

SCHOOLS & THE FUTURE OF WORK

The Extraordinary Education of an Elite, 13-Year-Old Problem-Solver

Emma Yang may be as close to future-proof as a 9th grader can get

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For a moment, Emma Yang was stuck.

It was March 2016. She was trying to get a new project off the ground. She needed artificial-intelligence technology that could identify faces in photographs. IBM's Watson wouldn't work. Developers at Google couldn't help.

Undeterred, the 7th grader kept pushing.

Online, she came across a Miami-based startup called **Kairos**. The company's new developer-friendly AI platform seemed promising. Emma wrote to the company's chief technology officer.

"I'm a 12-year old student in New York. I found your email on GitHub, hope you don't mind. My passion is to use computer science to improve people's lives. I'm currently working on an iOS app to help Alzheimer's patients...I'm struggling a bit. I'm trying to ask for two favors."

And with that, another door opened in Emma Yang's extraordinary education.

Now in 9th grade, Emma is the first student featured by *Education Week* for our new series, 'Faces of the Future.' These profiles will be part of our ongoing **special coverage of schools and the future of work**. We believe the stories behind these exceptional young people hold important lessons about the promise—and peril—that all of today's students will face in tomorrow's uncertain labor market.

In Emma's case, for example, there's no doubt she's a remarkable coder.

But that's just part of what makes her as close to future-proof as a 13-year-old can get.

As technology reshapes the labor market, experts are sharply divided over how disruptive the long-term impact will be for future workers. With so much uncertainty, what will give today's students the greatest chance to thrive?

The best guess is to combine technical ability with passion, people skills, and the probing mind of a scientist.

That's where Emma truly stands out, said Cole Calistra, the Kairos chief technology officer who received Yang's email inquiry back in 2016, and has been collaborating with her ever since.

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“Emma has the vision to stitch together different pieces of technology to solve a real-world problem,” Calistra said. “I don’t know how you learn that, but she did.”

‘Just Let Her Explore’

Across the country, talented and driven young people are pushing well beyond the boundaries of school, finding new ways to learn advanced computer science, tackle big challenges, and start mapping an uncharted future.

Emma’s journey began in Hong Kong, where she lived for the first decade of her life.

Her dad, Adrian Yang, was working as a software engineer at an investment bank. When Emma was 6, Yang introduced her to **Scratch**, a kid-friendly programming language.

“I just let her explore,” he said.

It worked.

By the time she was 10, Emma had developed a passion for computer science. She took part in the **Technovation Challenge**, an international competition for girls using technology to solve social problems. Emma’s prototype for **an app to help sports teams diagnose concussions** won second place.

A light bulb went off.

“I realized I could make an impact,” she said.

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Emma Yang with her grandmother, Chen-Yu Lien, in Hong Kong in February 2007. Lien is the inspiration for Timeless, an app that Emma is developing to help patients with Alzheimer's disease to manage their daily lives.

—Family photo

But as the precocious girl's world was opening up, her grandmother's world was going dark.

Emma and her parents had moved to a neat 5th-floor apartment on the Upper East Side of Manhattan. But back in Hong Kong, Emma's beloved grandmother, who had helped raise her, was struggling with Alzheimer's disease. Phone calls and video chats became harder.

Emma got the notion that she could help—by building her own app.

She won a \$3,500 "Discover Your Passion" scholarship for promising New York City students. She used the money to enroll in the Flatiron School, a coding bootcamp for adults. Her goal was to learn how to develop mobile apps using Apple's platform.

Emma kept thinking about the whiteboard that her family used to help her grandmother manage her contacts, communication, and calendar.

She also kept thinking about the online tutorials on machine learning and artificial intelligence she liked to stay up late watching.

An idea started to form.

What if she could create an app that helped Alzheimer's patients by performing the same functions as her grandmother's whiteboard—and also by employing facial recognition algorithms to help them recognize the family members in their photos?

The idea sent Emma's education spiraling off in new directions.

"Questions lead to other questions," she said.

