* (mike-walsh.com/algorthimic-leader).

We sat down with Walsh, an ISTE19 featured voice, to get his take on tech topics like AI, 5G networks and our personal relationships with technology.

WHAT’S THE MOST CRITICAL ETHICAL ISSUE RELATED TO TECHNOLOGY OUR KIDS WILL FACE IN THEIR LIFETIMES?

In the early days of the web, there was a lot of optimism that the digital age would help transform knowledge, understanding and tolerance by democratizing information. Few anticipated the rise of fake news, algorithmic filter bubbles and the shortening of attention spans through social media.

In my view, the foundation of ethics will be critical thinking around information authenticity and data anthropology. Rather than remembering facts, the real skill in the 21st century will be asking questions about facts, like: What is the source of this information? Who collected the data and for what purpose? Is this hidden bias and was the sample representative?

YOU'VE SAID WE NEED TO TEACH THE COMING GENERATION TO GET COMFORTABLE WITH AMBIGUITY AND TO BE FLEXIBLE IN THE FACE OF CHANGE. HOW CAN EDUCATORS TEACH STUDENTS TO EMBRACE UNCERTAINTY?

We need to help students embrace probabilistic thinking. Humans already tend to be naturally deterministic; we see the world in black and white. We are taught that X is Y, and not to act on information unless we are 100% sure. Unfortunately, that's not how complex problems in the world work.

In this new age of data and AI, it will be necessary to coach people to be more comfortable with operating with uncertainty. That means being confident to make decisions and act when you are only 70% sure of something, but being able to update your confidence levels as more information becomes available.

Of course, being able to handle ambiguity with Bayesian flair is only one reason why statistics will be such a valuable part of 21st century curriculums. Even more than traditional computer science, statistics and probability are at the heart of modern AI and the machine learning revolution.

YOU'VE SAID THAT TECHNOLOGY AND AUTOMATION WILL FREE US UP TO HAVE MORE TIME FOR FAMILY AND LEARNING. BUT THAT'S BEEN THE PROMISE OF AUTOMATION FOR DECADES AND IT HASN'T COME TO FRUITION. THE WORK WEEK MAY BE MORE FLEXIBLE BUT IT ISN'T SHORTER. WHY DO YOU THINK THIS NEXT WAVE WILL BE ANY DIFFERENT?

We're at a crossroads when it comes to automation. Techniques like "robotic process automation" have already started to replace human clerical activities in industries as varied as insurance to logistics, banking to retail.

If a task can be easily defined and repeated without much variance, it's an ideal candidate for being automated. Leaders in those organizations now face a choice. Do you automate and decimate your human capital, or do you automate and elevate the capabilities and responsibilities of your people?

Automation may not necessarily translate into more free time, but it will hopefully mean that our time is spent doing more interesting, meaningful and purpose-driven work.

WE'RE GETTING USED TO HAVING WI-FI IN CLASSROOMS, BUT 5G NETWORKS OPERATE AT MIND-BOGGLING SPEED AND HAVE THE POTENTIAL TO BE MUCH MORE DENSELY DEPLOYED THAN WI-FI, INCREASING THEIR REACH, FOR BETTER OR FOR WORSE, INTO THE DETAILS OF OUR LIVES. HOW MIGHT LEARNING CHANGE AS A RESULT?

The future benefits of 5G are more subtle than simply faster speeds. The advent of 5G is really the story of the rise of intelligent

“In this new age of data and AI, it will be necessary to coach people to be more comfortable operating with uncertainty.

“While there are no simple technological fixes for this situation, we do have a responsibility to coach kids and the next generation on taking steps to safeguard their own data, understanding risks to their online reputation and knowing how to protect their digital identities.

networks that can be configured and personalized for specific needs, whether it be for a high bandwidth application like real-time video, augmented or virtual reality environments, or the creation of a dedicated network for sensors and connected devices in the classroom.

SHOULD TEACHERS BE CONCERNED ABOUT BEING REPLACED BY AI?

The only concern teachers should have about AI is not being replaced by machines, but rather being replaced by teachers who are willing to leverage AI to be more effective at what they do.

Machines may ultimately be more capable at designing an adaptive curriculum for a particular student, grading papers at scale and keeping track of the latest research in a fast-changing field, however, they will always lack the cultural context, empathy and compassion that comes from having a human intermediary and guide in the educational experience.

IT DOESN'T FEEL LIKE YOUR DATA WILL ALWAYS BE SAFE AND ALWAYS BE PRIVATE GIVEN HOW MANY DATA BREACHES SEEM TO OCCUR WITH MAJOR CORPORATIONS ON A REGULAR BASIS. HOW ARE NEW TECHNOLOGIES SOLVING THIS PROBLEM, OR ARE THEY POTENTIALLY MAKING IT WORSE?

Unfortunately, cyber-insecurity is simply a new reality of the algorithmic age. Even as we start to deploy AI and machine learning in the fight to protect ourselves against hackers and outside forces, we'll see the same technologies and adversarial AIs being weaponized and used against us in a constant struggle for supremacy.

While there are no simple technological fixes for this situation, we do have a responsibility to coach kids and the next generation on taking steps to safeguard their own data, understanding risks to their online reputation and knowing how to protect their digital identities.

AS AI MAKES THE DIGITAL WORLD EVER MORE ENTICING AND PERSONALIZED, HOW CAN WE BE SURE THAT WE DON'T BECOME EVEN GREATER SLAVES TO OUR DEVICES? HOW CAN THESE TECHNOLOGIES BE USED TO ENCOURAGE MORE BALANCE BETWEEN THE ONLINE AND OFFLINE WORLDS?

Our smartphones are already like mobile Skinner boxes capable of seducing us with interactive reward loops and algorithmically targeted cognitive mind candy. And yet at the same time, with the right guidance and mindset, our devices can also be portals into infinite worlds of knowledge and potential.

Our challenge, both as educators and students ourselves, is to adopt an intentional approach to the role of technology in augmenting our capabilities and allowing us to solve more complex problems.

If you look back at the original vision of Douglas Engelbart, who famously invented the mouse and graphical user interface, it was at its core about computers augmenting human intelligence. Not, I would suspect, launching animated pigs into space or tracking the every move of a family of narcissists.

HOW DO YOU MANAGE THE FIREHOSE OF INFORMATION THAT COMES AT YOU? HOW DO YOU MAKE SURE YOU ARE FOCUSED ON THE MOST ESSENTIAL THINGS YOU NEED TO LEARN?

Knowing what's important and worth paying attention to is never easy. The question I always ask myself is: *Is this new and is it true?*

My simple hack when trying to get my mind around a new industry or an emerging technology is to spend some time with someone deeply embedded in the field and use their specialist frame of reference to filter out some of the noise. I then look for similarities and convergences with other fields or trends in other industries to see if there are patterns that are bigger and tell a more interesting story about the future.

