From Cyberspace to Augmented Reality: Education's Ongoing Journey on the Internet

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Science fiction typically predates reality, and a careful reading of a few authors show just prescient they are. In this brief document, we'll explore the changing nature of the Internet and speculate on how these changes will impact K-12 education in the near future.

The starting point for our story is William Gibson's novel, *Neuromancer* [1] in which he coined the word "cyberspace" to describe the shared hallucination of electromagnetic signals as a "place." Written in 1984, well before the emergence of the web, this leap into the unknown was amazingly accurate, Once the web became popular with the release of Mosaic in 1992, it was most often referred to as a place: a place where information was kept, where images (and later, movies) could be seen – in short, as another world lacking only tactile senses, and as compelling as Alice's looking glass pulling us into its world.

Today we see the web as an essential tool with great utility in education. Because the web is a symmetric medium (as easy to publish as to read), myriad sites have been developed for everything from reference libraries to the preferred distribution channel for software and (in some cases) powerful video resources. With the growing popularity of the web there arose a challenge: most schools lack sufficient bandwidth for students to use this resource freely during the day. But, when one considers that the vast majority of students have web access after school, we can see why, in many homes, the web is replacing television as a destination. A drawback of the traditional view of the web is that it treats education as an enterprise based on students acquiring a body of facts, rather than as an opportunity to explore, question, test hypotheses, and move from "knowing" to "understanding." One of the criticisms of the web

is that tools like Google are too good. Because a Google search often produces relevant results to a question in a heartbeat, students are deprived of the opportunity to puzzle things out on their own.

But if the web became the universal delivery medium for Gibson's shared hallucinations, it was soon to be augmented by a different kind of on-line application. In 1992, Neal Stephenson published *Snow Crash*[2], a novel that takes place in two worlds – one physical, and one in cyberspace. Stephenson's vision of a virtual world where one could buy "real estate," and have meetings through on-line avatars, clearly set the stage for the emergence of on-line programs like *The Palace* (inactive) in 1995 and, more recently, *Second Life*[3] in 2003.

These virtual worlds are more than places to visit; they allow members to craft their own spaces within the world where they can post information, chat with visitors, etc. Because people choose their own identities and avatars for these worlds, the shared anonymity lets anyone try out different persona. One challenge of *Second Life* in a educational setting is that the virtual world is open, and it is easy to get distracted by all the places to visit, and people with whom to chat. The jury is still out as to the power of this tool in an educational setting.

Technology, as always, marches forward. The novel that set the stage for our current interest is *Spook Country*[4], another book by William Gibson published in 2007. This book (like most of his works) is about many things, but the idea most germane to our thinking is the creation of "locative art." Basically, the viewer of the artwork wears a special headset that allows artistic renditions to be superimposed on real spaces. A café entrance (while empty of real people) may appear to have a line of famous luminaries. Locative art (in Gibson's view) required very accurate GPS information so the artwork would appear in the right place. Rather than set this novel in the future, Gibson chose "just about the present," and he was right to do so.

The recent emergence of augmented reality (AR) allows anyone with a computer and webcam to experience the blend of the real with the computational worlds. Furthermore, the worlds of AR are fully interactive, not just static representations of designs done by others. AR applications can range from entertainment to education. These systems have the following characteristics:

They can be-

- Static (moves with card in viewers hand)
- Dyanamic (is a moving object)
- Interactive (viewer can manipulate the object
- Autonomous (object is controlled by someone else or artificial intelligence)

They can be viewed with-

- Webcam and viewer's computer monitor – object only exists inside of computer space
- A wearable viewing device
- Projected image (implied hologram) – object is actually seen with naked eye

