Digital Media and Learning: A Prospective Retrospective

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Introduction

Recently the MacArthur Foundation released an important report on "connected learning" (Ito, Mizuko, Kris Gutiérrez, Sonia Livingstone, Bill Penuel, Jean Rhodes, Katie Salen, Juliet Schor, Julian Sefton-Green, S. Craig Watkins. 2013. *Connected Learning: An Agenda for Research and Design*. Irvine, CA: Digital Media and Learning Research Hub). This report represents the culmination of years of work on digital media and learning funded by MacArthur. The MacArthur funded work has given rise to a distinctive vision and helped launch an international movement devoted to digital media and learning in and out of school. In earlier days I was a small part of this effort exploring a somewhat different but related stream than connected learning. This paper is a reflection on the report, but only in the indirect sense that the report prompted me to these thoughts, thoughts which are often, I realize, tangential to the MacArthur report.

Optimal Human Learning

Humans learn from experience, but this does not mean they learn just by having experiences. The human mind learns through **well-designed experiences**. It finds patterns and associations across different experiences and—after lots of time, effort, and practice—generalizes these patterns and associations into the sorts of concepts, principles, and generalizations we humans capture in language and other symbol systems (like branches of mathematics).

A formula in algebra or a word like "work" in everyday life or in the language of physics is tied to a wealth of different experiences one has had and patterns and associations one has found in these experiences. A formula or word has meaning at two levels: in terms of different specific

meanings in different contexts and a more general sort of meaning in terms of larger patterns or associations one has found across those contexts. Meaning at both levels can change as new experiences—for individuals or a group—arise.

A word like "work" means different things in everyday life and in physics. This is so because it is, in each case, tied to different sorts of experiences and different relevant patterns and associations found in those experiences . Humans master a myriad of different "social languages" (social languages = different varieties of language associated with different functions or identities, like being an everyday person, a physicist, or a hip-hop fan).

The mind is **social** because we humans can each find a wide variety of different patterns or associations in our experiences. We humans are powerful—actually over-powerful—pattern recognizers. Thus, we need help from mentors (in families, communities, groups, institutions, and cultures) we need help from people who are more advanced than we are in their experiences. We need help to appreciate what patterns and associations we should be looking for. We need help to have the experiences that will best allow us to start and stay on a good path to find the "right" patterns and associations or good approximations to them. The patterns and associations important to a family, community, group, institution, or culture are stored not just in the minds of people but in social practices that design, guide, and mentor learning. Such social practices also norm everyone, new or old, to keep to the patterns and associations that ensure the group continues to function successfully.

This social process of learning and norming is "conservative" in that it offers a certain resistance to innovation and change. This is necessary for sustainability. But innovation and change inevitably come, nonetheless. They come because newcomers with different brains, bodies, and behaviors enter; old-comers have new experiences or interpret old ones in new ways; and the world changes and requires new ideas and practices.

Humans learn socially through well-designed experiences. But what constitutes a well-designed experience? Well-designed experiences for newcomers often have the following features:

1. The experience is designed, mentored, and monitored by a "teacher" (or "teachers") who ensure the newcomer is safe, has trust, and can risk failure in the experience without too great a cost. Teachers and teaching can take many different forms.

2. The newcomer has an action to take in the experience, has clear goals, and has a clear sense of what counts as success.

3. The newcomer cares emotionally about the outcome of the action. It matters.

4. The newcomer is helped to know what to pay attention to and what to ignore so that he or she is guided to a good path for finding helpful patterns and associations.

5. The newcomer is given on-going, copious, and helpful feedback.

6. After acting for a while, the newcomer gets to discuss his or her plans, strategies, and actions with others, new and old, to compare and contrast, to reflect and make new plans and strategies.

7. The newcomer is offered different models of what counts as a good performance and, perhaps, what counts as a bad one.

8. The newcomer is helped to succeed beyond his or capacity, but this help models what the newcomer should eventually do by him or herself.

