

Grand Challenges in Future Interactive Digital Media: One Page Summary

Creating The Next 500 Year Revolution After Printing

Introduction: The computer revolution has started, but hasn't happened yet. Like the start of printing, we are still making "Gutenberg Bibles" (which used the new press to imitate the look and content of hand written text media from the past). That is, today's computer representations are mostly used to imitate past media - texts, pictures, movies, recordings, etc. But the computer is a new medium that represents ideas in ways the old media can't, and this in turn leads to new ideas and the possibility of a new revolution in thought. In the printing revolution, the wider range and spread of ideas, and new kinds of descriptions and arguments that the press made possible - *literacy* - deeply changed European thinking about physical and social worlds to create the modern era. Real computer literacy means being able to represent ideas in dynamic "computer media" itself: to see new ideas through new glasses. The computer revolution will happen when a healthy percentage of people get fluent in the new ideas and ways to represent (write), acquire (read), learn and think. Studies of deep expertise show that it takes about 10 years of immersive effort to get truly fluent in world class arts, phi-losophy, sports and games. Most adults do not have the time or the inclination to really get fluent at activities started after childhood. Thus, as in the generations long printing revolution, the "healthy percentage" will be reached through what *children* are able to learn in the new rich environments. We start with **1.** old and new *powerful ideas* that provide great leverage and reach to human beings; **2.** create much better *representations* for powerful ideas by using new understanding of how human minds work, and new inventions in Interactive Digital Media; **3.** create new user-interfaces that can help children and adults *learn and do* the new ideas; **4.** invent fundamental new computing technologies to serve as the raw material for the next stage of the computer revolution. Each is a romantic and important "Grand Challenge" to be achieved.

1. Powerful Ideas: "Powerful ideas" give us great leverage on the physical, social and mental worlds we live in. Language itself is a powerful idea, and every known human culture has a developed language, tells stories, etc. Many powerful ideas are not found everywhere and were inventions, sometimes very rare ones: agriculture, writing, deductive mathematics, science, equal rights, democracy, and many more including the *dynamic simulation of ideas using the computer*. Stories seem intuitive to most humans, but science or equal rights do not. Education is fundamentally about powerful ideas, especially the more difficult non-intuitive ones. As a "*Dynabook*", the computer can help children and adults learn old and new powerful ideas by actually constructing them in computer stuff. This in turn will help (children especially) to think about ideas only the computer can represent. The eventual result will be a new kind of "literacy" and revolution.

2. Representations: This Challenge seeks the next qualitative stages of "complementary fit" between humans and com-puters. What if more "simple things were simple", and more "complex things were possible"? The computer is a kind of universal representor and, especially, a communicator: to others, the groups we work and play with, and more subtly, back to ourselves. It is an amplifier of both individual and collective IQ, yet its strongest possibilities are still difficult to use. There is an increasing hunger for end-user authoring and communication, but the media, tools, and ideas need much better integration, new inventions, and ways to be learned and used. Many of the technologies that made our current use of com-puters possible, especially the bit-map screen, easy to use graphical interface and end-user media, were originally invented for children, and new designs for children will again lead the way for adults.

3. User Interfaces That Aid Learning and Doing: A very Grand Challenge for our planet would be: *A Teacher For Every Learner*. What if many of those teachers could be new kinds of interfaces for personal computers? This would bridge an enormous gap, not just in the 3rd world, but in the developed parts of the world as well. The computer can hold most of the content in the world, old and new, but still requires teachers and tutors to learn it and its content. Today's stage of the com-puter revolution was fueled by the invention of the overlapping window, icons and pointing interface now used by about a billion people. It is explorable to a considerable extent, but it should also be a gentle flexible guide that can "read" enriched content of all kinds and help its users to understand and do. The "next 5 billion users" will require a great advance here.

4. Fundamental New Computing Technologies: The technologies of the first wave computer revolution - personal com-puter, bit-map screen, graphical user interface, media simulation and authoring, laser printing, object-oriented programming and systems, Ethernet, Internet, etc. - all had to be invented and tested before they could be fed into the new industrial revolution of silicon, magnetics, and robot assembly. The next wave towards the real computer revolution will also require fundamental inventions of new computing technologies - for computing, storage, displays, controllers, programming, sys-tems, and networks. Programming, especially, is a critical technology that must be greatly advanced for all levels of users, from young children through adults, from novices to professionals. An excellent Grand Challenge target for HW and SW are "below \$50 laptops" to change "have-nots" into "haves" by providing affordable and complete personal computers.