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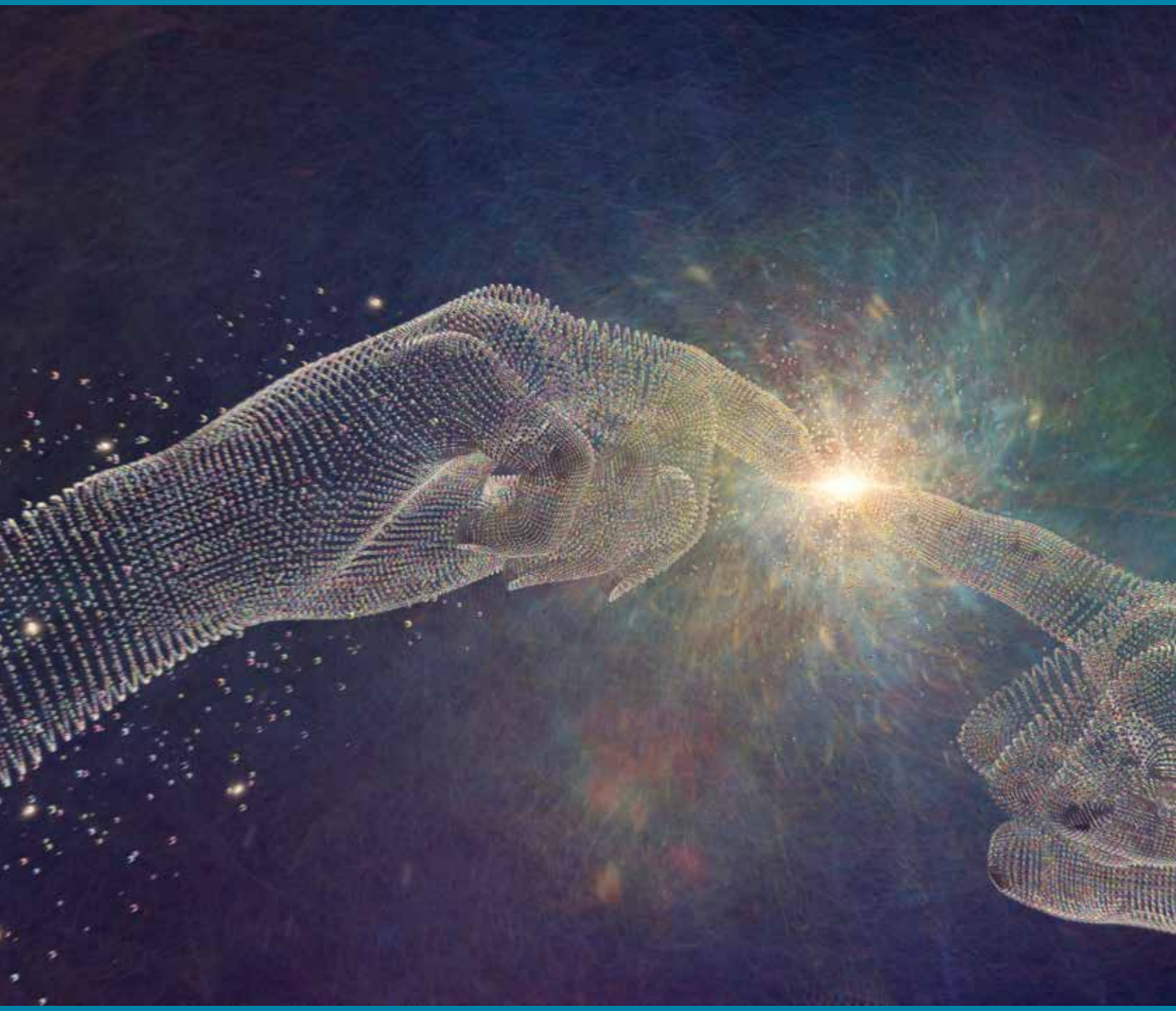

Building AI

When student creators meet artificial intelligence, sparks fly

By Nicole Krueger

Gati Aher already has some ideas about how artificial intelligence could improve her after-school job.

It's a small business with a heavy focus on marketing, where some employees spend hours each day tracking their ad clicks. AI, she says, could handle a lot of that grunt work while helping the company strategically target its advertising dollars.

"If you have AI communicate over the network to direct those ads to people who actually want them, you could use technology more efficiently," says Aher, a senior at Burlington High School in Massachusetts.

That, she admits, barely scratches the surface of AI's potential. Now that she's coded her first chatbot, she understands just how powerful the technology can be – and it's a skill she plans to develop.

"I think once we integrate AI into more things, it will allow us to be smarter about what decisions we're making for companies," she says. "Right now, I myself don't really know how to utilize it to expose its potential. Once I figure that out and find other people willing to bring that in, our business could do better at marketing."

Being the first generation to grow up alongside AI puts Aher and her peers in a unique position. As lifelong consumers of the technology, they're naturally adapted to using it. But because AI operates so invisibly within their lives, they may also be inclined to take it for granted.

Now, with a new generation of AI-powered tools at their fingertips, students can use artificial intelligence to create in all sorts of new ways, from animating videos to composing symphonies, without ever peeking under its hood.

"Most students don't know what AI is. They take for granted a lot of the things technology does for them," says tech integration specialist Deb Norton, who teaches ISTE U's course on artificial

Building AI

intelligence aimed at educators. "By teaching them what it is and how to work with it effectively, we have big aspirations that kids will be able to think about what else it might be good for, what they might do with it."

ISTE has partnered with GM to create the professional learning program AI Explorations and Their Practical Use in School Environments in an effort to cultivate future AI programmers and provide professional learning for educators to support student-driven AI explorations.

"ISTE was fortunate to find a partner in GM that's as passionate about the need to prepare students to lead in an AI-enabled world as we are," explains ISTE Chief Learning Officer Joseph South. "From the very beginning of our partnership, there was no question that we were going to work to empower educators with the background and skills they need to help their students not only understand AI, but to become AI designers and builders."

While using tools that have been supercharged with AI has its value, many educators believe it doesn't go far enough in preparing students to become stewards of this revolutionary technology. To truly understand how AI works, and to become effective problem-solvers with it, students need to learn how to build it themselves.

A different type of coding

Instructional technology specialist LeRoy Wong isn't a programmer, but he doesn't let that hold his students back.

As the facilitator for Burlington High School's student-run help desk, he gamely agreed to advise an after-school coding club – and when the opportunity arose to participate in an ISTE and GM-sponsored pilot involving chatbots, he followed where his students' interests led.

Using programming tools such as Lambda and Amazon Lex, they were challenged to code an AI chatbot solution to a classroom or schoolwide need. Their goal was to create a chatbot that would provide tech support to teachers and students.

"It was a struggle for me," Wong confesses. "Help desk isn't a CS class per se, though I feel like we're doing more things in computer science." Elements involving the Python coding language posed a particular challenge, but he was able to get some help from professionals in the tech field. "We managed to learn enough to get it working. I'd like to get it working even better."

It's one thing to talk about machine learning in class or help students create with AI tools. But even tech specialists and computer science teachers can be intimidated by the prospect of coding artificial intelligence.

"The truth is, it's not that difficult of a concept to truly understand," Norton says. "Is it difficult to create? Yeah, on some level, but there are also some basic low-level tools for incorporating or creating AI. It isn't just for people who are into computers or teaching science. It's for any educator and any student at any level."