9. The newcomer is given whatever good tools are available that will help with the task.

10. The newcomer is given language (oral or written) to help, but is given this language "just in time" (a small amount when it is needed and when it can be applied and tested) or "on demand" (a large amount when the newcomer is ready for it and wants and needs it).

11. The newcomer is actively helped to learn a social language (words and phrases and other symbols) that represents and regiments the experiences he or she is having and the emerging patterns and associations that she or he is hypothesizing or discovering in a particular domain of learning.

12. The newcomer is assessed on multiple variables sensitive to different sorts of growth across time (which can be "U-shaped", that is go up, then down, the up again) and which are useful for planning new and better goals and actions.

13. As newcomers advance, they are encouraged to learn to rethink goals, question things, innovate and not just imitate, and to take active control of their own learning.

14. As newcomers advance, they are encouraged to contribute back to the group (family, community, social group, institution, or culture) based on their learning. Their learning is "assessed" partly on how well they can contribute to the goals and outcomes of the group. This assessment is based on indigenous norms, standards, and values of the group: norms, standards, and values the newcomer has been expected to learn and share as part and parcel of all learning in the group (i.e., most learning has a value-laden, normative aspect).

Any force that ensures these features of optimal learning are met I will call a "teacher" (this may be a parent, more advanced peers, other adults, teachers in school, or even, today, various technologies). Eventually newcomers learn to do many of these things for themselves, to become their own teachers. And, of course, they learn how to request them from others when they need to learn new things.

Talk in Interaction

One of the most important parts of designed experiences for learning is **talk in interaction**. Newcomers learn a good deal about how to interpret (focus on, edit, and apply) their experiences and how to think about and organize patterns and associations in experience from talk with others, both "teachers" and fellow learners. When this talk is interactive and in context, the

newcomer sees how to apply words in specific contexts and how they apply differently across different contexts. The learner even learners how to guess what meaning a word might best be assigned in a new context.

The contexts in which interactive talk good for learning occurs should be replete and redundant enough to display meanings somewhat (but not too far) beyond the language level of the newcomer at the time. All learning is a form of language learning, learning a new "way with words" that a family, community, group, institution, or culture uses for specific purposes, work, functions, or identities. Humans never finish with language learning.

Skills and Success

When we turn to the world of schools and society we enter a vexed arena. We want children to be successful in school and society, but we disagree about what constitutes or should constitute such success and how it is changing in the 21st Century. Nonetheless, there are things we know here apart from all the controversy. We know that skills that have been referred to as "non-cognitive skills" correlate with success in school, society, and life even as things change.

Non-cognitive skills are things like the ability to engage in delayed gratification, to accept and look for challenges, to persist past failure, to adapt to change, and to have a healthy but realistic confidence in oneself that can resist setbacks and problems. These non-cognitive skills are often formed early in life. They are formed by "attachment parenting" or what is better called "attachment mentoring", because parents do not have to be the ones doing it.

Attachment mentoring involves lots of nurturing, sustained, and interactive talk with children and lots of guided, interactive activities. In fact, it involves "teaching" in the sense defined above: ensuring that the optimal features for learning are present in a child's socialization. When children do not receive attachment mentoring they often show signs (mental and physical) of stress—a phenomenon not uncommon among poor children and one becoming more common among children of the wealthy who are viewed more as investments and models of achievement than children.

Children who get attachment mentoring develop non-cognitive skills. These skills correlate with success in school and society more than does IQ. Further, such non-cognitive skills are malleable. They can be acquired later if stress is reduced and "teachers" design conditions for optimal learning in or out of school. However, a focus on attachment mentoring and non-cognitive skills demands that we see interventions for children and even adults as about life both in and out of school—in homes, communities, and society, as well as in schools, and not only in schools. A child hurt and abused out of school will not often flourish in it; a child hurt or abused in school will not often flourish outside it.

Digital Media, Learning, and Equity

My own work and that of many others has pointed out that today, thanks to digital media, the conditions for optimal learning are often available outside of school in homes and in popular culture. Indeed, popular-culture activities have become more complex and also more linguistically and cognitively demanding than they have ever been before.

