

# PRISM

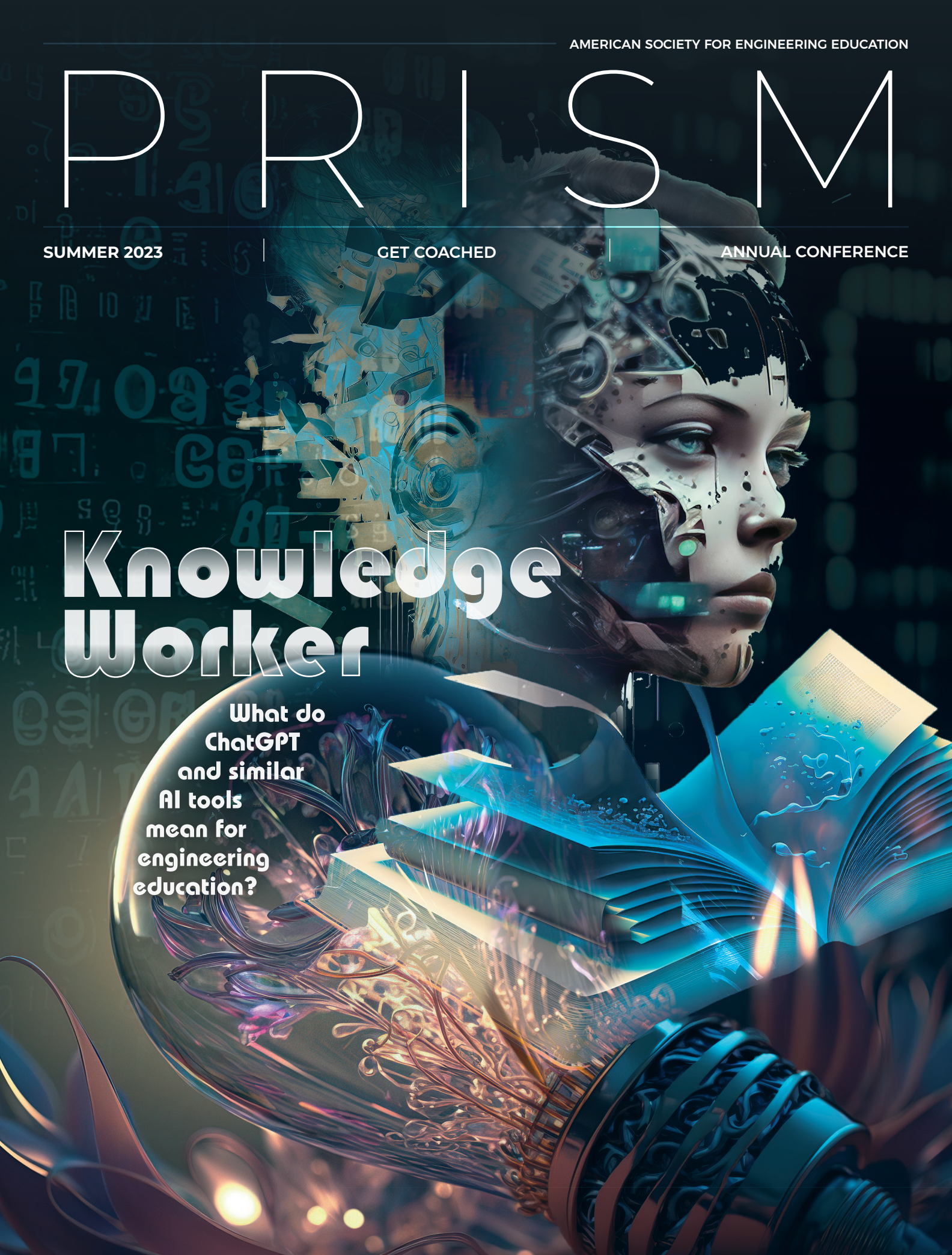
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## Knowledge Worker

What do  
ChatGPT  
and similar  
AI tools  
mean for  
engineering  
education?

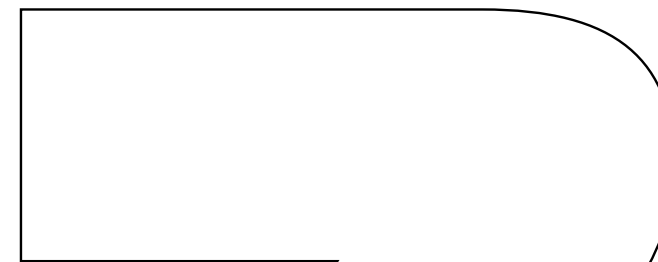




# Disruptive Influence

**Generative AI offers both a powerful temptation to cheat and a potent opportunity to learn.**

**By Thomas K. Grose**



## **hongyuan Yu**

spotted a telltale sign early this year while grading her students' work. Ordinarily not skilled writers, four of her Stevens Institute of Technology students had turned in surprisingly well-composed answers. Yu, a teaching associate professor and software engineering program director, is alert to students using artificial-intelligence-generated responses. She typically runs her assignment questions through ChatGPT, the chatbot that can churn out answers in polished prose. If a student's writing appears similar to the text generated by the tool, she'll apply an AI detector, such as Copyleaks. In this case, her sleuthing left no doubt. The students had "copied and pasted the ChatGPT answers," says Yu. When confronted, each confessed and received zeros for those answers.