For Aher, building AI was both easier and harder than she expected.

To truly understand how AI works, and to become effective problem-solvers with it, students need to learn how to build it themselves.

"It didn't have as much programming as I thought it would. Amazon Web Services provided a lot of the underlying framework for machine learning and intelligence, but using that as a development tool was kind of tricky," she says.

"I think coding AI is different in the sense that when you're writing a piece of code in class, you're using very simple libraries such as math function libraries and graphics. With Amazon, you're drawing from a larger code base. The functions still work as functions, but the objective is more abstract. Mapping out what functionalities you want your chatbot to have is the tricky part."

Programming AI, she learned, isn't just about writing lines of code. It requires students to think about the big picture and understand how the various pieces of code interact with each other.

Although educators have typically considered artificial intelligence a periphery topic within computer science, researcher Ben Shapiro argues that AI technologies such as machine learning have transformed the core of what tomorrow's computer scientists will need to know. Traditional coding requires students to think in terms of algorithms and data structures – in other words, to think like mathematicians. Machine learning (ML), on the other hand, requires them to think more like scientists.

"While traditional software is built by human programmers who describe the steps needed to accomplish a goal (how to do it), a typical ML system is built by describing the objective that the system is trying to maximize (what to achieve)," says Shapiro, assistant professor of computer science at the University of Colorado and co-author of "How Machine Learning Impacts the Undergraduate Computing Curriculum."

"To succeed with ML, many students will not concentrate on algorithm development, but rather on data cleaning, model choice and statistical testing."

Reverse engineering AI

In David Lockett's middle school STEM classes, students take a more experimental approach to AI. His project-based learners are testing the limits of machine learning by creating with a variety of emerging AI technologies.

They doodle in Quick, Draw! to see whether machine learning can recognize their drawings. They conduct AI symphonies through Google's Semi-Conductor. They compose music with the help of coding tools such as Apple Swift. They use AI to pare down existing musical compositions so they can better understand how various elements are combined to create a song.

The more they explore AI-powered creative tools, the more curious they get. How does machine learning actually work? What else can they do with it?

During a lesson on Alexa development apps in coding class, students listened to Lockett deliver voice commands while a monitor showed them the coding behind the virtual assistant's responses. It's a form of reverse engineering – getting to know what machine learning can do first and then dissecting how. Once they saw how simple the code was, they began clamoring to build their own AI chatbots.

"We saw some of same JavaScript based code that we've use for some of our other projects," says the teacher at Edward W. Bok Academy in Lake Wales, Florida. "Some of the coding is different, obviously, but if you can read JavaScript and read the div tags, you should have no problem transferring that over. They picked it up pretty quick. I was not even 10 minutes into going over each line of code, and I probably had about a fourth of the class who already had their chatbot done before I could finish."

Since then, Lockett's students have been obsessed with coding AI. They brainstorm project ideas in the bus line. They go home and immerse themselves in machine learning technologies.

"They're just amazed by the possibilities that can come from it."

Ethics, empathy and machine learning

Not all of those possibilities are good, however. While AI can help solve humanitarian problems, it can also be used to exploit users' private data, manipulate public opinion and widen inequality gaps – to name a few.

"Like any other tool, people can misuse it," says Yiannis Papelis, research professor and director of the Virtual Reality and Robotics

Building AI

Lab at the Virginia Modeling, Analysis and Simulation Center. "There's a saying that to err is human, but to really screw up you need a computer. This applies a thousand times to AI. It can be used for good or bad."

That's why empathy plays a key role in AI instruction for April DeGennaro, a gifted education specialist at Peeples Elementary School in Fayetteville, Georgia. She's teaching fourth graders about machine learning using Cozmo robots, which display personality and emotion as they learn from their users. Not only can students interact with the robot, but they can program the AI to perform new functions.

During a recent project, students collaborated in groups to devise problems and then program the robot to solve them. They also made up stories around the problems. In one scenario, Cozmo was a seeing-eye robot for a blind person at the grocery store. His task was to find three specific items, represented by cubes bearing different symbols. Once the robot learned to recognize the symbols, he was able to fetch the items.

DeGennaro hopes these experiences with Cozmo will inspire her students to become ethical creators of AI.

"We talk a lot about empathy and how so much of the AI community is working on solutions to make the world better," she

Getting started with AI

Looking for resources to bring AI to your classroom? Check out these options:

- AI4K12 is developing national guidelines for K-12 AI education and offers an online curated resource directory to facilitate AI instruction. (bit.ly/2DvBK3h)
- Google Semi-Conductor lets you conduct an orchestra through your browser. (semiconductor.withgoogle.com)
- AI Experiments showcases simple experiments that explore machine learning through pictures, drawings, language and music. (experiments.withgoogle.com/collection/ai)
- Amazon Lex is a service for building conversational interfaces into any application using voice and text. (aws.amazon.com/lex/)
- IBM offers a course titled Chatbots for Good (ibm.co/2DuB5Pz) and a related facilitator guide (ibm.co/2PpHj8c) for a deeper understanding of human-computer interaction and an opportunity to develop a chatbot.
- AI4ALL Open Learning offers free online curriculum to help students understand how AI works in daily life and spark a learning journey. (ai-4-all.org/open/)
- The ISTE U course Artificial Intelligence Explorations and Their Practical Use in Schools unpacks everything educators need to know about bringing AI to the classroom. (iste.org/AIcourse)
- AI Explorations and Their Practical Use in School Environments is an ISTE professional learning program funded by General Motors that cultivates future AI programmers and provides professional learning for educators to support student-driven AI explorations. (isteaiexplorations.org)

says. "Robots can map out a terrain and find people underground or rescue people who have been lost in water accidents. There are so many things AI is doing in the field that are so helpful and so positive."

On the other hand, AI toys like Cozmo can also help highlight the privacy concerns smart devices raise. When children interact with these toys, what information are they revealing about themselves? Who owns this information once it's captured? How will it be used?

To navigate these legal and ethical thickets, students "will need to be well-rounded and capable of considering a range of implications, including legal protection, ethical considerations, and what will happen when machines become more like humans," says Michelle Zimmerman, author of the ISTE book *Teaching AI: Exploring New Frontiers for Learning*. "Will we treat AI as machines or as humans? These are critical conversations as we attempt to impose order on the Wild West frontier of AI."

Bias poses another area of concern. Because AI learns from data furnished by humans, machines can inherit the biases of their programmers. Plus, developer bias influences which problems machine learning will ultimately solve. To encourage a more diverse pool of creators, students of all genders and backgrounds need in-depth exposure to AI. One group that's making strides in addressing this gap is AI4ALL, a nonprofit working to increase diversity and inclusion in AI by creating pipelines for underrepresented talent (ai-4-all.org).

Building AI helps pull back the curtain on what makes artificial intelligence tick, showing students that the keys to this powerful technology are within their grasp.

"The connection I'm making for them is that they've already learned to code, and there is coding behind AI," DeGennaro says. "It is not magic, just like the computer is not magic. Someone coded it to do what it does."