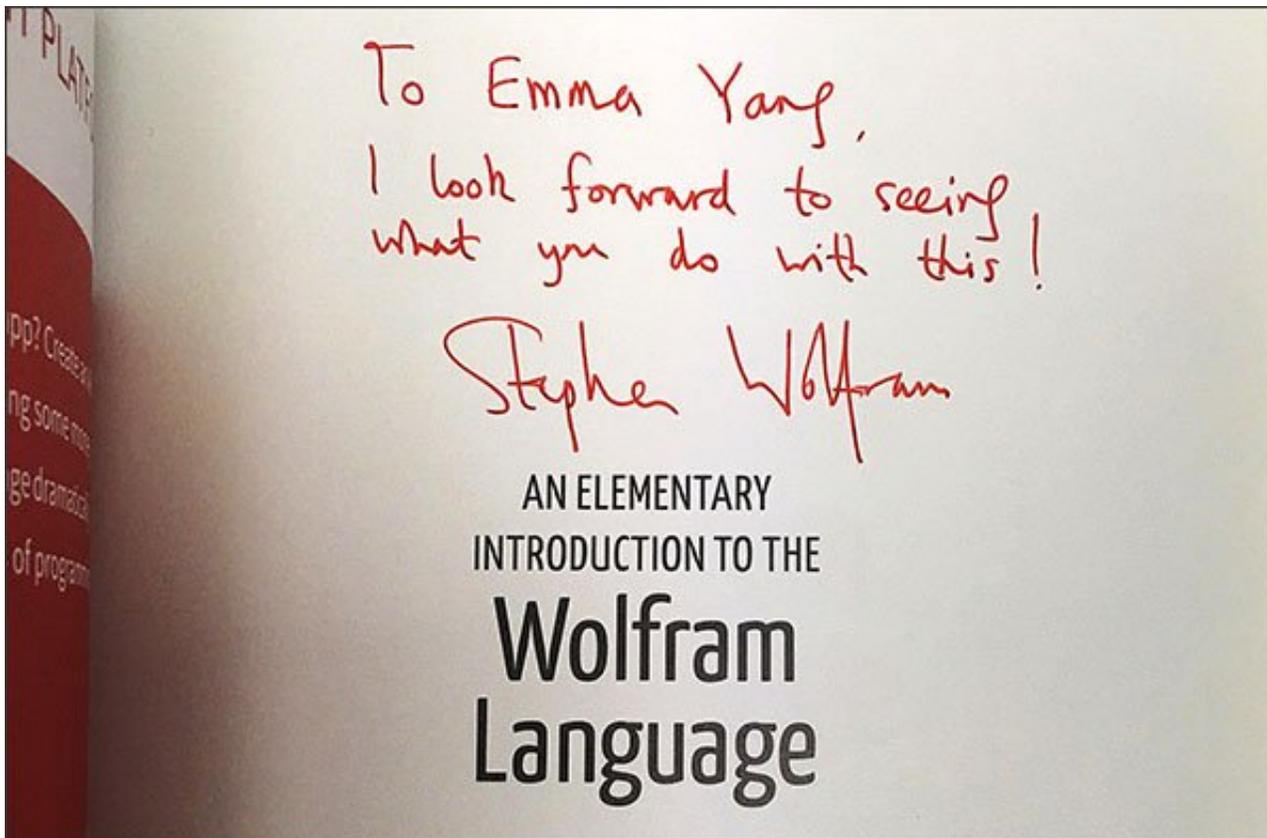
A network of mentors

More than anything, that mindset is why Emma has captivated luminaries like computer scientist **Stephen Wolfram**, the creator of the Mathematica programming language and the Wolfram Alpha search engine.

In the fall of 2015, Wolfram was giving a talk at the New York City Maker Faire. Afterwards, a small girl approached him. She asked whether his programming language could support facial recognition in mobile apps.

It could not. But the two struck up a correspondence anyway. Wolfram asked Emma to review a draft of a book he was working on.

"She read it and gave me a bunch of comments, especially about one section she thought was awful," he said. "Which I changed, because she was right."



Emma still treasures her signed copy of Stephen Wolfram's computer-programming book, which she helped edit.