The changes that have been most important in digital media and society are ones that have led more and more people, young and old, to be (and want to be) participants not just spectators, producers and not just consumers, and experts even without formal credentials. Digital tools, often associated with people organizing themselves into **"affinity spaces"** (affinity spaces = Internet or "real life" sites where people organize their own active participation and production around a shared endeavor, interest, or passion and shared goals, norms and values) allow people to collaboratively engage in their own designs, critique, and discussions of news, games, media, science, policy, health, civic participation, or any other domain or topic one can imagine. Affinity spaces often are not age-graded (all ages are welcome), contain both newcomers and experts and everyone in between, and contain people who have achieved mastery with or without formal credentials. In such spaces, leadership and mentorship is often flexible, some days one leads or mentors, other days one follows or gets mentored.

It has missed next to no one's attention that digital tools and affinity spaces organize learning in ways that are often powerful, but that are quite different than the way learning is organized in school. It is also commonly mentioned that the skills picked up via digital tools and affinity spaces are often different from skills picked up in school. Furthermore, they are sometimes argued to be skills more attuned to 21st Century changes and needs. Finally, because this out of school learning is commonly tied to popular culture—or at least to people's non-institutional identities—it is often argued that there may be deep problems in moving such learning to schools as institutions seen as hostile to popular culture.

The rush to demonstrate the optimal learning going on via digital media and affinity spaces has led sometimes to a romantization of digital media and associated affinity spaces. We have lots of good examples of digital media and good learning, replete with hope, but there are just as many or more bad examples of digital media and stupidity, replete with peril. This is nothing new. Any media—most certainly including books—can lead to good, bad, or much of nothing depending on how, when, and where they are used. Any social group—most certainly including churches—can lead to equity and access or in-groupism and tribalism, some of which leads to narrow-mindedness and even to hostility to others.

It has been a great hope of everyone concerned with the ways in which digital media can enhance learning that technology-rich learning will close our worrisome and long-standing equity gaps—the gaps in literacy, learning, and technology, especially in school, between the rich and poor. I would argue that technology-rich learning cannot close these gaps or even close the emerging digital participation gap which technology itself is helping to create. Something else can, but that something else would require a political will missing in the United State today.

What is the digital participation gap? It is a gap between the rich and the poor, but it is not a gap that can be solved by equipment. While it is true that poor kids have access to less and less good technology, solving this problem will not get rid of any or our equity gaps. We can see this if we look at books and the reading gap before we look at technology (really, other technologies, since literacy is a technology).

We have long had a reading gap. Poor kids learn to read less well than rich ones. Just giving

poor kids books does not begin to close the gap. How much good giving books does—even if it

does any good at all—depends on what you DO with the books. The same is true of computers,

video games, and other forms of media and multimedia. It is not what you have that matters, but

what you do with what you have and who you do it with.

What makes books good for preparing for and doing well in school? Many things, of course, but

two are most important. First is interactive talk of a certain sort. Second is experience of a

certain sort. Both talk and experience—two key elements of learning we discussed above—are

crucial to book-rich learning. They are, as we will see, crucial to technology-rich learning, as

well.

The sort of interactive talk around books that is good for school and good in school is sustained

dialogic talk that: a) stresses connections among books and the world; b) stresses thinking about

thinking and language about language ("going meta"); and c) that helps young people read like

writers (Why is this written this way? How would I say it, write it? This is a form of "going

meta").

The sorts of experiences that are good for and in school are ones that give a learner what I call

"situated (or embodied) meanings" for words in oral and written language. Any language like

English is composed of a great many different styles of language (or what linguists call

"registers" or what I have called "social languages" above). These styles are things like the

"language of law", "the language of physics", the "language of video gamers", "the language of

street gangs", and so on through a long and ever growing list. School and life are about learning new styles of language tied to new identities and new activities as we learn new ways of being in the world.

If a person can associate images, actions, experiences, goals, or interactive dialogue with words, that person has situated meanings for those words. If a person can only associate other words (definitions, paraphrases) with words, then that person has only verbal meanings for those words, not situated meanings.