ChatGPT is just one of the large language model (LLM) AI platforms that have recently taken the world by storm. Created by San Francisco start-up OpenAI and released free to the public last November, the revolutionary chatbot has since been joined in the market by Microsoft's LLM-enhanced Bing and Google's Bard. Each uses a form of generative AI that vacuums up massive amounts of text, essentially the entire written internet, learning textual patterns and relationships to be able to predict the next word or phrase in a sentence. ChatGPT can not only spew out natural

language answers to questions but also compose original text, ranging from a sentence or two to many-pages-long essays. It can also spit out basic computer code that can be copied.

Generative AI tools can either help or harm higher education, depending on who you ask. As Yu and other educators have learned, ChatGPT enables students to take shortcuts or cheat by having the bot essentially do their work. But the platform also afforded Yu a convenient detection tool to catch students copying and pasting ChatGPT's responses. Ultimately, when used with clear guidelines, generative AI can legitimately help engineering students improve their productivity.

ChatGPT, responding to an electronic prompt from *Prism*, spelled out several ways students can benefit: Its "detailed answers" provide them with "valuable insights and ideas for their work." The bot can offer "step-by-step explanations that can help them understand difficult material"; "suggestions for how to structure their writing, what content to include, and how to cite sources properly"; and a means of collaborating with peers on projects in real time. At the same time, students need to be aware of generative AI's flaws, including factual errors and confused garble, all delivered in an authoritative voice.

Besides working out classroom ground rules for ChatGPT, educators face an even bigger challenge of navigating an AI-filled world where written communication can be automated and so much of human knowledge—at least up to ChatGPT's late 2021 collection cutoff—is accessible with a few mouse clicks. How can they exploit AI's instructive potential and add value to it? And what do students still need to learn the old-fashioned way to develop the expertise required in a changing economy?

## **No escape from ai**

"You can't ignore that it exists and not prepare your students for a future that will be highly ingrained with AI," says Dan Baker, a teaching associate professor of civil and environmental engineering at Colorado State University. Andrew Katz, an assistant professor of engineering education at Virginia Tech, adds that students have an understandable desire to experiment with the tools. "The concerns are very real; I'm not trying to minimize them," he says, "but I'm a firm believer that formal education is a time for students to try things out."

Chatbots are the latest in a long line of disruptive technologies that engineering schools have learned to make peace with. An early example cited by educators is the calculator. "In the past we used to do logarithms and square roots manually. Now no one does and we use calculators," notes Carlo Lipizzi, an associate professor of engineering and a colleague of Lu's at Stevens, in Hoboken, New Jersey. He teaches and researches natural language processing, machine learning, and data science, and also chairs graduate studies in engineering management and systems analytics.

Chirag Shah, a professor of information science at the University of Washington, says the question instructors need to keep in mind is:



“What do we consider the critical element of education?” One danger with technology arises when it becomes a substitute for knowledge and skills students need. “It’s okay if someone doesn’t know how to multiply two large numbers—they can use a calculator. But it’s not so good if you have to pick up a calculator to multiply 3 times 4,” says Shah. When he asks his students not to use a calculator—to do more work—he’s trying to ensure they grasp the underlying math. He would take a similar approach to written work. “I want to be able to explain to them: ‘Why do I want you to write this by hand, even [though] ChatGPT can do it?’ Or, ‘Why do I want you to edit this even [though] what ChatGPT gave you seems so good?’ I need to give them a rationale.” Peter Stone, a teaching professor of computer science at the University of Texas–Austin, wants to ensure that his students can write essays on their own before finding ways to incorporate chatbot responses into their work.

## Detect and deter

With the emergence of chatbots, some engineering schools, such as the Whiting School of Engineering at Johns Hopkins, have moved to update their academic integrity policies to take generative AI into account. In engineering, academic integrity is just one of several key ethical considerations, which also include public health and safety. That’s why at Colorado State, for instance, ethical values are woven into coursework by each engineering instructor.

Many professors take the view that a certain minority of students will cheat. “The idea that a student can cheat on essays is not new; you can pay people now to write essays for you,” Stone says, adding ruefully, “It’s no secret that if a student cheats, it’s not unlikely they’ll get away with it, and I admit this to my classes.” Chatbots just provide a new way to do it, but their lure may be especially strong.