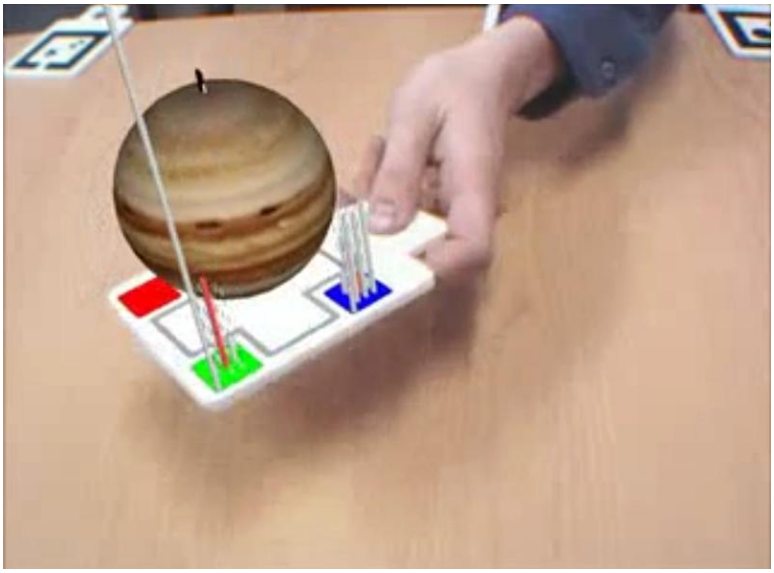
Information using AR has interesting properties-

- Data is predetermined by designer
- Data can be manipulated by viewer
- Data is changing autonomously with user
- (This progression of change also happens with other web technologies.)
    - The designer creates for an audience
    - The audience becomes the designer
    - The design adapts to the audience

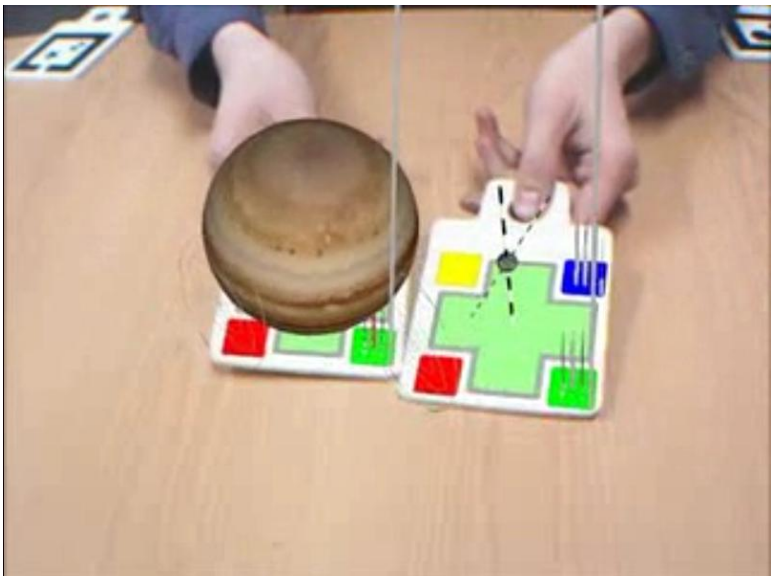
We believe that the educational application of AR represents the emergence of a new paradigm of Internet use.

The user of one of these products navigates and operates using special markers or paddles that are printed out in advance. These paddles contain special markers that, when detected by the webcam, are provided (typically) with superimposed images from the topic being studied. Rather than navigate with a keyboard and mouse, AR tools are much more versatile. For example, consider the AR application *Imaginality* from Mindspace Solutions[5]. The tool itself is installed on the user's computer, and various modules can be downloaded from the Internet. For example, the solar system model has many interesting features.

Each paddle calls up a different planet (or the sun) when seen by the webcam. The planet rotates on its axis and can be moved around, looked at from different angles, etc., all by moving the physical paddle.



This image of Jupiter contains vertical bars with more information about the planet.



When the paddles for two planets are placed close to each other, the smaller planet shrinks to the correct relative size of the larger one (in this case comparing the Earth to Jupiter.

And, there's more. An information paddle provide textual information when placed near one of the planets on the screen.

This information paddle can be brought closer to the webcam to allow it to be read with ease.

Other topics can be explored in much the same way – anatomy, DNA, the list is endless. But Imaginality is far from the only AR application with educational value.

While these technologies are still in the early stages of development, one can see where we might be headed in the future. Some informational technologies of the future were proposed in the film version of Philip K. Dick's story, *Minority Report* (published as a short story in 1956 and republished as part of a collection in 2002)[6]. The film featured many AR technologies that had yet to appear: Physical newspapers that could show changing stories as they emerged, "mouseless computing" where displayed images were manipulated using hand gestures, to name just two. By 2009, these (and other breakthrough technologies) were implemented as part of the "Sixth Sense" project at MIT by Pranav Mistry. His TED video is well worth watching to get a glimpse of our short-term horizon[7].

