

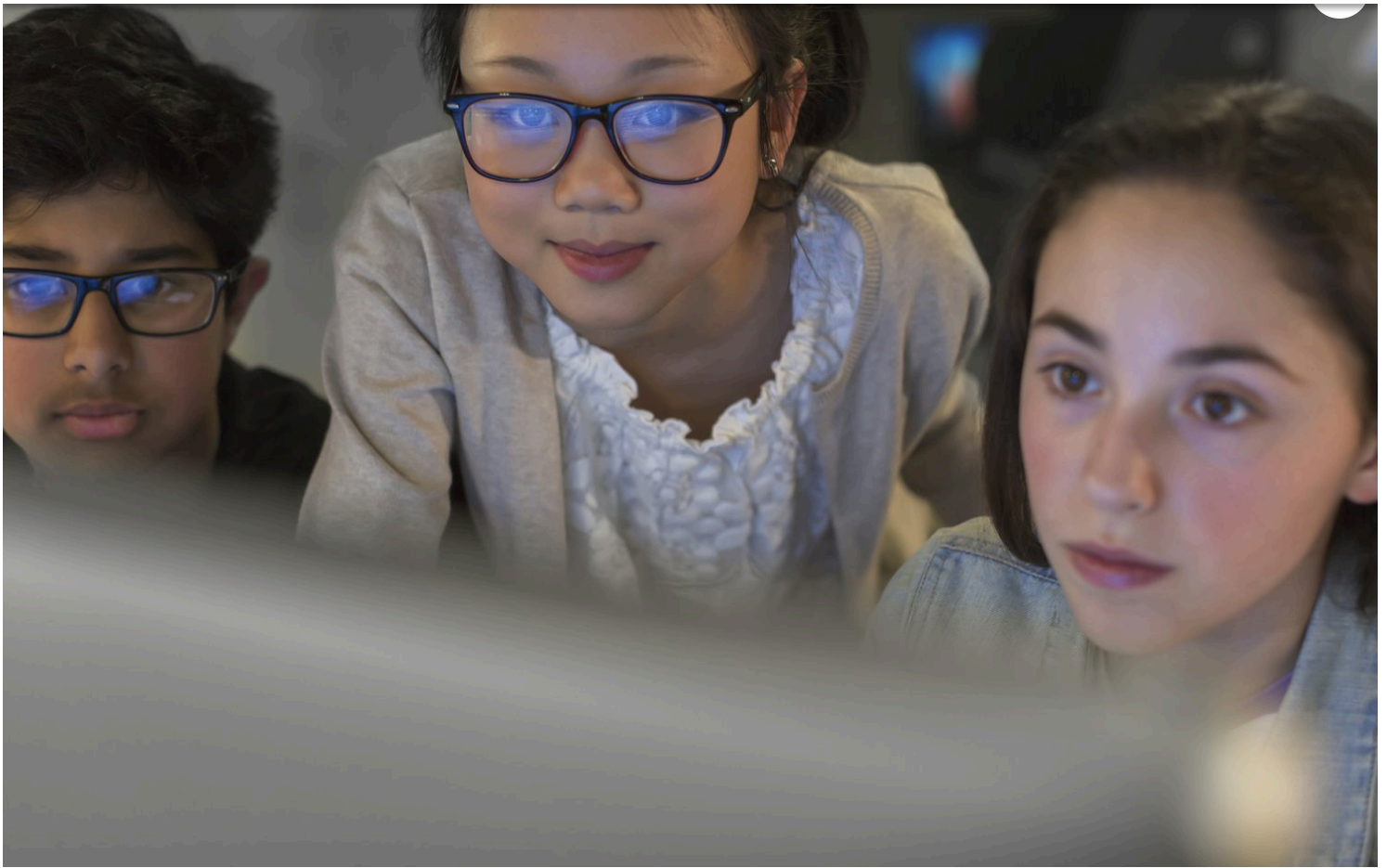


TECH + ENGINEERING

AI Technology is Disrupting the Traditional Classroom. Here's a Progress Report.

Artificial intelligence has the potential to personalize learning at scale. The challenge: making sure it benefits everyone.