Technology can only go so far to fix the problem. While Stevens’s Yu quickly caught her four master’s students in the act by giving ChatGPT the same assignment, Lipizzi notes that clever students could avoid detection by engaging the platform in a more detailed conversation on a topic.

Commercial plagiarism-detection software has been available to teachers for many years now, and several companies have already introduced versions to snoop out ChatGPT. Ellie Pavlick, an assistant professor of computer science at Brown University, says some technologies use another AI model to read through the material, and some chatbot developers are considering embedding traceable statistical watermarks into anything their model writes. “But these can be easily gotten around by making a few minor rewrites,” Pavlick tells *Prism*. “The technology is getting better, but I think it will always be a game of cat and mouse.”

Daniel Khashabi, an assistant professor of computer science at Johns Hopkins, believes that “in some ways, detection is in a dismal place.” He notes that detection algorithms can’t keep up with the frequent updates of AI models, and they’re also stymied because each chatbot’s model is different, with no commonality.

As an alternative to detection, educators can revert to conducting handwritten or oral tests in the classroom. “We need to change how we set up exams,” Khashabi says. “There’s no need to give students 24 hours or a week to write up an essay or to take home written exams. It

can all be done in class.” Oral tests, apart from limiting opportunities to cheat, help determine whether students really understand the material they’ve been given to learn, some educators say.

It’s one thing to detect or deter cheaters; it’s another to instill respect for norms of academic integrity and disclosure. A third challenge is to ensure that students actually learn. Stevens’s policy on AI makes a stab at all three: yes, cheaters get a zero on the test, but the school also allows students to use ChatGPT to complete assignments, provided they acknowledge doing so and fact-check and rewrite whatever they use, Lipizzi says. Baker stresses to students the perils of falling into a habit of cheating: ultimately it can undercut their careers. It’s imperative, Stone adds, for teachers to drill into their students the notion that assignments are designed to prepare them for exams and to help their teachers determine if they understand the material. So they’re only hurting themselves when they cheat. “They may get away with it for the test, but they are not learning,” Lipizzi says. “They may get the job, but the employer will fire them because they cannot do what they are hired for.”

## Awash in code

In computer science courses and in writing code, generative AI is seen as just a new variation on a familiar theme. “Before ChatGPT, there was already so much code online that finding it and using it for homework wasn’t hard to do,” Shah says resignedly. He tells his students he’s not grading them on their programming skills, so if they copy from some online source that’s OK, as long as they cite it. “But if they don’t cite it, that’s a violation.” Similarly, Jean Mohammadi-Aragh, an assistant professor of engineering education at Mississippi State University, knows students can find sources to program the Snake Game or to calculate the volume of a tank. She doesn’t care, so long as they understand the logic and concepts needed to do the programming.

The real problem with code spun out by ChatGPT may be one of quality: it’s acceptable but not great, according to Lipizzi. For more senior students, it would be fine to use it to get a basic foundation and then fix what’s not right, he says, “but many of our beginning students don’t know how to code at all, and if you don’t know how to code, then you’re stuck with a copy-and-paste solution that’s subpar.” That won’t be good enough for companies that hire programmers, “so we need to try to get young students to avoid using it.”

Between barring the use of chatbots and accepting them as a default student accessory—the new calculator—most professors interviewed favor letting students use the technology within specified guardrails, while standing ready to deal firmly with any misconduct. Fully embracing ChatGPT and similar platforms and embedding them in courses is a work in progress, but one that Mohammadi-Aragh greets enthusiastically. “I’m definitely in the camp of embedding it,” she says. “Think of what it can do and how it’ll help industry with different tasks, and teach students how to use it.” Open to permitting ChatGPT for homework, she likes the idea of “having students see what it can produce, from essays to programs, then find errors and ways to write them differently.” She would use orals to assess students’ understanding of a topic.

In discussions among colleagues at Brown about deploying ChatGPT, “the main use case I’ve heard is having students grade or

critique the code or proofs that the chatbots generate,” Pavlick says. Khashabi says he may ask students to use ChatGPT in their research, with the caveat that whatever it turns up needs to be verified. Katz may encourage students to use chatbots to generate study questions from lecture material, while Baker is not averse to students using them for outlining or brainstorming.

## Put it in writing

The most valuable benefit ChatGPT may offer to engineering students—particularly international students for whom English is a second language—is assistance to improve their writing. Students could either have a chatbot write text and then rewrite it or have the bot rewrite what they’ve composed. “Many engineering students are poor writers,” Pavlick notes. “It might help them with writing assignments, if they avoid plagiarism, to write more fluidly. Students don’t need my level of expertise to write a paper. There’s no shame in relying on tools to help you write.”

