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# **Inventive Minds**

## **Marvin Minsky on Education**

**By: Marvin Minsky**

**Edited by: Cynthia Solomon, Xiao Xiao**

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## Introductory Remarks to Essay 6

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Patrick Henry Winston

Schools allocate time for learning all sorts of skills, ensuring that children learn how to read, write, calculate, and perhaps name all the state capitals. But what about allocating time for learning about thinking? What would children do during that hour? How could you go a step beyond, teaching them not only better ways of thinking but how to teach themselves better ways of thinking? These are the questions Minsky addresses in his essay “Education and Psychology.”

Once, in the course of my research, I developed a mathematical expression I needed to integrate. I had taken freshman calculus at MIT, but that had been a long time ago, so I was unsure what to do. Then I remembered one of Minsky’s suggestions: when in doubt, just think about what a program would do. So instead of looking for my calculus textbook, I pulled out James Slagle’s symbolic integration program, which he wrote for his thesis that Minsky supervised.<sup>1</sup> The integration problem yielded. Minsky’s essay is all about pushing the same kind of idea down to the earliest years of elementary education: let children figure out how to make a program think, and they will have a better understanding of better ways to think because they have been led to think about thinking.

Minsky notes that one powerful idea learned by thinking about thinking is the power of naming and how naming can make us better

thinkers. He writes this about feedback: “everyone should know these ideas, but unless we teach people names for them, they’ll find it hard to think about such things, or even to learn to recognize them” (essay 6, “Education and Psychology”). My colleague Gerald Sussman, who was another of Minsky’s students, promotes the same idea. He says, “When you name something, you get power over it.” So once you have *feedback* in your vocabulary, you get power over the feedback idea. I call it the Rumpelstiltskin principle, after the fairy tale in which a miller’s daughter gains power over an imp by knowing his name.

Minsky explains that many such powerful ideas—the power of good representation, the notion of state, the divide and conquer idea, what to do when interacting with an adversary—are acquired by way of projects reminiscent of those Seymour Papert and Minsky devised when Papert developed the Logo programming language specifically for children.

Minsky and Papert favored projects involving feedback because it is a powerful idea and because children greatly enjoy programming little robots to follow a track by reducing off-track deviations.<sup>2</sup> Then a little later, the child programmers can see the same difference-reduction idea in Newell-Simon-style problem solvers.<sup>3</sup> The problem solvers apply operators to reduce the difference between where you are in solving a problem and having the problem solved. Then, having thought about difference reduction, given it a name, and noted its power, the children can use the difference-reduction idea themselves when they solve problems. They will have learned something important about how to think.

Other projects Minsky suggests in this essay sometimes seemed beyond the capacity of children younger than PhD age, but that was Minsky being Minsky—often, through conversation, surprising projects were born from his suggestions. He treated everyone the same,

totally ignoring their age, gender, and all the other things that do not matter with surprising results.

A decade after Minsky wrote “Education and Psychology,” some of the goals he suggested for educational projects, such as object identification, have been achieved by large research groups with massive amounts of computing. Deep neural nets, somewhat unexpectedly, can distinguish between cats and dogs. Minsky’s project suggestions remain in force, however, because figuring out how we humans see remains an open and extremely hard problem.

Evidently Minsky believed that perceptual projects could be made easy enough for children to work on; he was less confident about projects involving common sense. But Minsky himself often noted that what seems hard may be easy and vice versa. The cognitive projects Minsky thought to be hard might actually be easier from the perspective of what we have since learned about modeling what we humans do when we listen to and read stories about people and things.<sup>4</sup> Reading this essay on education and psychology led me to wonder how his ideas about teaching thinking might complement my Minsky-inspired thinking about the role of story understanding in setting us humans apart from other animals.

This is what I think: We have common sense, and we can reason, but commonsense reasoning is a special case of recipe following, and recipe following is a special case of storytelling. So let us encourage children not only to understand perception and action better by programming robots but also to understand how stories work by way of projects aimed at thinking about story understanding.

When I was in elementary school, I had a lot of fun diagramming sentences, and the sentence-diagramming exercises taught me a lot about sentence structure. So why not have children diagram stories? Which events cause others? What common sense rules do you need to understand “Goldilocks”? Where do you have to make

assumptions? Can you use the story, augmented by common sense, to draw a picture of how the events fit together? How can you recognize concepts, such as revenge, in the picture?

Hand simulation would go a long way; writing programs could come later with something like a Logo-for-working-with-stories language. Children could work on projects aimed at telling stories persuasively, which would help them to understand how to be more persuasive. They would also understand techniques used by others to persuade them. Projects could turn to thinking about how to determine credibility. They could build detectors for fake news. All of this would dovetail nicely with Minsky's suggestion that children learn how magic works. In one case, it is about understanding perceptual trickery; in another, it is about the kind of storytelling trickery we call either telling true stories persuasively or propaganda, depending on which side of an issue we favor. So understanding how stories work might make those children into better voters than many adults. But more important, it might make those children less susceptible, as they grow up, to the stresses of modern life.

As Minsky concludes this essay, he talks about thinking with "My" instead of "I," with the "My" acknowledging that everyone has parts and those parts can have correctable bugs. With "I," he notes, you are a single thing, with no parts you can work on separately. One aspect of this, I think, is that we all have a part that tells stories about ourselves, and that essential part is rarely bug free. We may tell ourselves disparaging stories about ourselves and become depressed. On the other hand, we can tell other kinds of wrong stories and become dangerously narcissistic. What is the cure? Maybe we should have children write programs that tell stories about themselves so that children can see what happens when their programs tell themselves the wrong kind of story. Could they

then recognize, and perhaps avoid, the wrong kind of storytelling in themselves?

I have always thought that Minsky's writings are like diamond mines—immensely full of ideas, which when cut and polished, shine refulgently. This essay on education and psychology is a prime example. It is so full of inspiring ideas that it took me several sessions to get through it, all interspersed with excited thinking about implications and what to do next.



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