BY [JACKIE SNOW](#) TUESDAY, JANUARY 15, 2019 [NOVA NEXT](#)



The recent explosion in cheap computing power, development in algorithms, and the increase of available data are making new classroom learning tools possible. Photo credit: Getty images

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Technology has fundamentally transformed most aspects of modern life, from how we travel to our healthcare. But there's one place that remains markedly unchanged: the classroom.

The schoolrooms of today are strikingly similar to those of 50 years ago. Students sit in a room together and complete the same lessons—typically using the same textbooks—no matter their learning styles or mastery of the topic. Some students get left behind. Others are left unchallenged and bored by this middle-of-the-road approach.

AI could change that. The field of AI in education, or AIEd, started around 30 years ago, with systems designed to teach basic skills, like arithmetic, while recognizing and addressing common mistakes. More recently, the explosion in cheap computing power,

development in algorithms, and the increase of available data are making new, more sophisticated tools possible.

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“You’ve got a perfect storm, really,” says Rose Luckin, a professor at University College London who has studied AIED for the past 20 years. “You can do things that you weren’t able to do before.”

AIED now helps investigate the steps students go through when learning subjects from calculus to chemistry, shining a light on what individual learners need to progress. To get there, an AI program is first trained on hundreds or thousands of students’ work, gaining a knowledge base of the common areas that give learners trouble. Then over time, as an individual uses the system, the AI homes in on specifics to focus on, usually offering bespoke lessons to brush up on skills, and, in some cases, offer pep talks through bots. These insights are also given to teachers for more focused help.

Math is a particularly ripe subject matter for AI to tackle because it follows sets of rules that are easier for AI to understand—compared to something like creative writing, which has more subjective criteria for success. Math is also an area in which American students are falling behind their international peers. [According to one survey](#), American 15-year-olds are 38th out of 71 in the world for mathematics among developed countries.

Companies like Thinkster Math and Carnegie Learning are designing tools to help students learn math, as well as provide more insights for instructors. Every response by a student updates Thinkster Math's personalized algorithm to create a "brain fingerprint," which helps recommend the next set of assignments, whether it be remedial practice or moving students along. Teachers have the option to reject the suggestions and provide a different set of work for students.