And so can they.

NICOLE KRUEGER IS A FREELANCE WRITER AND JOURNALIST WITH A PASSION FOR FINDING OUT WHAT MAKES LEARNERS TICK.

Jason Trinh explains why educators need to take a stance on equity issues.

Building a diverse, inclusive edtech community

By Jason Trinh

When students enter our classrooms for the first time, teachers may unconsciously judge them based on where they sit. Did they choose a seat front and center? They must be eager to learn and participate. Did they sit in the back corner? They're probably going to be disengaged or even disruptive.

When I attended my first edtech conference, I was faced with the same decision of where to sit. Looking around the room filled with people, I spotted the empty seats, but I also noticed the lack of diversity. I grabbed a seat in an empty row and began to plan the sessions I wanted to attend. Scrolling through pictures of the keynoters, spotlight speakers and workshop facilitators, I also noticed who had been invited to grace the stages.

Just like where a student sits in a classroom sets an expectation, who attends a conference and those who are invited to speak also sends a message. While many white educators may see only empty seats, educators of color tend to see who's in the room. Similarly, on the stages, the lack of diversity and representation sends a message to people of color that they're not welcome, their voice is not important or they provide no value to the to the edtech community.

The case for diversity and equity in all spaces is well established. The current challenge is taking action instead of simply expressing platitudes. How do we create spaces where educators of color have opportunities and feel welcome and safe in all educational spaces? The Canadian government offers one example.

Government projections indicate that by 2031, close to one-third of Canadians will belong to a racialized group. As the demographics in Canada change, public servants are becoming increasingly mindful of the diverse communities they serve.

That desire prompted a government task force to issue a report of 43 recommendations for improving inclusion in public services. Many of those recommendations can be applied to the educational space, regardless of where in the world you're teaching.

Here are some highlights that education leaders across the globe should consider:

Diversity training. Mandated training in diversity, inclusion and unconscious bias not only during the onboarding process but during all required trainings ensures that training will not be one-off, but active and continuous.

Focus on leaders. Developing a diversity and inclusion lens is framed in the recommendations as a leadership competency where "consideration for diversity and inclusions in all decisions … by default [is] a forethought and not [an] afterthought."

Integrated inclusion. All of us can integrate inclusion into our work by asking three simple questions:

1. Who is not included in the work we do?

2. What could be contributing to this exclusion?

3. What can we do differently to ensure inclusion?

Taking an equity stance requires a conscious effort, courage and a willingness to fail. These are traits we encourage in our students, but are we modeling them? We're all on this journey together and all of us bring a unique perspective to the conversation.

The report concludes with wise words: "With today's global political context, including its divisiveness and the recent inward turn toward homogeneity and nationalism, Canada … must lead by example, embrace its people and make strides toward a better, brighter and more equitable future."

Shouldn't educators do the same?

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Food computer is catalyst for growth at innovation lab

By Jerry Fingal

At Andover High School in Andover, Massachusetts, students' work on a computer-controlled hydroponic growing system earned a gold medal at an international tech competition in China.

It was a high honor, beyond anyone's expectations when work on the food computer began. But the students' accomplishment had a bigger effect closer to home: It kick-started the school's innovation lab and led participation to jump from just a handful of students a few years ago to more than 90 this year. It also was validation for the innovation lab's newly instituted curriculum based in design thinking.

"It's really evolved in just a few years and we're just growing with it," says Shelagh St. Laurent, the school's digital learning coach. "We're really excited about it and the kids are, too."

PHOTO BY CRISTEN FARRELL

The food computer project, which the students dubbed the Smart Garden, was an outgrowth of the school's student-staffed technology help desk. As the help desk evolved, the school started to think about "passion projects" that the nine students on the help desk could work on together. The first was

an augmented reality sandbox that uses an Xbox Kinect camera to project contour lines on "land forms" created in sand.

The sandbox creation led to an invitation to nearby Massachusetts Institute of Technology (MIT). It was at MIT that students were introduced to a food computer, which is part of the university's Open Agriculture Initiative that aims to create innovative and sustainable ways to produce food through open-source technology.

The Andover students found fresh inspiration in the food computer, which is a self-contained growing environment controlled by software that can be used anywhere. Anything that can be grown outside can be grown inside a food computer as long as the plants don't need more space than provided by the device's container. Berries and greens do especially well.

Using directions provided by MIT that are publicly available and a couple hundred dollars' worth of supplies, the students embarked on building their own with mint as the crop.

"I feel like the food computer really gave us the chance to understand that kids are interested in this type of learning and we're able to support them now in ways that we just couldn't before," St. Laurent says.

Why does it work?

It puts students' programming skills to work and offers new challenges.

Seniors who had taken programming classes since they were freshmen embraced the project because it was unlike anything they had done, St. Laurent says. "We had kids who were excited about this different type of learning opportunity. I think they were just excited to do something different."

Although the plans were provided by MIT, it was not an easy build. There was lots of trial and error along the way. "It might sound really simple but it was much more complicated when we got down to business and tried to go right through it. But it really was student-led. They were excited about it."

They learn the dynamics of working on a team.

"They had to understand the whole picture and how everything worked," St. Laurent says. "So, it really was a collaborative team of kids with different skill sets who were challenged in new ways."

Lessons in collaboration were just as important as the technological ones.

"The computer was amazing and challenging and offered them lots of new skills, but there also was understanding the dynamics of working on a team and the frustrations."

It taps into students' passion.

The project's cutting-edge connection to a real-world initiative gave students the sense it wasn't just an exercise. That real-world connection has fueled the innovation lab's subsequent work on wearable technology. Students look for problems around them to solve. The results have been a jacket for bicyclists with turn signals on the back and gloves that charge phones and act as a keyboard.

JERRY FINGAL HAD A 35-YEAR CAREER IN NEWSPAPERS AND IS NOW A FREELANCE WRITER AND EDITOR SPECIALIZING IN EDUCATION, BUSINESS AND FINANCE.


E=MC2

ALL IN!

4 LEADERS SHARE HOW A DISTRICTWIDE VISION LED TO TRANSFORMATION

By Jennifer Snelling

Too often, tech integration is driven by innovative teachers working alone in classrooms, tech directors and coordinators with too many teachers to adequately serve, or a single school that becomes the showcase of an entire district. But when district leadership gets behind an initiative – and takes a holistic approach – successful outcomes are far more likely.

"Stories of success and failure in digital learning almost universally hinge on one factor: district leadership," says Doug Casey, executive director of the Connecticut Commission for Educational Technology.

District leadership is at the core of the four districts profiled in this article. The approaches are all unique and tailored to each district's individual circumstances and overall goals. Each is an example of how real educational transformation can be accelerated with a districtwide approach.

MIDDLETOWN CITY SCHOOL DISTRICT MIDDLETOWN, OHIO

6,341 students,10 schools
463 certified personnel
92% free and reduced-price lunch (FRL)
6.6% English language learners (ELL)

When Middletown High School hosted an open house last winter, more than 2,000 people showed up, including many senior citizens with no ties to the school who were just curious. Families and community members alike came out on a cold night in January to learn about the urban district's Middie Modernization Movement.

