Science Fiction and Reality: From Star Trek to the iPad,
and some random thoughts on design in education

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Science fiction is a well-known route to the invention of actual technologies, but where do the sci-fi folks get their incentives to invent? In some cases, it comes from having to invent their way around very low budgets.

This was demonstrated through the invention of the PADD (Personal Access Display Device) for the Star Trek Next Generation series over 20 years ago (1). This device has since become quite real in the form of Apple's iPad. So what was the spark of genius that led designers to come up with such an amazing idea for a science fiction device so many years ago? As mentioned in the article cited above,

> According to Michael Okuda, original *Star Trek* art director Matt Jefferies had practically no budget. "He had to invent an inexpensive, but believable solution," he told Ars. "The spacecraft of the day, such as the Gemini capsules, were jammed full of toggle switches and gauges. If he had had the money to buy those things, the Enterprise would have looked a lot like that."
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> "We had a much lower budget than the feature films did," Okuda told Ars. "So, for example, I looked at the production process of making a control panel, and I said, How can I make this as inexpensive as possible? Having made those decisions, now what can I do to make it as

futuristic as possible?"

What could be simpler to make than a flat surface with no knobs, buttons, switches, or other details? Okuda designed a user interface dominated by large type and sweeping, curved rectangles. The style was first employed in *Star Trek IV: The Voyage Home* for the Enterprise-A, and came to be referred to as "okudagrams." The graphics could be created on transparent colored sheets very cheaply, though as *ST:TNG* progressed, control panels increasingly used video panels or added post-production animations.

"The initial motivation for that was in fact cost," Okuda explained. "Doing it purely as a graphic was considerably less expensive than buying electronic components."

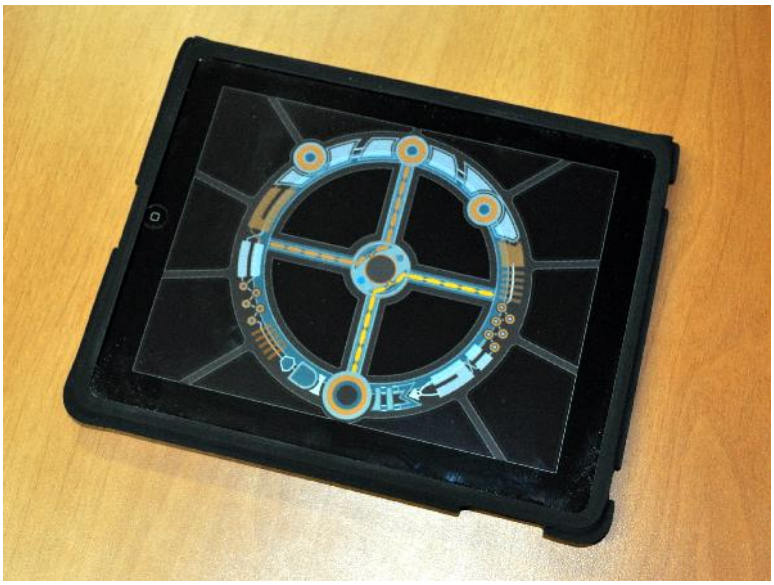
And so, by printing images on plastic sheets and gluing them to an aluminum plate, the PADD was born. The user interface was pure touch – no switches – and the PADD could show anything you wanted, and even had the "power" to control the Enterprise!

This image, from Star Trek: Deep Space 9, looks almost identical to the iPad. The device was perceived as being futuristic (and it was), and powerful (thanks to the magic of film) and surely provided impetus to those who wanted to bring the future home to reality today.

For example, the following image shows an iPad running a spaceship database application written as part of an Educational Holodeck™ mission. The Educational Holodeck™ is an

almost empty room that can be transformed into almost anything through the use of computers running specialized applications that turn the room's walls into interactive devices. This room is both immersive and interactive, and is used by students who go on missions where they have to develop and use skills in (for example) STEM fields. It seems only natural that, for our mission to Mars, students would use iPads to hold mission database applications, etc.