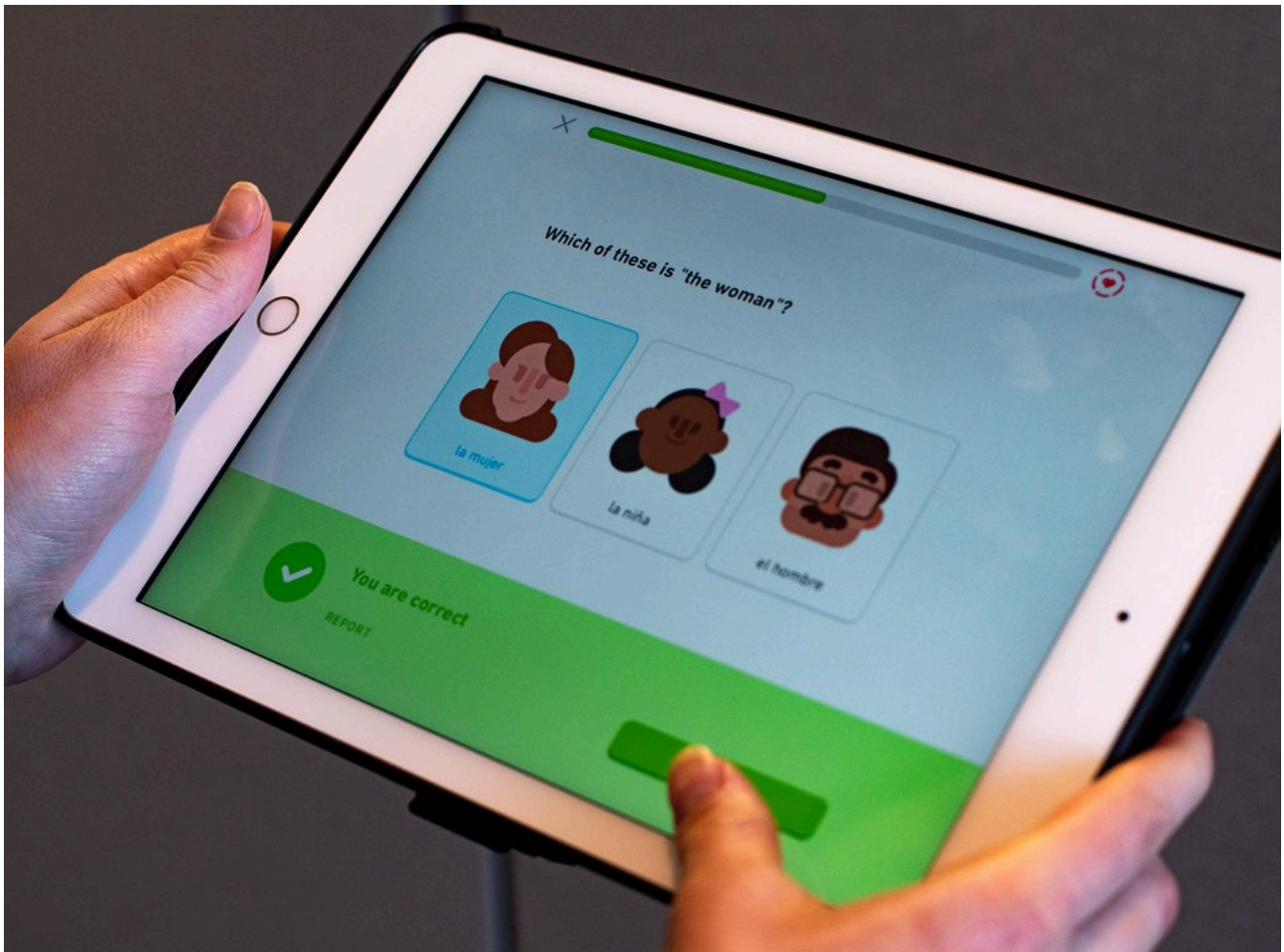
"We can't rely on AI alone," says Raj Valli, founder and CEO of Thinkster Math.

AI-powered assistance is also being applied to language acquisition. For example, Duolingo is a free app that offers curriculum for learning 33 languages for English speakers. It includes a Duolingo for Schools program, which gives students personalized lessons and feedback in over 300,000 classrooms around the globe. Since Duolingo's launch in 2011, it has incorporated more machine learning into every segment of its work.

Though not as good as moving to a new land and being immersed in a language, Duolingo is accessible and free, and has gathered enough data to know when to present new concepts to the user, quickly figuring out what users already know.

"After five minutes, we could put you halfway through the course if that is where you belong," says Burr Settles, the research director at Duolingo.

The app also recently introduced an [AI bot](#), which lets users practice speaking a new language. Duolingo found that when people talk to a chatbot, they don't feel as embarrassed as when practicing with a human.



Duolingo, a free app that offers curriculum for learning 33 languages for English speakers, has gathered enough data to know when to present new concepts to the user. Image credit: Emily Zendt, WGBH

That kind of one-on-one tutoring has a long history of giving students an advantage (see: Plato, Aristotle, Socrates). The problem is, individualized tutoring doesn't scale if only human teachers are available—in many cases, there simply aren't enough of them to go around. AI could help fill the gap by simulating one-to-one human tutoring, delivering activities paced to a learner's abilities.

AIEd doesn't mean cutting teachers out: Instead, they would be freed up to work on social skills. After all, most researchers working on different technologies say that AI isn't anywhere close to good enough to do all the things we rely on human teachers for.

"There are some things that the computer is really good about, like collecting data points, and there are some things that teachers are really good at, like motivating students," says Steve Ritter, the co-founder of Carnegie Learning.

Carnegie Learning is also working with [Lumilo](#), a startup building an AI and augmented reality (AR) assistant that will keep teachers in the loop as students work on assignments. Built with input from teachers and tested in more than 30 classrooms around Pittsburgh, Lumilo allows teachers to monitor students' progress in real time. Information on how students are doing is picked up by the AI and projected above each of their heads, visible only to the teacher wearing AR-powered glasses. The teacher is able to pinpoint who may need a more challenging assignment and who might be struggling, even if those students aren't asking questions.