If you try to read a video game manual before you have ever played a game, you can, at best, associate definitions and paraphrases with the words in the text. The manual is boring and close to useless, when it is not simply inexplicable. If, however, you play the game for hours—you do not have to play at all well—then when you pick up the manual again everything will be clear.

Now you will be able to associate images, actions, experiences, goals, and dialogue from the game with each of the words in the text. You will have lived in the world the manual is about and will know how the words of the text apply to that world to describe it and allow you to solve problems in it.

The same thing is true for any text, for example, for a middle school science text. If you have lived in (mucked around in, played with) the world it is about and applies to, you have situated understandings for the words in the text and can use the text to facilitate problem solving. If you have not had such experiences, then all you have, at best, are verbal meanings. These may be

fine for passing skill-and-drill paper-and-pencil tests, but they are not fine for deep understanding or problem solving.

Because situated meanings are important for real understanding and problem solving, today most games build the manual right into the game. The game gives language "just in time", when you can immediately put it to use and see how it applies in the virtual world. Or it gives language "on demand", when the player needs it, wants it, and can cope with large blocks of it out of the context of the game (as, for example, with the virtual encyclopedia that comes with the game *Civilization*). Language should work the same way in school: just in time and on demand.

Knowledge is not pure thought. It is thought and the work of inquiry translated into appropriately communicative styles of language (like the special languages of literary criticism, video games, law, anime, or physics). So technology-rich learning is always and also language-rich learning. We cannot close the digital gap without closing the literacy gap and we must close them together.

Learning to use any technology—whether this be video games, digital video, digital fabrication, social media, blogs, web quests, or anything else—is a "literacy" in the sense that, just as with books, we need to learn to "read" (consume meanings) and "write" (produce meanings). There are ways to "read" (play) video games that lead to success and ways that do not. There are ways to "write" them well or poorly.

In fact, for video games, "reading" (playing) is already a type of producing (thinking like a designer). Good gamers must think critically about how a game is designed in order to leverage that design for their own goals. But that is true of books too: good readers read like writers (designers).

There are ways to "write" video games, to design them. In fact, today many video games come with a version of the software by which they were made and players can "mod" (modify) them, redesigning small or large parts of the game. Such "writing" (modding) is the higher value-added end of gaming. It can lead to 21st Century skills with technology.

But, then, writing has always been the higher value-added end of print literacy. Unfortunately, both writing and modding tend to be the preserves of the more privileged kids, though popular culture today does offer more kids the opportunity to write (e.g., fan fiction) or mod (e.g., interest-driven web sites devoted to fans of a give game) than ever before. However, less privileged kids often need mentoring to enter these sites and often, too, need higher literacy skills.

When I say experiences in the world are the foundation for situated meanings for language, I am pointing to the importance of images, actions, goals, and dialogue. I am, in a sense, repeating what Paulo Freire said long ago when he argued for the priority and importance of "reading the world" to "reading the word".

So back to our question: Can technology-rich learning close the digital gap? The answer is no, no more than books can close the literacy gap. These gaps are caused by a lack of access to sustained interactive talk with adults and more advanced peers; to practice with diverse styles of oral and written language, including academic styles; to attachment mentoring; and to well-designed, well-mentored experiences in the world.

The learning factors we have discussed are most effective when they start early in the home well before school has begun. Their absence is extremely hard to make up for when they have been missing early, though it is not impossible. As a country, if we want to close gaps, we need to ensure that all children get these factors early in life. They are the foundations of learning, language development, school success, and success in work and in society as an effective civic participant.

Early and late, we need to use books and technology—anything we can get our hands on, well integrated—to give learners situated meanings. These are the meanings that give people power over texts and the world.

Our current paradigm of schooling, which stresses age-grading, assessing by standardized amounts of time, and texts torn out of the worlds they are about, are not up to this task. That is why we still have the gaps in the first place.

Passionate Affinity Spaces

Today, out of school in popular culture, young people (really everyone) can enter a new and different educational system. They can enter what I will call the "passionate affinity school system". This system is technology-rich, language-rich, literacy-rich, and socially-rich when it operates at its best. At its best it is a gold standard to which schools can aspire and which can help us think about real paradigm change for school.