—Mark Abramson for Education Week

In return, Wolfram arranged for Emma to become the youngest student to ever take part in a mentorship program run by his company, Wolfram Research. The focus is on cultivating "computational thinking." Wolfram believes deeply this is the key to the future.

"It basically boils down to this," he said. "Can you take something you're wondering about and understand it deeply enough that you can explain to a smart computer how to do it?"

Through the program, Emma first worked on a project **analyzing police-department data** to look for patterns that might explain where, when, and why cars crash in New York City. Then she began using machine-learning techniques to **train computers to recognize road signs**, a key technology for self-

driving cars.

For the past several months, Emma's been working to use those same types of techniques to detect cancerous tumors in human lungs. It's difficult to describe how advanced the work is.

Among the steps in Emma's process have been helping build computer-vision and machine-learning algorithms that can identify cancerous nodules in human lungs; applying the algorithms to CT scans to determine if patients are at risk of lung cancer; and finding new datasets that can be used to improve the algorithms' accuracy.

"All the things that seem out of reach, Emma will reach for them," said Andrea Griffin, her mentor at Wolfram Research.

Griffin said her main job is to help connect Emma with other experts, such as machine-learning developers and oncologists.

Emma says those are the types of learning opportunities she values most.

"Sometimes, when I'm curious to learn more, people will say, 'You won't understand 'til later,'" she said.

"But at my mentorship program, they give me all the information I want, and I can go as deep into it as I want. I really appreciate that."

'A traditional liberal arts education'

Despite all her drive and accomplishments, Emma has only taken an introduction-to-programming class in school.

That's by design, said her mother, Alyssa Tam.

"I wanted her to get a traditional liberal arts education," said Tam, the director of innovation for a large life insurance firm that operates in Asia. "If you read well, you write well. And if you write well, you think well".



Emma and her parents, Alyssa Tam and Adrian Yang, in their New York City apartment. "We've always wanted to include her in our world, and understand what she's doing as well," Tam said.

—Mark Abramson for Education Week

Since moving to the United States, Emma has attended the **Brearley School**, a prestigious private school a few blocks from her home.

The classrooms are small. Brearley's computer lab is cramped. The middle-school hallways feature antique science instruments, rather than the latest robotics equipment.

But parents like Adrian Yang and Alyssa Tam don't pay the school's hefty annual tuition primarily because of the technology it offers.

"We place a high value on cultivating girls' voices and helping them find their own unique creativity," said Tim Brownell, Brearley's head of middle school life. "It's important to make sure every student feels known and encouraged in who they are."

In Emma's case, Brownell said, that's meant pushing her to take part in free-flowing classroom debates, challenge her teachers, and practice public speaking.

It's also meant encouraging her relentlessness, even when it creates administrative headaches.

Back in 7th grade, for example, Emma decided she wanted to start an after-school coding club. She sent Mr. Brownell a proposal. His response: Who would the faculty advisor be? Where would they meet? How long would it last? What curriculum would they use? Why was coding more important than other activities?

In shredding Emma's initial idea, though, Brownell also outlined for the girl a process by which she might craft something better.

So Emma kept revising. She found an advisor. She sketched out a sequence of units and projects that would build upon each other.

The past two springs—in between swapping ideas with Cole Calistra at Kairos; and preparing for her **first TEDX Talk**; and pitching potential investors in her app, now called Timeless; and trying to explain the project to her grandmother back in Hong Kong—there was Emma, teaching coding to other Brearley girls.

The future of work may be uncertain.

But we already have a pretty good idea of how to best prepare students for whatever may come, said James Paul Gee, an Arizona State University professor who has been studying the intersection of technology, learning, and identity for the better part of a decade.

The adults in Emma Yang’s life take her seriously. She’s constantly encouraged to cross the boundaries between school and society, and between the physical and digital worlds. Everywhere she goes, there’s someone to feed her curiosity. The focus is always on making sure Emma has a problem-solving process she can apply, not an answer she can recite.

“She’s getting a beautiful education,” Gee said. “The real question is whether we’re willing to give that to every kid.”

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