The aim of the movement is to transform the low-performing urban district, located 30 miles from Cincinnati. What the community learned was not just figures on a school report card, but how STEAM experiences, robotics and a literary corner with celebrity readers can revive a school and the surrounding community.

"We've not just enlisted the school, but transformed the whole community," says Fran Morrison, Middletown's senior director of curriculum and innovation. "In a district where there is poverty, it's always a challenge to address the reality of students. Our teachers take a positive attitude, and the way we've branded our district has made a significant impact. For us, the Middie Modernization Movement is a way to brand what we do, not just on social media, but also how teachers can embrace that mindset in their classrooms."

Middletown is in the final year of $96 million new middle school building project and renovation of the high school and, yes, they're a 1:1 district. But the tech isn't the main ingredient in the Middie Modernization Movement, says superintendent Marlon Styles, named one of America's Top 30 Technologists, Transformers and Trailblazers by the Center for Digital Education.

"The Middie Modernization Movement fuels our efforts to transform the way we educate," says Styles. "The goal is to modernize our approach and find innovative ways to shift practice and leverage tech."

Before the tech even arrived, Middletown partnered with ISTE for executive-level coaching to develop a strategic plan in four parts: closing the achievement gap by integrating tech in appropriate ways, focusing on student wellness because healthy students attend school more often, valuing diversity by redefining hiring practices and telling Middletown's story to the community starting with social media using the hashtag #middierising.

An inaugural group of four teachers were enrolled in ISTE Certification for Educators. Eventually, 26 educators became

"Stories of success and failure in digital learning almost universally hinge on one factor: district leadership."

ISTE certified and then worked with building and district leaders to become digital leaders. The district ran a five-day digital bootcamp for administrators, along with two additional days to focus on tech integration.

The framework includes teacher leaders who are cross-trained in STEAM and maker movements, the district's learning management system or Google Classroom, and who act as instructional coaches in the buildings. These leaders provide "Lunch and Learn" professional development sessions for their buildings and host monthly Twitter chats for all teachers that dig into what's happening at the classroom level.

Middletown is eight months into the strategic plan, and there are no hard numbers yet. In high-poverty districts like Middletown, students can be two to three years behind their peers. The district is reaching for a 1.5 growth metric per year to close that gap. So far, the benchmark reading and math data look good. Perhaps more importantly, the culture and the climate have shifted.

"We anticipated that we would need to take into consideration the readiness level of our staff to interact with technology, so we invested in adults heavily," says Morrison. Buy-in from staff has increased because the district is offering staff access to opportunities to invest in themselves.

"We challenge teachers to be designers of instruction, but also use the science behind instruction to personalize that instruction, not for a mysterious group of students, but the ones in their classrooms."

DRY CREEK JOINT ELEMENTARY SCHOOL DISTRICT
ROSEVILLE, CALIFORNIA
6,300 students, 9 schools
320 teachers, 9 edtech coaches
41% FRL, 17% ELL

PHOTO BY DRY CREEK JOINT ELEMENTARY SCHOOL DISTRICT

PHOTO BY DRY CREEK JOINT ELEMENTARY SCHOOL DISTRICT

Like most districts, Dry Creek Joint Elementary School District didn't start its technology integration with a clean slate. In 2012, the rural Northern California district in the foothills of the Sierra Nevada Mountains spent $2.2 million to update and rewire classrooms. In 2013, Dry Creek added 1:1 Chromebooks, and continued to add devices over the next several years.

A couple of years ago, Dry Creek reinvented the position of technology director. The district hired Bryan Wilke because he had 15 years of teaching experience and an edtech background. With Wilke in place, the focus shifted from devices to how Dry Creek students are thinking in the classroom. The goal: Teaching the skills needed in the future workforce.

"The reality is that many districts rushed out and bought devices without much training or forethought about how to support student learning," says Wilke, a participant in the ISTE Digital Leadership Summit. "I'm always looking for the next iteration to make that work better. We have to account for the fact that our staff needs more training on every device and that our users are at different levels."

Dry Creek developed a Tech Integration Committee that meets regularly to develop an overall plan to address the different levels of tech competency throughout the district. The committee started by looking at different standards, including the ISTE Standards, then backward-mapping existing projects. The result is classrooms driven by project-based learning that's more in-depth and interactive.

For example, the California state standards have fourth grade students learn about the state and the region. Coyote Ridge fourth grade teacher Jamie Albracht-Halsey, also on the Tech Integration Committee, had been teaching the same lesson for years, but says it was dry with little interaction or creativity.

She looked at the ISTE Standards and tweaked the project to incorporate the Knowledge Creator, Digital Citizen and Creative Communicator standards. She had students use Google Maps to plan a trip across the state, documenting the places they go on an interactive map by adding pictures and text. Kids shared their projects using Flipgrid and reflected by writing blog posts as they went on their journey.

PHOTO BY ELIZABETH BEADLE

"Incorporating the ISTE Standards and backward-mapping the project made the subject come alive for students," says Albracht-Halsey. "Some teachers are excited, and some are more reluctant, but teachers realize we're not going backward with tech. It's here to stay and doesn't have to be scary. They don't have to know everything before they put these tools into kids hands."

The Tech Integration Committee spawned professional development after school, led by teachers like Albracht-Halsey who have implemented successful projects. The PD is delivered in a cafe model, with multiple types of classes requested by teachers. Teachers are reimbursed for this professional development, demonstrating that the district considers it essential and values their educators' time.

"Some people think it's just one more thing, but one of my charges is to shift that mindset. Kids are already doing it," says

"We've not just enlisted the school, but transformed the whole community."

Wilke. "If it's meaningful, it makes the information live beyond something out of a book."

BALDWIN COUNTY PUBLIC SCHOOLS
31,519 students
45 campuses and a virtual school
2,500 teachers, 20 curriculum leaders
40% FRL

One of technology's great promises is that it can level the playing field for all students through personalized learning. Of course, that's not true if all students in a district don't have access to the same technological opportunities.

Equity is an issue for Alabama's Baldwin County Schools. Located in the southwest corner of Alabama, Baldwin runs along the Gulf of Mexico and spreads across 66 miles as the largest county east of the Mississippi, encompassing some of the wealthiest and most impoverished areas of the state.

Baldwin demonstrated its belief in the power of technology by putting a computer in the hands of every K-6 student and giving every student in grades 7-12 a laptop to take home.

The ambitious program didn't come without problems. Laptops got broken and were expensive to fix, leaving kids without computers. The district asked families to pay a technology fee at the beginning of the year,

PHOTO BY ELIZABETH BEADLE

but some families were unwilling or unable to pay meaning teachers had to provide two lessons, one for students with computers and one for students without.

"The technology is a tool the student needs because it's like your pencil or paper," says Jeremy King, Baldwin County Schools' tech coordinator. "It has to be there for you, or it's an equity issue."

The district solved the problem by replacing the original laptops with less expensive Chromebooks, which included the cost of repairs.