Stone says that teachers are already comfortable with students using programs that correct spelling and grammar. ChatGPT “is the next level up,” he says—permissible as long as students fact-check everything. “I could see it playing the role of a good TA.” A lot of what engineers have to write—for example, emails or memos—is

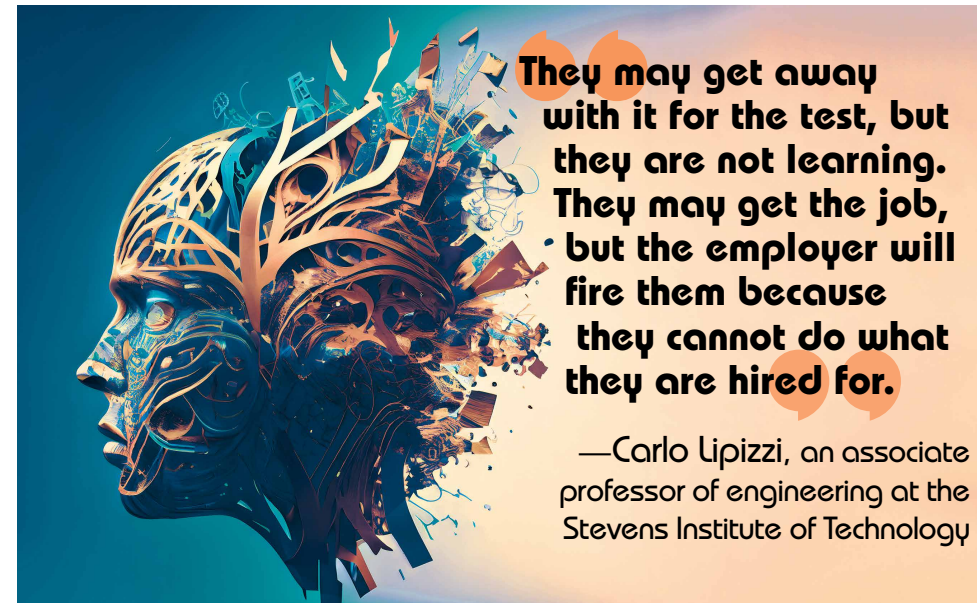
the student it was okay to use it if they wanted, but whatever they got out of ChatGPT they [would] have to verify and make sure they [could] defend every word of it.” Ultimately, the student instead used ChatGPT to improve and critique what she wrote, and Shah was happy with that. The final version was better. “But it’s hard to tell how much of that improvement was due to ChatGPT” and how much was “just iterative process,” he says.

Some instructors see a risk in students’ overreliance on chatbots to improve their writing. “I fear that, if we use it too much, it may affect learning,” Baker says, because practicing writing and organizing thoughts helps students learn. “I am not in favor of having all writing done by an AI bot because of the potential impact on long-term memory.” Katz says he’s OK with using it as an editing tool, but “if it’s writing for you, then you’re not using the thought processes that we exercise when we write.”

Overall, most instructors think that helping students use ChatGPT responsibly and ethically will prepare them for the job market and guide them toward becoming lifelong learners. “They will likely have to use this in their jobs,” Katz says. “There is a nontrivial chance they’ll have to interact with these models.” Pavlick says engineering schools can’t be in the position of tailoring teaching methods to the “latest hot trend that’s soon likely to become passé.” Overall, “we need to teach them to learn how to learn new skills and adapt, to be students who are comfortable teaching themselves new skills and who are also fluent in AI.”

*Prism* gave ChatGPT the final say on the subject of engineering students using chatbots in their studies. Chatbots, it responded, are a useful tool for students, noting that they can provide “personalized assistance, help with studying and revision, and facilitate learning through interactive conversations.” But there are risks, it warned. Overreliance on chatbots by students could lead to an erosion of their critical thinking and problem-solving skills. Moreover, it said, chatbots can provide false information and misunderstand a student’s query. Its summation: “it’s important for students to use chatbots as a supplemental tool rather than a replacement for human interaction and independent learning.” A human engineering professor couldn’t have said it better.

Thomas K. Grose is *Prism*’s chief correspondent.



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—Carlo Lipizzi, an associate professor of engineering at the Stevens Institute of Technology

very pro forma, Baker says. A friend of his, a professional engineer in her early 40s, hates writing reports, so she uses old ones as templates. “This could be the same thing, a tool that spits out prose, and you customize it.” Lipizzi says using chatbots to improve writing “may be a reasonable goal. For the assignments in my courses, I care more about the content than the prose, but I’m teaching data science, machine learning, and AI, not literature.”

One of Shah’s graduate students, while working on a research project, wanted to use ChatGPT to write a draft proposal. “I told

What are your thoughts on the use of generative AI tools in engineering education? How have you implemented or do you plan to implement the technology? Send your responses to [prism@asee.org](mailto:prism@asee.org) and we may run them in a future issue.