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Northwestern University cognitive scientist Ken Forbus demonstrates the capabilities of his CogSketch program.

Sketching a path to better education

by [Markham Heid](#)
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Four-year-old Nicholas, of Wilmette, assesses his latest piece of artwork. With the help of Forbus' software, childhood drawing skills could translate to success in fields such as mathematics, science and engineering.

“There’s his tail. There’s his legs - 1, 2, 3, 4, 5, 6 legs!”

Nicholas, 4, proudly describes his latest insect creation as he pushes a blue Crayola marker across a piece of white paper in his Wilmette home. His 2-year-old brother Oliver watches intently by his side. For the moment, Oliver withholds judgment.

“First a ladybug, then humungousaurus,” the artist says, resolutely.

Nicholas is fortunate to live in a school district willing to nurture his artistic inclinations. But, for many four year olds, their blue ladybug drawing days may be cut short.

A recent study conducted by the U.S. Department of Education found that art instruction in American classrooms has stagnated, prompting one official involved in the survey to remark that student achievement in those areas was “mediocre.” The ramifications of those findings could be significant.

“If you don’t learn to read well early on, there are ample studies showing that you are crippled all through school,” said Ken Forbus, head of the Cognitive Systems Division at Northwestern University’s Department of Computer Science. “The question is: Is there an analogous phenomenon in spatial thinking” that relates to sketching?

Forbus said spatial ability is a great predictor of whether a student will excel in the “STEM” disciplines: science, technology, engineering and mathematics.

Just a couple miles from Nicholas and Oliver’s home, Forbus is developing a software program called “CogSketch,” which he hopes will one day improve education curriculum.

“Working through ideas with sketching is a fundamental thing people do that’s not something you can do well with software right now,” Forbus said. “Software doesn’t actually understand what I’m doing. Now if the software did understand, it could actually give you help or feedback.” That’s what CogSketch is designed to do.

Forbus’ software recognizes and tracks a person’s ability to sketch or construct visual representations, such as a stick figure of a person. Software analysis could help educators monitor the development of students’ spatial capabilities based on sketching ability.

“The better you are at spatial things,” Forbus said, “the more likely you are to go into those [STEM] areas.”

Due in part to reforms implemented after the No Child Left Behind Act was passed in 2002, current education curriculum is moving away from art and other exercises that assist spatial development.

For those school districts targeted for improvement under the act, the average number of minutes per week spent on art lagged far behind the time spent on other subjects, reported a 2008 nationwide study from the Center on Education Policy, a non-profit Washington, D.C., policy institute. For example, the study found that for every 97 minutes spent on art education, 568 minutes were devoted to reading.

Children still have access to art classes, and many kids continue to sketch and draw in their free time. But once students demonstrate basic artistic and spatial abilities, the emphasis of the curriculum focuses on other areas of education and teachers are no longer tasked with monitoring spatial development.

That can happen “somewhere between 3rd and 5th grade,” said Dr. Ray Lechner, superintendent of the Wilmette Public Schools District 39. “By 5th grade for sure we’ve made the switch.”

“The way our curriculum gets decided is a strange thing,” said Dan Schwartz, a professor of education at Stanford University. Schwartz has conducted studies on childhood development related to drawing and visual representation. “Why do you get taught the quadratic equation in Algebra? You know, it’s not like you used it recently.”

Leaning over an HP tablet-style notebook computer in his Evanston office, Forbus demonstrated the CogSketch program’s ability to interpret sketches. The program asked

him to sketch and label the layers of the Earth and to note the radius of its core by drawing on the computer screen with a small stylus.

After drawing a series of crude concentric circles and labeling the various layers, Forbus estimated the radius of the Earth's core to be 800 meters. The program provided feedback on his sketch, telling him his radius fell short.

"That would be a very small world," Forbus chuckled.

The program, he said, is working from a prepared teacher's solution and utilizes a knowledge base comprising "some 50,000 concepts and several million facts."

Later, Forbus launched a video demonstration of the program's various capabilities, which include the ability "to determine the plausibility of engineering sketches in terms of functionality." Spatial development and its roots in those preschool doodles are crucial here.

Forbus said the program has two major purposes: to help cognitive scientists gather information relating to spatial reasoning and brain function, and to improve education. These two functions would feed into each other, leading to developments in both fields.

Ideally, Forbus hopes the program will give educators the ability to better monitor spatial development.

"If you know students are walking in with certain strengths and weaknesses, we can do better as educators," Forbus said. "And we're not there right now."

An invigorated emphasis on spatial development throughout a student's curriculum could translate to greater abilities in the STEM disciplines, although "could" is the operative word here.

"The correlations between spatial ability and success in other endeavors exist, but they're not very strong," said Schwartz, emphasizing the need for further research.

"Einstein presumably had this spectacular spatial ability that allowed him to do what he did," he continued. "But for the rest of us? This is yet another tool in the tool belt that allows people to express themselves ... and achieve both academically and personally."

Back in Wilmette, Nicholas puts the finishing touches on his blue ladybug.

If Ken Forbus' CogSketch software is a success, Nicholas' drawings may one day lead to much bigger things. And not just a humungousaurus.

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