The previous image is from fiction, the following shows a functioning device.



This iPad image shows the main interface for the database for the ESF (Earth Space Federation) Beagle – the interplanetary spaceship used in the Educational Holodeck™ mission to Mars. This application was created well in advance of the publicly released version of *Hyperstudio* (2) player for the iPad in our ongoing quest to explore the use of powerful new technologies that can have a huge impact on education.

Without a doubt, the iPad was influenced by older visions (including those of Alan Kay's Dynabook at Xerox PARC (and before) (3,4)), but the connection between the iPad and the Star Trek PADD is just too tight to ignore – and it all came about because production budgets were tight. Necessity was clearly the mother of invention here.

This is not a new idea. Four decades ago, I developed a design methodology called "Zero Mass Design"(5). The idea behind it was that new products should not be designed by making incremental improvements of existing designs, but by starting with a clean slate. So, for example, when I set out to create an inexpensive computer graphics tablet in the early

1970's, I did not start by asking how to lower the cost of existing technologies (all of which cost over $1000 at the time). Instead, I started from scratch by asking what the easiest way was to translate pen position to x-y coordinates on a computer screen. The result, which worked well, cost only $10 to make, and is still used every time you sign your name for a charge card purchase on a screen. This one idea led to the creation of a company (Koala Technologies) and the incorporation of touch screens on products like the Apple Newton. In fact, until capacitive multi-touch technologies were developed, virtually every touch sensitive screen, from credit card verifiers to the SMART interactive white boards used the same technology, and this technology came about because I was willing to let go of the established way of doing things, and start over from nothing except the goal to produce functionality at the lowest possible cost.

The Star Trek designers also started with a clean slate. And, instead of trying to find a cheap way to replicate the spaceship controls of the time (toggle switches, etc.) they chose to do something completely new – to create a "touch-driven" system that could be carried around the ship in one hand. Their motivation was not just to imagine the future, but to design something that was amazingly cheap to use as a prop. From this simple cost constraint, we arrive, over 20 years later, with reality overtaking fiction in the form of touch-sensitive PADD-like devices that are being sold in huge quantities all over the world.

Science fiction is a powerful motivator for invention. Science fiction on a budget can be even more powerful!

And this brings me to an important point. When we think about "fine art" in K-12 education, we focus on paintings, sculpture, etc. In reality, engineering can be looked at through the same lens – as an art form. As Paley(5) points out, the key elements of a successful design are simplicity, elegance and robustness. These topics are, to my knowledge, not part of any general curriculum in K-12 education anywhere in the world. It is little wonder that we are running out of engineers. When our focus is on the test-induced regurgitation of one (and only one) view of a subject, what else are we to expect?

Acknowledgment
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References:

1. http://arstechnica.com/apple/news/2010/08/how-star-trek-artists-imagined-the-ipad-23-years-ago.ars
2. Hyperstudio - http://www.mackiev.com/hyperstudio/
3. http://en.wikipedia.org/wiki/Dynabook
4. http://www.mprove.de/diplom/gui/Kay72a.pdf
5. Paley, Steven, *The Art of Invention: The Creative Process of Discovery and Design*, Prometheus Books, in press.

About the author:

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David is the Founder and Director of Global Operations for the Thornburg Center for Space Exploration. He is an award-winning futurist, author and consultant whose clients range across the public and private sector throughout the planet.

He is engaged in helping a new generation of students and their teachers infuse STEM skills through the mechanism of inquiry-driven project-based learning.

His educational philosophy is based on the idea that students learn best when they are constructors of their own knowledge. He also believes that students who are taught in ways that honor their learning styles and dominant intelligences retain the native engagement with learning with which they entered school. A central theme of his work is that we must prepare students for their future, not for our past.

He is also the inventor of the Educational Holodeck™, a technology that is transforming the face of education in several schools.

Please contact Dr. Thornburg if you are interested in presentations and/or workshops or want to know more about the Educational Holodeck™ (dthornburg@aol.com).