

I argue that discussions of learning and assessment should be placed in the context of the dramatic changes in our world. These changes are fueled by technology and by today's interacting social, environmental, economic, and civilizational crises. This context of change involves emerging technologies whose effects are already being felt and technologies on the horizon that can shape a better or worse future depending on how we prepare now for that future.

I want to list just a few of the most salient items that compose the context of change relevant to what students should know and be able to do in a 21st Century world. I also want to offer a wider reading list for educators. None of these changes are good or bad in and of themselves. All of them hold out potential for good or ill depending on how we engage with them.

1. The Producer/Participant Movement. Thanks to digital technologies, many more people than ever are becoming (and demanding to be) makers, participants, and designers, not just consumers and spectators. Everyday people are producing, often collaboratively, media of all sorts, science and knowledge, news, ads, and Internet interest-driven learning communities devoted to almost any topic one can imagine.

Jenkins, Henry (2006). *Convergence Culture: Where Old and New Media Collide*. New York: New York University Press.

Shirky, Clay (2010). *Cognitive Surplus: How Technology Makes Consumers Into Collaborators*. New York: Penguin.

2, The Fab Movement. The Fab Movement involves 3D printers and extractors that can make anything from human skin to houses and nearly any other physical object one can think of. The Fab movement erases the barrier between atoms and bits, since 3D reality-capture technologies can digitize an object that can then be digitally transformed and "printed" out as a new physical object. In the near future, people will be able readily to print houses for the poor or bombs for terrorism.

Gershenfeld, Neil (2007). *Fab: The Coming Revolution on Your Desktop—From Personal Computers to Personal Fabrication*. New York: Basic Books.

3. The DIY Biology Movement. The DIY Biology Movement uses low cost technologies now available to almost anyone to investigate and redesign cells, viruses, DNA, and other biological materials. DIY biologists are seeking cures for cancer in their homes, but also redesigning viruses that could have good or dire effects.

Wohlschlag, Marcus (2011). *Biopunk: How DIY Scientists Hack the Software of Life*. New York: Penguin.

4. The Amateur-Expert Phenomenon. Today amateurs can use the Internet and readily available technologies to compete with and sometimes out-compete experts in a great many domains. Credentials mean much less than they used to.

Hitt, Jack (2013). *Bunch of Amateurs: Inside America's Hidden World of Inventors, Tinkerers, and Job Creators*. New York: Broadway.

5. Big Data. New technologies allow for the collection of massive amounts of data of all sorts and its use in real time, across time, and after action for learning, knowledge building, and successful action for individuals, groups, institutions, and society at large. Data collecting devices are being incorporated into objects and even people's bodies allowing people to plan and act in their daily lives based on copious data.

Smolan, Rick & Erwit, Jennifer (2012). *The Human Face of Big Data*. New York: Against All Odds Production.

6. The Dangerous Expert Effect. Big Data and recent research have shown that credentialed experts in a great many domains make very poor predictions (no better than chance) and that their predictions get worse, not better, when they get more data. Such experts often under-value what they don't know, over-value what they do know, and look at data through unwarranted generalizations to which they are professionally attached. Networked groups of people and tools, using diverse perspectives, make better predictions.

Silver, Nate (2012). *The Signal and the Noise*. New York: Penguin.

7. Crowd Sourcing and Collective Intelligence. Thanks to the failures of narrowly focused experts (like economists in terms of the 2008 recession), there has been, in science and business, a push towards systems of collective intelligence that network diverse points of view from experts and amateurs in different fields with knowledge stored in smart tools and technologies.

Nielsen, Michael (2012). *Reinventing Discovery: The Era of Networked Science*. Princeton, NJ: Princeton University Press.

Weinberger, David (2012). *Too Big to Know: Rethinking Knowledge Now That the Facts Aren't the Facts, Experts Are Everywhere, and the Smartest Person in the Room Is the Room*. New York: Basic Books.

8. Jobs. Changes in technology—for example in generalized robots that can be programmed to carry out different functions and in tools for digital fabricating—look like they will soon remove the low labor-cost advantage that led to out-sourcing and the success of countries like China. They will dramatically change the nature of work, the types of skills needed for success, and the types (and number) of jobs available. Many

new businesses will leverage consumers and digital tools rather than workers for design and production.

Andersen, Chris (2012). *Makers: The New Industrial Revolution*. New York: Crown Business.

9. **Longer Lives.** New research in biology and new technologies—for example, digitally designing new viruses and new forms of life—hold out the possibility of greatly extending human life, some claim even to a form of “immortality”. In an already crowded world, this is good news for individuals, but, perhaps, bad news for the world.

Church, George, M. & Regis, Ed. (2012). *Regenesiis: How Synthetic Biology Will Reinvent Nature and Ourselves*. New York: Basic Books.

10. **Growing Inequality.** Inequality between the rich and the poor is growing ever greater in the United State and across the world. In the United States inequality is as bad or worse than it was in the 1890s, the Age of the Robber Barons. Class has, for the first time, passed race in terms of educational gaps. Research has clearly shown that high levels of inequality in a society lead to poor levels of health and high levels of social problems for both the rich and poor in the society.

Joseph E. Stiglitz (2012). *The Price of Inequality: How Today’s Divided Society Endangers Our Future*. New York: Norton.

Pickett, K., & Wilkinson, R. (2011). *The Spirit Level: Why Greater Equality Makes Societies Stronger*. New York: Bloomsbury Press.

11. **New Technologies for Solving our Major Problems.** New technologies are emerging and on the horizon, that have the potential to actually solve some of our most serious problems, problems such as global warming, public health, environmental degradation, energy consumption, and housing for the poor. We hear less about these because of the academic urge to stress disaster and the negative.

Diamandis, Peter H. & Kotler, Steven (2012). *Abundance: The Future is Better Than You Think*. New York: Free Press.

12. **Sustainability, Resilience, and Anti-Fragility.** The effects of global warming and other human-environmental interactions are occurring so much faster than predicted that there may not be time to leverage new technologies and practices. This has led some people to argue that it is too late for “sustainability” as a goal (which means that people and systems sustain themselves through change). We need to move to either “resilience” (people and systems adapt and transform amidst change) or “anti-fragility” (people or systems are designed actually to get better with change and chaos).

Zolli, Andrew & Healy, Ann Marie (2012). *Resilience: Why Things Bounce Back*. New York: Free Press.

Nassim, Nicholas Taleb (2012). *Antifragile: Things That Gain From Disorder*. New York: Random House.

Mainstream discussions of school reform mainly frame issues of learning and assessment in terms of a narrow focus on current technological changes (e.g., adaptive technologies and customization) and not more broadly on the interactions between technology and our fast-changing and high-risk global world. Such discussions risk being rendered irrelevant by change and, worse, forestalling the contributions education, learning, and assessment can make to saving our world and making a better long-term future for all.

James Paul Gee (2013). *The Anti-Education Era: Creating Smarter Students through Digital Learning*. New York: Palgrave/Macmillan.