For any interest you can think of—making digital video, designing all sorts of things, women's health, pet care, video gaming, fan fiction, citizen science, robotics, anime, and many more—people today can enter interest-driven web sites to discuss, interact over, and produce things in the service of this interest. Better yet some people on these sites gain a real passion for this interest, put in thousands of hours of practice, and become real masters of the domain—often better than credentialed experts. On such sites people are helped and mentored to fan their interest into a real passion that fuels lots of practice and growth towards mastery.

These sorts of interest-driven sites I call "passionate affinity spaces" because everyone in them is there, not because of their age, race, background, or skills, but because of an interest that might be fueled into a passion. They have an affinity for others with this interest and respect for the passion even if they choose to stay at the level of interest alone. They come to share common goals, values, skills, and endeavors. Their differences in life experiences are leveraged for the good of the space as it pools difference to create an expansive collective intelligence that draws on far more experiences and skills than any one person or one type of person could have.

To take one example of a passionate affinity space: people young and old using 3D software of various sorts on various web sites to design (and sometimes sell) virtual clothes, houses, furniture, and landscapes for the video game *The Sims*, a life and community simulator and the bestselling video game in history. Thanks now to digital fabrication tools, by the way, any of these virtual things could be or soon will be able to be "printed" into real objects.

In passionate affinity spaces age does not matter. Time does not matter. What matters is interest, passion, practice, mastery, talk, shared experiences, feedback, mentoring, production and not just consumption. Leadership is porous, on some days a person leads or mentors and on other days he or she follows or gets mentored. People construct tutorials and learning for each other and they discuss, negotiate and set high standards. They pick up 21st century skills—skills like the ability to design and innovate, to collaborate, and to deal with complexity, technical information, and new technologies—in the context of clear actions and clear goals fueled by interest or passion. On a design site for *the Sims*, people use a plethora of specialist language concerned with *the Sims*, design, and software, but their understandings are always situated in experiences, interactions, and mentoring.

Books and digital technologies can be tools for better social interactions, richer experiences, and new styles of oral and written language. When they are such tools, then learning is rich and it is not only the rich who learn. When they are not such tools, they can create gaps, but they cannot close them.

This view of passionate affinity spaces is really just a vision. For each good, healthy, nurturing passionate affinity space on the Internet, there are bad, rude, and un-nurturing spaces. People who care about designing better learning for "academic content" in or out of school need to improve and improvise on passionate affinity spaces and adapt them to new settings.

However, as we think about new ways of learning in school, we have to think also about what we mean by "academic content". An academic area—like physics, biology, or literary criticism—is not a body of facts or information, though academic areas are usually treated this way in school. An academic area is a set of practices, activities, and goals—with associated norms, standards, and values—that are used to produce knowledge in a given domain. Facts are used as tools— along with many other sorts of tools—to engage in these practices and activities. Facts are also the result of knowledge building activities and newly discovered facts become new tools for problem solving. Furthermore, facts are always open to revision in a knowledge building enterprise. "Content" in school should be problems to solve and good tools with which to solve them (including collaboration as a tool).

Academic knowledge building enterprises are social and collaborative in the sense that claims to know must always be open to critique, revision, and assessment by others. Furthermore, in any knowledge building enterprise we are expected to build on what others have done and let others build on and revise what we have done.

Today, knowledge is being built in academic disciplines in different ways than it has been before, with different disciplines being transformed into integrated trans-disciplines centered on

a grand theme or hard challenge and shared tools. Furthermore, there are now a great many

knowledge building enterprises outside the academy in businesses, institutions, and even in

affinity spaces where amateurs sometimes become experts without formal credentials. Because

of these changes, we need to broaden the context or "frame" of our discussions of learning and

assessment in school and society. It is to this issue that we now turn.

