

'Intelligent' Tutors: Will They Change Teaching? Teachers' jobs aren't going away, but they could be different

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How 'Intelligent' Tutors Could Transform Teaching

Robots won't put teachers out of a job soon, but tutoring systems powered by artificial intelligence might well change classroom practice.

Schools may be critiqued as "factories," but robots aren't going to replace human teachers any time soon. Still, that doesn't mean that artificially intelligent systems won't transform education just as they are changing a variety of fields and practices, from the way oncologists diagnose cancer to how lawyers analyze cases.

Intelligent-tutoring systems like ALEKS (for Assessment and Learning in Knowledge Spaces), Cognitive Tutor, and a new program in development by IBM's Watson initiative are starting to expand in K-12 education, and experts argue that teachers need new training not only to use intelligent systems in the classroom but also to prepare students for careers in increasingly technology-integrated fields.

"Any skill that a computer can teach is going to be done by a computer in the workplace, and that's something people don't think about enough," said Christopher Dede, an education and technology professor at the Harvard Graduate School of Education. For that reason, he said, teachers can use computer programs not simply to replace pieces of their instruction, but to model for students how to work with technology professionally. "It changes the skills people need to be employed. AI changes teaching, yes, but more important than that, AI changes the goals and purposes of teaching," Dede said.

Artificially intelligent tutoring systems, or ITS, are computer programs that model students' psychological states as well as their prior knowledge to personalize instruction for them. As students interact with them, the programs collect data about how the students approach each problem, when they are likely to get frustrated, and so on. The system evolves in response to the people who use it, to improve the lessons and assessments it presents.

"In the tutorial, you have a conversation, and the tutor-machine knows an awful lot about your background in the course and can build on that in a way you can't in a regular classroom," said J.D. Fletcher, a researcher with the Institute of Defense Analyses and a primary developer of the U.S. Navy's Digital Tutor ITS, which is used to train Navy staff for technical jobs in the force, such as troubleshooting systems on a ship. "Some of your kids will take one day what it takes others four days to learn. In a traditional classroom, the fast students are left twiddling their thumbs. If you have [an ITS] engaging in a conversation with you, the tutor can just keep piling on the questions to you that are progressively more difficult."

Such tutoring systems have had mixed effectiveness over the years, but more recent programs have shown significant promise. A 2014 meta-analysis of several different ITS found they were as effective in helping students learn as a person leading one-on-one or small-group instruction and more effective than full-sized teacher-led classes, workbooks or textbooks, or traditional computer-based instruction.

A separate evaluation of the Navy's intelligent- tutoring system found those who used it outperformed those using standard technical training—not just on other tests, but also on practical troubleshooting exercises. Navy staff who had been trained using the tutoring program also attempted more challenging problems and tasks than students who had been trained in other ways.

"Whether the [ITS] is like a human or not doesn't matter if it works better in some ways," said Kenneth Koedinger, a professor of human-computer interaction and psychology at

Carnegie Mellon University, who helped develop another artificial-intelligence teaching program, Cognitive Tutor. "In a system that big, you can replicate a strategy in a reliable way and try it against a separate strategy and see what works better, very quickly. You can't do that with a classroom teacher."

Yet across the board, researchers developing the programs argue that teachers are critical to making the systems work effectively. "These intelligent-tutoring systems, people always worry they are going to replace teachers," said Art Graesser of the University of Memphis, who developed the AutoTutor and ALEKS systems. "I would argue they don't, but they take over a lot of tasks teachers don't like to do: to grade papers, to cover the same skills over and over. In ideal systems, teachers will be creating the material, working with students on broader life goals."

Yet Graesser, Koedinger, and others all agree that teachers need more specific professional development in how to integrate intelligent systems into their classrooms. "Teachers can say, 'Oh, the tutor teaches X, I teach Y.' That does not work," Dede said. "It's actually a very rich kind of sharing of responsibility between the teacher and the machine. The people who build the intelligent-tutoring systems often don't understand this very well and don't provide support to teachers to implement them."

Chalapathy Neti, the vice president of IBM's Watson initiative, agreed. The Watson intelligent system has already been used to help accountants at H&R Block unravel tax law and to help oncologists at the Mayo Clinic diagnose cancers, but the system is just being launched this year in higher education and preschool. Neti said the group is piloting cautiously, while keeping teachers in the development process.

"The time a doctor has with a patient is very episodic and sporadic, but a teacher is with the student every day. We need to lay a foundation for the learner," Neti said. "We don't think of 'AI' as artificial intelligence, we think of it as 'augmented intelligence,' and we are thinking of how we improve this partnership" between teachers and computers.

Hazelwood East High School in St. Louis is a case in point: When it started using Graesser's ALEKS intelligent-tutoring system, teachers were making a virtue of necessity.

A majority of the 1,300 students there are poor and black, and the school was among the lowest performing in the state in 2010. It used a federal school improvement grant to join a pilot program to use the ALEKS tutoring system for Algebra 1, a subject in which only 6.5 percent of its students were considered proficient.

The school identified incoming freshmen who had previously performed poorly in math and required them to take a double block of algebra: One 90-minute section included traditional lecturing, while the other was a 90-minute lab with ALEKS that teachers facilitated.

"You cannot simply hand ALEKS over to your teachers and say, 'Here's a great intervention, run with this,' " said Michael Peoples, then a math instructional coach at Hazelwood. "No. You need a very clear plan and you need to involve teachers in your plan."

It took nearly three years for teachers to really integrate the tutoring system into their instruction, Peoples said, in part because the school's low performance came with tight scrutiny and high teacher turnover. Hazelwood provided collaboration time for teachers, as well as a series of training sessions—first on just the technical aspects of how to use the system and later on how to monitor students' progression and use the results to plan instruction.

As the teachers adjusted to the new system, the school's algebra-proficiency rate climbed steadily, from 6.5 percent in 2010 to 44.8 percent scoring at "proficient" or "advanced" by 2015—even as the statewide algebra-proficiency rate dipped slightly. Last year, the district launched a 1-to-1 tablet initiative and integrated ALEKS into all algebra classes, not just remedial ones.

"Our school at the time was under a microscope," said Peoples, who is now the school's assistant principal, so implementing the intervention "was not presented as an option." As teachers learned more about the system, he said, "it has birthed a movement toward more cooperative learning. We began to push more for activities that required students to engage in discourse.

"You began to hear students taking the lead more in class, presenting more, critiquing each other's work and students defending their own work, and talking through their thinking more," Peoples said. "Ultimately, there was a movement from teachers as lecturers to more of facilitators."

<http://www.edweek.org.proxy.library.maryville.edu/ew/articles/2017/09/27/how-intelligent-tutors-could-transform-teaching.html>

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