

BACKGROUND ON HOW CHILDREN LEARN

By Alan Kay

Most traditional cultures haven't set up schools, nor have they needed to. Children are set up by nature to learn the world around them by watching adult activity and playing imitation games. Most of the important things concerning what it means to be a member of a traditional culture and how to make a living in it are out in the open enough for children to learn through imitative play.

Dewey pointed out that this is difficult in today's developed cultures because many important adult activities are opaque or not found in every home. Montessori thought that children's urge to learn the world by immersion and play could be powerfully used for 20th century learning if the children were placed into 20th century environments and given toys that embodied 20th century ideas. One of her special insights was that a main task of early education was to reshape the ordinary common sense that every child picks up into the "uncommon sense" that is needed as the foundation for many modern ideas, especially those in science.

Much of today's motivation for the education of children is vocational -- to prepare children for the job market. More important is the need to raise voting citizens to join the "big conversation" with enough background, thinking skills, and points of view to participate fully in a democracy that -- among other things -- uses the vote not just to choose political representatives, but to **unchoose** them (perhaps the most important part of a democratic republic).

Vocational goals argue for fairly early specialization, even in this changing world. Political education argues for a broader preparation that includes the world of ideas, both historical and modern. It's pretty clear that learning some science is quite important for the latter, even if the student's avocation has no overlap with science.

But there are larger considerations than job and citizen training. These have to do with actualizing the human possibilities that are as yet unrealized in children. With this in mind, we can argue not just for learning to read and write, but for fluent learning, and to be able to read literature and think and write about ideas. This gets to some of the older reasons for education. Deep experiences with deep ideas help grow deep people. And not just deep people, but people who are less easily fooled in a wide variety of areas.

Shakespeare had Puck say, "What fools these mortals be!" He meant not so much the modern meaning (that we are idiots and simpletons), but that we are all too easily fooled about almost everything. Anthropologists tell us that modern human types have been around for 40,000 years (perhaps as long as 80,000 years). But the "real science" that has revealed so many surprising and powerful things about the world is only a few hundred years old. We have been fooling ourselves about most things for tens of thousands of years.

Now theater and other forms of fiction work because we not only are easily fooled, but we **like** to be fooled. This kind of foolery can be very rich and some of it is very important. It would be a mistake to form children in such a way that they automatically resisted all attempts to fool them. But it's important that children are able to decide when they are going to allow foolery and to have the discernment to make these decisions wisely. For example, a theater is a dark place with lots of other people watching good looking people on stage say good sounding words, hearing good sounding music, and able to pretend that the scenery is not cardboard and that they are really immersed in "somewhere when". But we are also describing a political rally! And here, the audience had better have a completely different stance about what they are willing to go along with.

"Theater" is a good metaphor for human consciousness. The world isn't inside our head. Only representations of various kinds, most of them language like. We can believe many more things than "reality is". That is, language is "bigger than the universe" -- for example, we can describe inverse cube laws of gravity, but all

careful probing of the universe only reveals inverse square laws. This is what makes fiction possible.

A trickier notion is that even when we are describing "reality", we can at best make a kind of careful map. This is in part because we have to make the map from something that the reality being mapped **isn't**. We can describe language in language, and mathematics is the rich art form for this. So Euclidean Geometry can be completely consistent about spatial relationships of rigid bodies, but we now know that as long as our universe has one blip of mass energy, space will not be flat and Euclidean Geometry will not be "true" -- only "close" -- to being an accurate map of the real world.

Another good metaphor is Marshall McLuhan's: "I don't know who discovered water but it wasn't a fish!". He meant we are the fish and the water is our beliefs/assumptions, most of which have been with us so pervasively as to have disappeared from view. When we are "being rational", most of the time our logic is quite narrowly tied to invisible contexts. There have been many rational attempts to explain the world we live in, but only in the last several hundred years have techniques been consistently used to make the contexts visible enough to be avoided. Then, almost suddenly, we found that we live in a completely different world than most rational views proposed. Moreover, this completely different world came with newly discovered powerful "handles" that enabled us to harness energy, build better artifacts, deal with deadly diseases, make molecules that we need, and much more.

A new art form with new important ideas for thinking about the world -- called "Modern Science" -- was born.

In the dawn of the 21st century, Science and its knowledge have become extensive. A professional scientist learns only a very small part of what is now known. But all scientists learn the powerful deep ideas of Science. These are the ones that have to do about how to avoid being fooled, how to find out something with some level of confidence, how to criticize (especially in a helpful way) proposed knowledge, etc. These "metaskills" of Science are important for all humans. For vocational reasons. For reasons of citizenship. For health and nutrition reasons. For artistic reasons. For becoming a fully vested person in the 21st century.

As Frank Smith has pointed out, where there are important ideas being discussed and a writing system, a literature arises. In our history, the ideas and the writing system have often coevolved. For example, having a writing system makes it possible to discuss things in a way and "at a length and depth" that oral communication finds difficult to impossible. Having a printing press allows more complex arguments and expositions to be formed than handwritten manuscripts permit (because the galleys once proofed will be printed with verbatim accuracy). And the press allows the ideas to spread much more widely and increases the probability that they will get to someone who can take them further (or show why they are not well founded).

The 17th century brought in the start of "Modern Science" and its new ways to look at the world, probe, and discuss it. The printing press was critical for the viability and spread of this new process. Here we had new important powerful ideas and a writing system, and a literature did indeed spring up. In the 18th century, it was as important to read Newton's Principia Mathematica (about gravity and how the solar system works), as it was to read Shakespeare, Fielding, Johnson, and Paine.

As C.P. Snow pointed out in his "Two Cultures" lecture, this deteriorated even (and especially) in academia -- into the "Two Cultures" of old style "letters" (literature which included fiction, essays, and classical and modern thought, but not science) vs. the new ideas and processes of science. He also noted that it was far more likely that a scientist would be quite conversant with old-style literature than an old-style literati would be conversant with science.

In American schools today, parents and school boards would fire any teacher who was found to be illiterate (though they don't try very hard to find them), but are quite happy to have their children taught by teachers

who don't understand even one important idea of mathematics and science. In part, this is because American parents and school boards are mostly composed of citizens who are the product of American education and have no strong background in areas that were poorly taught when they were in school. And the teachers are also mostly a product of this poor education process, so most of them have no idea of what is being missed. And so on, generation after generation.

There are books about how to learn all this in the thousands of free libraries in the United States. But if you haven't learned the discernment to use libraries and don't have a hint of what you are missing, you have to be a pretty special type to find a way into these ideas by yourself. The Internet is now starting to bring the libraries of powerful ideas into the home, but most people will still need the discernment and the hints to provide the motivation for exploring ideas that require some effort to learn.

The most important thing about powerful inexpensive personal computers is that they form a new kind of reading and writing medium that allows some of the most important powerful ideas to be discussed and played with and learned than any book.

This is what our work and Squeak is all about. We are interested in helping children learn to think better and deeper than most adults can. We have made the Squeak medium to serve as a new kind of electronic paper that can hold new ways to represent powerful ideas. We have written examples of this new literature and they are published over the Internet for children and adults to "read" and play with. Readers can also become writers, because "authoring is always on". In fact, much of the learning of this new way to represent and think is best done by "authoring along with the author" in what we call "active essays". To try one of these out right away, look at "Methinks It Is A Weasel", an active essay about one part of Evolution. To go to a "home project" to choose from a variety of essays into this new literature, go to [Active Essays](#).