What We Measure

Education needs its own sabermetrics revolution. Sabermetrics started as a movement where

amateurs demonstrated that official baseball statistics measured the wrong things. The new

statistics came to impact the decisions of scouts, coaches, and the front office. The amateurs

beat the experts and some of them got hired by the teams as a new class of experts.

Sabermetrics was an early example of phenomenon that is now pervasive. Thanks to new digital

technologies, amateurs without credentials are competing in many different areas with

credentialed experts and sometimes beating them. Everyday people are using digital design tools

to make their own media, ads, news, science, and art. They are using computers to design

objects of all sorts and printing them with new 3D printers and extractors. Businesses—but not

yet schools—are asking their consumers to help them design and produce.

In another piece of bad news for credentialed experts, research with Big Data and better models

for prediction have shown that in most areas—such as economics, research, and policy—experts'

predictions are often no better than chance. Worse yet, experts' predictions often get worse with

more data, not better, thanks to their false confidence in their disciplinary-favored

generalizations. Networking amateurs and experts with diverse backgrounds and viewpoints with each other and with smart tools has turned out to be a better way to make predictions and even to make new discoveries.

Networking people and tools is done in the service of collective intelligence. A now well-known example is the video game *Foldit*, a game where players tackle the hard problem of protein folding. *Foldit* presents players with a model of a protein, the pieces of which they can fold by using a variety of tools. The game scores the player on how good of a fold the player has made. Scores are uploaded to a leaderboard, creating competition between players from all over the world. *Foldit* results have been published in prestigious science journals, including in the leading science journal *Nature* in a paper with thousands of authors, a first for the journal.

In official competitions *Foldit* players have in some cases beaten scientists' super computers in the search for correct protein structures. In 2011, *Foldit* players helped to decipher the structure of the Mason-Pfizer monkey virus (M-PMV) an AIDs-causing monkey virus. While the puzzle was available to play for three weeks, players produced an accurate 3D model of the protein in ten days.

Collective intelligence spaces like *Foldit*—or *Galaxy Zoo* where amateurs have discovered new types of galaxies unknown to professional astronomers—often come with an affinity space where members mentor each other and design tutorials and curriculum for each other. Indeed, even apart from collective intelligences spaces designed by scientists to let amateurs help

scientists, the Internet is full of passionate affinity spaces where people organize their own learning around a passion and often become masters of a domain.

So are we measuring the right things in education? How are education experts and their predictions faring as we enter yet another round of standards, accountability, and reform? Are we empowering amateurs—including our students as amateurs—in education? Are we leveraging collective intelligence at the level of policy or research or, indeed, even in the classroom? In an age where people, young and old, want to be empowered makers and participants and not just passive consumers and spectators are we joining the "maker movement" in our schools and new standards?

Broadening the Frame for Discussions of Education

The context in which we carry out discussions of educational reform is often very narrow. Yet we live amidst dramatic changes in a global world replete with risky interacting complex systems that threaten to destroy us. Global warming, environmental degradation, growing massive inequality, and rapid technological changes—for example new tools to redesign viruses and make new forms of life—all set a context that I argue is relevant to what young people should know and be able to do in the future, if they are to have one. It does no good to beat other countries at algebra if your school is under water or out of water thanks to global warming.

Education is fundamentally about making human beings—who, as we well know, can be quite stupid if left to their own fears and prejudices—smart. But in an age of complex crises and dramatic changes in technology and science don't we have to transform our ideas about what

makes a person smart? In an age of amateurs competing with experts, people organizing their own learning, and collective intelligence, I would argue that it is time to see human minds not as individual smart devices put as "plug and play" devices that are at their best when they are collaboratively networked with other people with diverse skills and viewpoints and with smart tools all working together on hard problems. But if this is the sort of intelligence we want to produce—and maybe even need to produce to save our world—then we are clearly not now measuring the right things in education.