Of course, technology is only one part of the equation. Teachers must be trained to use technology appropriately. Baldwin decided to use a train-the-trainers program called Enhancing Missouri's Instructional Network Teaching Strategies (eMINTS) and covered 150 teachers a year in the two-year program.

Katie Nettles, a consulting teacher, says the program has been successful for teachers across the board, even in special education classes. Nettles worked with a teacher whose special education students participate in a pull-out class during which they were reading a theater-based version of *Anne Frank: The Diary of a Young Girl*. The class was assigned essays about the book, but the students were having a hard time with the writing skills.

The teacher, who doesn't consider herself very tech savvy, had the students design a virtual field trip of the Anne Frank home and do a Google Slides presentation. The teacher felt the students rose well above her expectations and made her feel that she had been holding them back.

"The professional development of teachers is what caused that change. With that, students were better able to work together, seek out information and think critically about they are seeing," says Nettles.

The professional development was pushed out to district schools through the central office staff, curriculum leaders and classroom teachers who have been through eMINTS training.

PHOTO BY ELIZABETH BEADLE

"At first, the idea was getting the kids to work in groups and other 21st century skills," says King. "Now, they're just skills because we're here in the 21st century. Did the technology make the test scores improve? We don't have it isolated so we can't say, but what we can say is that our teachers have gotten more comfortable doing things with students, and that kids like being in school better."

PRINCE WILLIAM COUNTY SCHOOLS

91,000 students, 100 schools
11,500 staff
26% ELL, 42% FRL

Prince William County Schools in the Washington metropolitan area is the second largest district in Virginia. As a decentralized district, independence is encouraged, and school leaders are allowed to forge their own path to success. The challenge in such a system is equity.

Take two schools who share the same campus. The first was a 1:1 elementary school where the teachers were innovative and students were empowered to create. The second was a middle school where kids were mostly doing packets. The principals were not collaborating in any intentional way.

"We challenge teachers to be designers of instruction, but also use the science behind instruction to personalize that instruction, not for a mysterious group of students, but the ones in their classrooms."

That is until the district decided to see how these schools could partner and learn from each other. Each school created teams and did classroom visits with the principal in every classroom. The two staffs learn from each other, and the students benefit. As they transition from elementary to middle, students are finding a more cohesive experience.

This is an example of how schools can work together, even across a decentralized district, says Diane Harazin, supervisor of instructional technology. Through newsletters to administrators, Harazin highlights the successes of schools who have put effort into technology and professional development, and offers support to help other schools get there.

Prince William schools are all focused on future-ready skills, thanks to a statewide Profile of a Graduate program. All schools emphasize the four C's, and there's a tech coach at every school to support content area teachers with embedded technology.

Harazin meets with the coaches monthly, and the district has partnered with ISTE for the last two years. The coaches reference the ISTE Standards for Students and ISTE Standards for Educators during these meetings, and Harazin always asks teachers to share how they're empowering students. The coaches also collaborate on Twitter.

"We are decentralized, but when it comes to instructional technology we have a structure in place to create a unified vision with these instructional technology coaches," says Harazin. "The power behind our site-based management system is that those people who are true leaders, lead. They pave the way and have this opportunity to do what they think is right," she says. "We have a vision in our district, but it's looked at differently in every school."

JENNIFER SNELLING IS A FREELANCER WHO WRITES FOR A VARIETY OF PUBLICATIONS AND INSTITUTIONS, INCLUDING THE UNIVERSITY OF OREGON. AS A MOTHER TO ELEMENTARY AND MIDDLE SCHOOL-AGED CHILDREN, SHE'S A FREQUENT CLASSROOM VOLUNTEER AND IS ACTIVE IN OREGON SCHOOLS.

Jorge Valenzuela describes how to use the ISTE Computational Thinking Competencies to create valuable learning experiences.

Computational Thinking Competencies: Embrace integration across the curriculum

By Jorge Valenzuela

When embarking on your school or district's computer science (CS) journey, computational thinking (CT) should be taught first, primarily because CT helps learners understand the logic and algorithmic processes that are the foundation of both hardware and software designs.

Educators can leverage the power of CT as a higher order problem-solving skill by helping students develop their versatility or recognizing and applying the four elements of CT to everyday problems and situations prior to doing so with CS-related scenarios.

The newly developed ISTE Computational Thinking Competencies are an excellent resource for helping educators create the learning experiences that are best for students.

COMPUTATIONAL THINKING COMPETENCIES

To complement both the K-12 Computer Science Framework and the CSTA K-12 Computer Science Standards for Students, ISTE developed the CT Competencies for educators to help schools integrate CT across all disciplines and grade levels by correlating it to what they already teach.

As teachers begin to unpack the competencies for lesson planning, it's important to know and understand that the CS standards and CT Competencies are not just about programming and coding. They were purposefully written to align with the academic standards and subjects that have to be taught in schools. The competencies list indicators that assist educators with both planning and delivering instruction with CT.

Now that computers are part of everything we encounter and edtech must be used by all teachers to augment instruction, these competencies are extremely helpful in assisting learners with becoming computational thinkers who can leverage computing to solve problems creatively, innovatively and while working collaboratively with peers.

Let's take a dive into the five CT competencies for educators and explore ways we can address them in classrooms and with students:

1. Computational Thinking (Learner)

The key here is for educators to help students make sense of the four CT elements of decomposition, abstraction, pattern recognition and algorithm design. Teachers need to help students make connections between the elements using familiar, unplugged scenarios while also being strategic in correlating CT to the content of the class.

An example of this is connecting algorithm design to everyday tasks like

For students, collaboration also needs to be structured, learner-centered and a fruitful and productive struggle.

brushing teeth or tying a shoelace. What these simple tasks have in common with more complex problems is that they are accomplished by completing a series of steps. Whether a student is reducing fractions or solving long division, they need to use a step-by-step process. Decomposition can be compared to making breakfast and decomposing text. Pattern recognition can be applied to making predictions, concept mapping and looking at text or pictures to identify similarities. Finally, abstraction can be demonstrated by creating timelines or by using the process of removing features from something to make a new set of essential features.

2. Equity Leader (Leader)

For leading with an equity mindset, it's critical for educators to understand that some learners may lack confidence, are being bullied, struggle with identity, lack a sense of belonging, are experiencing hardships, have learning disabilities, lack social skills, have gaps in knowledge or just need to develop their voice. The key here is to remove the isolation that often impedes the social and academic success of our students.

Therefore, creating a school or classroom culture based on deep mastery of CT competencies requires educators to take equitable and practical steps toward learning objectives and intended outcomes for all students. When educators integrate CT into their lessons, they should be mindful of those students who are furthest from opportunity – those who are typically left out have a chance to engage in the productive struggle that is vital for developing social and emotional learning as well as academic and career learning.

3. Collaborating Around Computing (Collaborator)

Collaboration between both educators and students is key for successfully mastering the indicators within this competency.

Although our classrooms are typically siloed, our students are not and many interact with teachers in their grade level every week. We, therefore, should connect our classrooms by planning rigorous instruction that reinforces the CT elements for students.