His system uses a webcam and small projector on a lanyard around his neck. This allows physical objects to be seen and recognized, and to have relevant images projected on them.

For example, this image of a newspaper weather map has, projected on it, the current temperatures and weather conditions for the country. For many applications, tools like this eliminate the user interface – the one barrier remaining between the physical and virtual worlds.

From this starting point, one can visualize where we might be headed next. Again we turn to science fiction for the impetus: in this case the holodeck of Star Trek fame. The holodeck first appeared in the pilot for *Star Trek: The Next Generation*[8]. It appeared numerous times since. In essence the holodeck is an empty room that can become anything you desire, for example a sailing vessel on the open ocean. People on the holodeck and then sail the ship, or do other tasks just as they would in the physical world. At a time when many classrooms have yet to install two-dimensional projectors through which teachers can show slides, this vision of the future is staggering in its implication for education. Rather than provide a teacher-centric view of education, activities on the holodeck are based on the active participation of all. There are no passive observers, no seats from which you can watch. You are fully immersed in this simulated world.

For those who think that the holodeck is implausible, the same could be said for the other technologies we have explored, each of which had its start in science fiction. Two of the major technologies required of a real holodeck are three dimensional projection, and the simulation of physical touch. Both of these have been demonstrated in research projects, and both have been merged at the Shinodalab at the University of Tokyo[9]. Thus far they have demonstrated virtual 3-D raindrops that can be felt as they hit your hand. While still a far way from the fictional holodeck, progress is steady.

As we enter the next phase of technology use with children, there is little question that augmented reality and its progeny will have an important role to play.

Interesting AR web sites:

Augmented reality browsers:

http://www.augmentedplanet.com/2010/01/wheremark-augmented-reality-browser/

Software to make AR:

http://www.metaio.com/products/

AR Design Companies:

http://www.metaio.com/

News sources:

http://augmentedrealitynews.info/
http://www.augmentedplanet.com/
http://augmentedblog.wordpress.com/

Future Thoughts / Predictions:

Education Facilitators (teachers) will view student data in AR format, much like what will become available in the sports industry: (http://www.augmentedplanet.com/2009/12/augmented-reality-and-the-future-of-sport/). Instead of a teacher having to memorize an IEP of a student, the data will seem to be floating near his or her head in an AR depiction. This will increase a teacher's awareness of each child's specific educational needs.

Question: how could the following impact Education?

Smart Packaging:
http://augmentedblog.wordpress.com/2010/01/19/augmented-entertainment/

References

1. Gibson, W. *Neuromancer*. 271(Ace Books: New York, 1984).
2. Stephenson, N. *Snow Crash*. 440(Bantam Books: New York, 1992).
3. Virtual Worlds, Avatars, free 3D chat, online meetings - Second Life Official Site. at <http://secondlife.com/>
4. Gibson, W. *Spook Country*. 371(G.P. Putnam's Sons: New York, 2007).
5. Imaginality Unleashed - Exciting Hands-On Educational Software - Virtual, 3D, Educational Objects in the Real World for fun, enjoyable learning experiences. at <http://www.mindspacesolutions.com/imaginality/iuhome.html>
6. Dick, P.K. *The Minority Report*. 103(Pantheon Books: New York, 2002).
7. Pranav Mistry: The thrilling potential of SixthSense technology | Video on TED.com. at

<http://www.ted.com/talks/pranav_mistry_the_thrilling_potential_of_sixthsense_technology.html>
8. Encounter at Farpoint - Wikipedia, the free encyclopedia. at <http://en.wikipedia.org/wiki/Encounter_at_Farpoint>
9. Touchable Holography. at <http://www.alab.t.u-tokyo.ac.jp/~siggraph/09/TouchableHolography/SIGGRAPH09-TH.html>

About the authors:

David D. Thornburg, PhD

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.

As a child of the October Sky, David was strongly influenced by the early work in space exploration, and was the beneficiary of changes in the US educational system that promoted and developed interest in STEM (science, technology, engineering, and math) skills. He now is engaged in helping a new generation of students and their teachers infuse these 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.

David currently splits his work primarily between the United States and Brazil, although he has been engaged in activities in other countries as well.

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