Big Data is one tool that will lead to demands to change how and what we measure in education and a tool, as well, that can help fuel our own sabermetric revolution. With new information – gathering digital tools—tools that now even be embedded in objects and bodies—we will be able to measure growth across time in regard to multiple variables across millions of people. In the act we will discover diverse trajectories to mastery in different domains, we will use data to empower learners to theorize their own learning and problem solving, and we will use the same data, represented in different ways, to help teachers and leaders resource individual learners and smart networked teams. The "drop out of the sky", single measure, standardized test will be a relic. New standards—more attuned to and validated by the indigenous development of people and collaborative networks—will arise. Or, I should say, this will happen if we want education to be a participant in the salvation of our imperiled world and not a spectator of its demise.

Connected Learning

It has been popular for quite some time now to stress that schools must make connections to students' own interests and backgrounds and encourage students to do so as well. Today, thanks

to digital media, young people are participants in more groups than ever. Thus, they bring to school ever more and new "cultures" to which the school needs to bridge and be sensitive. Many young people today actively bridge and connect their own interests, values, skills, and multiple social identities to each other and often even to school or academic interests defined more broadly.

The importance of such connecting and bridging has been central to the MacArthur Foundation funded work on digital media and learning. And, indeed, such connecting and bridging is crucial for reforming schools and creating equitable access to learning and to trajectories towards societal success outside of school.

However, all learning in and out of school also has and should have a "new horizons" aspect. We are often expected to expand our horizons and become new types of people and in the act perhaps even critique our earlier social groups and social identities. This process is all the more important in a fast-changing, high-risk global world. It should be a core part of modern schooling for the 21st Century.

Stressing how to make and build on healthy connections across interests and social groups is crucially important. Knowing when and where connections are not helping or are even hurtful is important too. And knowing when to sever connections or to create new ones is crucial as well. Young people need to be savvy about the **social geography** of their lives and their society, about the networks and connections that empower or limit, that help or harm. They need to be savvy about how to negotiate and transverse this geography even as its shifts, transforms, and changes.

Progressive pedagogies stress immersing young people in rich environments with minimal amounts of overt instruction. They focus on the learner and his or her interests. Traditional pedagogies stress overt instruction and goals set by teachers. We educators often behave as if these are the only two choices. Furthermore, liberals in their rush to disown traditional pedagogies disown direct instruction and overt adult interventions, despite the fact that both are very much part of the mix in rich digital and affinity-space learning out of school. Indeed, the point is: it's a mix.

It is core to much sociocultural-sociohistorical theory on learning (i.e., work inspired by Vygotsky) that "teachers" in a sense dominate newcomers' interpretations of what they are doing. They take up the newcomers' early activities and incorporate them into their own so as to model success and the meanings of language. They instruct in a context of early joint success, a dance where the "teacher" often leads, as a path to eventual individual accomplishment.

There is a crucial role of teachers as designers of experiences good for learning. As in a good video game, this is not "anything goes" learning controlled by the learner (player) or "do what you are told learning" controlled by the teacher (game designer). It is, rather, a mutual, collaborative, social act in which, nonetheless, there is an "instructor", "teacher", and "designer", at least at the outset.

Such learning is neither progressivist or traditional. It is what I have called "post-progressive learning". There are times where it builds connections, there are times when it blocks them, and

there are times when it makes new ones. After all, the best learning is often a new game for a new day.

There is also another sense of making connections that is important for the future of work on digital media and learning. Work on digital media in the lives of young people in and out of school needs to be connected to and integrated with work on child development, language and literacy development, modern theories of the brain, society, and learning, and with the growing work on collective intelligence, Big Data, and the massive on-going transformations in our complex and imperiled global world. As in other areas of science today, this one calls for a trans-discipline.

Note: For research and references relevant to the claims in this piece, see: Gee, J. P., *Situated Learning and Language* (Routledge, 2004); Gee, J.P. & Hayes, E.R., *Women as Gamers: The Sims and 21*st *Century Learning* (Palgrave/Macmillan, 2010); Gee, J.P. & Hayes, E.R., *Language and Learning in the Digital Age* (Routledge, 2011); and Tough, P., *How Children Succeed* (Houghton Mifflin, 2012). The Appendix below gives a wider array of references.

APPENDIX

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.

Wohlson, 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 & Erwitt, 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). *Regenesis: 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.