However, making solid cross-curricular connections by a grade-level team is often not easy, especially when the learning goals of computational student products are not always clear to teachers. That's why it's important when we're using edtech to take some time to learn the tool first and bring to our planning sessions working models of whatever we want students to create. This provides clarity to the other collaborators and sets up a meaningful way to structure the learning experiences, which each team member can then support in their classroom.

For students, collaboration also needs to be structured, learner-centered and a fruitful and productive struggle. This requires teachers to become master facilitators of the learning process – but not necessarily all of the content – and to group students strategically (not by academic levels). As facilitators, educators should create roles within teams, make tasks lists and contracts,

and implement protocols such as Charrette, Say Something and the Question Formulation Technique (QFT) to help students collaborate effectively and within guidelines. The key here is to create a culture of both self-management and interdependence.

4. Creativity and Design (Designer)

The goal here is for students to harness CT for making creative and authentic computational artifacts. This competency is excellent for teaching CT and allowing students to transfer their new knowledge while using familiar tools like YouTube, Canva and Google Slides. Since not all classes will be coding and programming, CT skills can be transferred in other creative ways such as creating apps, webpages, podcasts, videos, blogs or recorded PSAs, among others.

In specific CS programming courses or in those that involve coding and programming, students can learn to apply the CT elements in more complex and diverse ways within computer programs they create.

5. Integrating Computational Thinking (Facilitator)

Facilitation is a skill that teachers should add to their teaching toolkit for effectively engaging students in learning CT and CS. This can be done by structuring learning experiences within projects and requiring students to share in the workload.

The project-based learning (PBL) instructional approach is excellent for making this happen. By using the High-Quality PBL framework and receiving professional development through PBLWorks (formerly known as Buck Institute for Education), schools are increasingly building capacity for implementing PBL with fidelity and successful student outcomes.

It's also important to note that facilitation must be supported with adequate planning, direct instruction and management of learning. Any intended CT learning outcomes must align to standards and require teachers to allow students multiple opportunities for capturing and transferring the learning. For this purpose, the K-12 CS Learning Framework, the ISTE Standards for Students and the ISTE Standards for Educators are excellent resources to help teachers plan learning goals, craft learning targets and create checklists and rubrics for empowering students to take ownership of their learning.

DON'T GO IT ALONE, BUT DON'T COMPARE YOURSELF TO OTHERS

The power of the ISTE Computational Thinking Competencies is that they're not one size fits all – nor are they intended to keep educators stifled in set ways of integrating CT. The approaches in this article are merely ways that colleagues and I have unpacked the CT Competencies for meeting the needs of our learners.

I urge you to never go it alone and to leverage the collective wisdom of your colleagues in your schools and professional learning networks (PLNs). Think of them as a support system and a familiar place where

In specific CS programming courses or in those that involve coding and programming, students can learn to apply the CT elements in more complex and diverse ways within computer programs they create.

Facilitation is a skill that teachers should add to their teaching toolkit for effectively engaging students in learning CT and CS.

you can go to learn and share. Having this access makes learning and understanding CT no longer appear daunting, but the next step in the evolution of our teaching practice.

Also, it may be natural to compare our teaching (or life) journey with those of others, but Australian Diamonds captain Caitlin Bassett says the trick is not to do so. "Everyone's journey is different. You might be starting your chapter at chapter one while someone is at chapter 20 of their life."

JORGE VALENZUELA IS AN EDUCATIONAL COACH AND A GRADUATE TEACHING ASSISTANT AT OLD DOMINION UNIVERSITY. HE'S ALSO THE LEAD COACH FOR LIFELONG LEARNING DEFINED, INC., A NATIONAL FACULTY MEMBER FOR PBLWORKS, A NATIONAL TEACHER EFFECTIVENESS COACH WITH THE INTERNATIONAL TECHNOLOGY AND ENGINEERING EDUCATORS ASSOCIATION (ITEEA) AND PART OF THE LEAD EDUCATOR PROGRAM FOR LITTLEBITS. YOU CAN CONNECT WITH VALENZUELA ON TWITTER @JORGEDOESPBL TO CONTINUE THE CONVERSATION.

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Trina Davis helps educators reimagine their classroom approach and develop curriculum based on authentic research experiences.

Trina Davis

She's reinventing how educators learn to teach STEM

By Nicole Krueger

To create unforgettable STEM experiences for students, teachers need to have them first.

That's how Trina Davis sees it. An associate professor for Texas A&M University's Department of Teaching, Learning and Culture, she's pioneering new models of technology-enhanced learning for both preservice and practicing educators.

Every summer, teachers roll up their sleeves and immerse themselves in hands-on inquiry side-by-side with university researchers. Davis then helps them reimagine their classroom approach and develop curricular materials based on their own authentic research experiences.

In Glasscock Island, a 3D virtual space Davis designed, preservice math teachers hone their craft by running teaching simulations and experimenting with problem-solving lessons combining music and math. Her hope is that they'll be inspired to incorporate both creativity and 3D immersive learning experiences into their own classrooms.

At the intersection of tech integration, STEM learning and digital equity, Davis is working to reinvent how teachers learn to teach. By researching – and disseminating – best practices for technology-enhanced learning, she aims to disperse the pockets of excellence endemic to the education field.

"What kinds of experiences are we equipping teachers with so they really understand and become great integrators of technology in teaching and learning?" she asks. "We need to continue to make sure we keep digital equity on our radar so those experiences are for everyone. Every aspect of the work I've done for the past 20 years has been to make sure we are scaling really good practices and experiences, and not just creating pockets of excellence."

Better professional learning, she believes, is the key to both leveling the digital playing field and enticing a diverse new crop of STEM-qualified graduates.

"If you don't have focused professional development that goes alongside putting resources in classrooms, the technology just doesn't get used," she says. "Even if the tools are there, you'll still see the digital-use divide. Without effective and high-quality PD alongside them, students are not getting innovative, higher-level technology integration or the kinds of experiential learning opportunities it creates."

Her career journey – from a sixth-grade math teacher in Texas, who used websites in her lesson plans back in the pre-graphic days of the internet, to a researcher and teacher educator who impacts

Trina Davis says that without effective PD, teachers can't deliver innovative, higher-level tech integration or the experiential learning opportunities it creates.

PHOTOS BY GT STUDIOS

"If you don't have focused professional development that goes alongside putting resources in classrooms, the technology just doesn't get used."

teacher prep programs throughout the state and region – has been a serendipitous one.

A year after landing her first teaching job, she was tapped as a district technology coordinator. That led to a position in the dean's office at Texas A&M's College of Education, where she ran technology training programs while earning her Ph.D. in curriculum and instruction. Now a tenured professor, she pursues funding for groundbreaking research programs such as the KATE Project, which involved redesigning a teacher prep course to incorporate virtual classroom simulations, giving preservice math teachers early experiences in teaching algebra for equity, such as calling on girls and being sensitive to how cultural biases might influence the way math problems are framed.

While her interest in digital equity stems from her struggles at a resource-poor school where she scrambled for small pots of money to bring more technology into her classroom, joining ISTE helped expand her reach and provided the underpinnings for some of her greatest successes.