"Without real-time analytics, the teachers don't have a lot to go on," says Ken Holstein, a doctoral candidate at CMU and one of the creators of Lumilo. "Their attention goes to the hand raisers."

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Pitfalls of Technology in Classroom Settings

Despite being worked on for decades, AI hasn't made huge inroads into schools yet. That is partially due to how conservative the field is compared to other areas that are being upended by AI, Ritter says. Limited resources are also a factor, as school districts with tight budgets are naturally reluctant to invest in risky new technologies, however promising they might be.

“We aren’t competing against other software,” Ritter says. “We are competing against textbooks.”

But AI in classrooms is also slowed by concerns over equity, one of the biggest problems facing the field of education. Intelligent tutors could be used to help close the achievement gap, or it could replace teachers for poor students while wealthy students get a more balanced mix of human and AI help. Where some see the potential for AI—like other new technologies—to make education more equitable, others fear it will do the opposite, further widening disparities between rich and poor schools.



One of the biggest problems facing the field of education is equity. AI could transform traditional classrooms on a global scale—as long as its technology remains accessible. Image credit: SchoolPRPro, Pixabay

AI-powered tools also run the risk of creating classroom-based, mini-surveillance states. [At least one Chinese high school](#) is currently using facial-recognition technology that scans students every 30 seconds, looking to see if students are paying attention or losing interest. The privacy of a student’s data is also a huge concern. A hack could expose sensitive information or be used without permission later in a person’s life:

Imagine your high school physics test result being something that potential employers could look up.

Bruce McLaren, the president of the International Society for Artificial Intelligence in Education and a research professor at Carnegie Mellon University, says that after speaking at a recent conference about AIED, almost every question was about the intrusion of tech in classrooms. He says it's a valid concern, but believes AI is a net positive and probably inevitable anyway.

"It's the way the world is going," McLaren says. "And education will not be the exception to that."

Learning AI to Avoid Being Replaced by AI

Besides AI changing how students learn, schools are gearing up to teach students *about* AI. The Montour School District outside of Pittsburgh is the first in the country to create an AI curriculum in a public school. Justin Aglio, the Director of Academic Achievement and District Innovation of Montour School District, says the curriculum launched just a few weeks ago and that he and his colleagues are already getting calls from around the country asking how to roll out similar programs.

"AI is not part of the future anymore," he says. "It's the present."

The inaugural first class, which is starting in one middle school but will be rolled out to the rest of the 2,900 students in the district if things go well, is on ethics in AI. Other plans include an autonomous robotics class with [Cozmo](#), a small, programmable robot, and a music project using AI-powered [Amper](#). Aglio says he and his colleagues are also planning field trips to local companies working in AI.

Most importantly, the AI lessons will be integrated into classes that all students take so it's not just a self-selecting, privileged group willing to try out a new curriculum. "I've seen too many times where you create these fancy classes that intimidate students and you have the same population taking the class," he says.

The first students going through the program are graduating from high school in the early 2020s. By then, Aglio says, the world will be totally changed by AI, and it's

education's job to make sure students are ready.

"If we aren't teaching it to them now," Aglio explains, "they are going to be dinosaurs by the time they get out."

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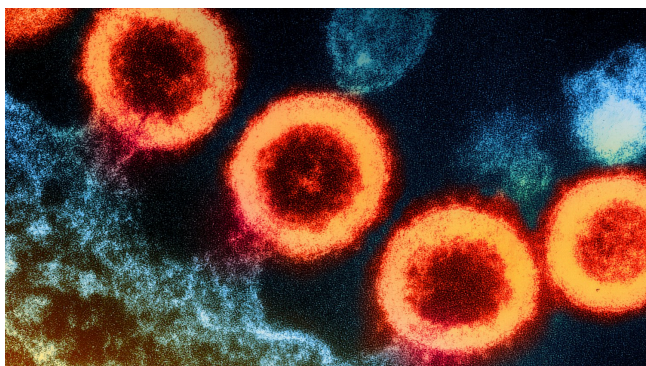
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