In 2001, she joined the organization as one of the first fellows in an annual minority leadership symposium. Within a year, she was planning digital equity summits. By 2007, she had become ISTE's first African American president, meeting with President Barack Obama's transition team during her tenure to advocate for edtech funding. She later helped revamp the ISTE Standards for Educators, bringing the new standards back to her campus to help preservice teachers unpack and embody them.

As teacher educators increasingly abandon the one-size-fits-all approach to professional learning, Davis remains a steadfast innovator in the push to develop new models that actually work. She favors a more hands-on approach, working intensely with teachers to help them critically reflect on their practice, develop new curricula using research-based approaches and solve real-life problems of practice – all while offering plenty of support and follow-up as they strive to take what they learned back to their students.

"Most teachers want to do well. They really want to be effective," she says. "When you start looking at effective models of professional development, to the degree that we can design programs that help teachers take a critical look at solving a particular problem of practice, those are the kinds of learning experiences teachers will find valuable."

NICOLE KRUEGER IS A FREELANCE WRITER AND JOURNALIST WITH A PASSION FOR FINDING OUT WHAT MAKES LEARNERS TICK.

Partnerships net critical resolution that makes edtech a priority

By Jon Corippo
CUE Chief Learning Officer

California schools are funded at a per-pupil level that currently places them at somewhere between 46th and 49th out of 50 states. This lack of funding is compounded by the fact that the cost of living in most of California is far above the national average.

During the 2009 recession, California educational spending was drastically reduced and is just beginning to be restored. This fiscal reality has made educational innovation and edtech infusion extremely challenging, and in several areas, access to high-quality professional development and tech infrastructure has become a student equity issue.

Something had to change. And CUE knew it could help lead the charge.

In fall 2018, CUE's Legislative Advocacy Team worked to support Assembly Concurrent Resolution 268 (ACR 268) to help provide statewide funding, support and direction for public schools to re-establish the resources that were allowed to lapse in 2009.

The intent of ACR 268 was for the California Legislature to encourage the state superintendent of public instruction, the governor and the State Board of Education to move forward with a comprehensive educational technology plan that includes recommended policies, legislation, and sorely needed state and federal funding.

CUE's Legislative Advocacy Committee and advocacy consultants assembled a coalition of education stakeholders in support of the resolution and worked closely with the original authors, steps that all ISTE affiliates can emulate when supporting important edtech measures.

The measure, which was supported by the California Department of Education and California's Emerging Technology Fund, Assembly members Tony Thurmond (now state superintendent), Kevin Mullin and Cecilia Aguiar-Curry, Napa County Superintendent of Schools Barbara Nemko and CUE Legislative Consultant John Cradler:

- Establishes education technology as a major priority for California education.
- Recommends a statewide summit representing all K-12 education stakeholders to inform education technology-related needs, goals and resources.
- Suggests development of a California Education Technology Plan.
- Suggests state policy, legislation and funding potentially needed to implement the plan.

Supporting the ISTE Standards and the CUE Legislative Advocacy Platform, ACR 268 identifies 17 critical priorities and needs, ranging from professional development to technology access, to be made available on an equitable basis to all regions of the state.

Addressing the 17 ACR268 priorities will help the California education system to prepare students to thrive in a constantly evolving technological landscape as defined by the ISTE Standards for Students.

Resolution ACR268 references the creation of a new California Educational Technology Plan that will outline the needs and priorities for education that will be clearly improved with technology and telecommunications networking in schools and homes for all students.

CUE is proud to have been a key player in the development of this critical resolution that will benefit all California learners. By creating a coalition, advising on key resolution language and including the ISTE Standards, CUE was able to influence smart education policy – something all ISTE affiliates can replicate!

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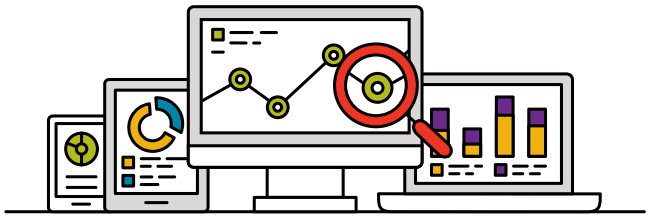
AD INDEX

EMPOWERED LEARNER

COMMUNITY VOICES

This question was asked and answered in ISTE Connect (iste.org/connect), home of ISTE's Professional Learning Networks.



What do you think is the most transformative technology for education in the past 40 years and why?

The most transformative technology over the past 40 years is G Suite for Education. Having the ability to interact, communicate and assess through all of the different applications has really revolutionized how I approach pedagogy. Students being able to easily collaborate and communicate with classmates and teachers in so many different ways truly promotes 21st century learning. Also, the suite makes communication with parents and community stakeholders easy and accessible!

Jon Markowich, STEM teacher
Avon Grove Charter School, West Grove, Pennsylvania

Over the past 40 years, the most transformative types of technology have been those that mitigate developing inequities and that allow *all* students to participate fully. These technologies include closed captions for deaf and hard-of-hearing students, text resizing and screen readers for students with visual impairments, translation technology for ELL students and parents, and connectivity hardware like hotspots that can provide students access to the internet outside of the classroom.

Matt Hiefield, digital curriculum specialist
Beaverton School District, Beaverton, Oregon

For me the most transformative is the iPad. I love the mobility of the iPad, rear-facing camera and built-in creativity tools where you can app smash to easily and fluidly create a product and then share it in so many ways. Our schools use built-in apps to do field sketches for geography over a photo they have taken, code for STEM, control robotics like Spheros, create digital books, etc.

Lisa Nash, digital learning and library services
Catholic Education Diocese of Parramatta, Parramatta, Australia

One transformative tech tool is Skype. I remember when I used to write letters to communicate with someone. Nowadays, we can have impromptu or programmed meetings with people around the globe. Teachers can communicate with other teachers all over the world, and their classes can be part of a joint project. Skype allows us to meet experts and make virtual trips. Everything is at our fingertips.

Sylvia Fojo, grade and computer science teacher
Uruguayan American School, Carrasco, Montevideo, Uruguay

One technology that has changed the educational experience for millions of children is the Logo programming language with LEGO robotics. This was introduced in the 1970s and is still being used today. I'm sure Seymour Papert is still smiling as he sees how this wonderful tool is still alive and well in the hands of creative students.

Dennis McElroy, Ph.D., professor of education
Graceland University, Lamoni, Iowa

Computer science tech tools – both physical computing and software – have definitely changed over the past 40 years. Block-based computer science programming has changed the game on how we learn computer science.

Kim Lane Clark, Ed.S., director of blended learning
Lancaster Independent School District, Lancaster, Texas

Hands down, the most transformative tech of the last 40 years was the birth of the World Wide Web and the corresponding explosion of internet connectivity. That change – from a model of education where we needed to memorize things to one where we have vast amounts of information at our fingertips – is a fundamental one that's still happening. Web 2.0 allows for new ways of collaborating and honoring student voice and choice.

Jennifer Chance Cook, technology integration specialist
Perry Township Schools, Indianapolis, Indiana

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