

EXCERPTS FROM THE COLUMN,
“THE NEW GUTENBERG REVOLUTION,”
BY RAND J. SPIRO

The New Gutenberg Revolution:
Radical New Learning, Thinking, Teaching, and Training
with Technology.... Bringing the Future Near

Rand J. Spiro

GOOD-BYE GUTENBERG: INTRODUCING THE COLUMN

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A millennial opportunity... and just in time

This is the ultimate in *propitious moments*, a millennial opportunity that finds a fortuitous convergence of technological leaps and urgent educational and societal needs. A fundamental premise of this column is that the present is the merest of preludes to the future. So it will be toward the future that we will look. And instead of starting from where we are now – a place so likely to be supplanted in a short span of years - our gaze will instead be guided by a prospective analysis of where our needs might ideally take us and what affordances educational technologies might have to meet those needs. The goal is to set the stage to *leapfrog* over some of the missteps that naturally occur when we are too bound by our present lenses.

At the same time, although we will unflinchingly focus on – and hope in some way to shape - the radical changes ahead, we will do so in the most reasoned and sober manner. There will be no starry-eyed whimsy or baseless speculation. We are professionals in fields of education, design, training. I was educated as an experimental cognitive psychologist, and I am a firm believer in the need for evidence (although I will argue in columns to come that we need to broaden our conception of what constitutes good evidence in educational technology, that this field requires new ways to think about “proof”). We are going to examine horizons; but we are also going to keep this venture firmly on the ground upon which we stand.

So, that caveat recorded, I will argue that the change to come will be at the most fundamental level of *how* people think and act – and that thought and action down the road will in many ways be as unrecognizable to the present day eye as the technologies will be that support (and, in prior turn, *shaped*) thinking and acting. This is going to be *bigger than Gutenberg*.

An example: Those big sci-fi brains of the 50s are coming back

Consider just one example. In the past, when I found myself in a situation that made me curious about some bit of additional knowledge that I lacked, perhaps one time in twenty I would write it down to check later. And then I might actually go ahead and pursue, oh, maybe one out of twenty of those. Today, pretty much wherever I am I have a wireless high-speed connection, and I've become pretty adept at Google searches (finally – lots to teach and learn here) – and I look up *everything*. Millions of people find themselves with high-speed, wireless connections to the web and powerful search engines like Google. And they are starting to do the same thing. Kids who aren't doing this already will be soon. (We'll leave the digital divide aside for now – but as I will argue in a future column, I think technology is going to help to erase the economic divide, not entrench it further).

And that knowledge you seek – to satisfy your curiosity, or to help with a problem, or to fill an inferential gap in text – is going to *stick*. Because it is not arbitrary. You are encountering it in a context that has sparked your interest and which will provide a comfortable cognitive resting place for it in memory. Because the new information is embedded in real contexts, it is more likely to be non-inert knowledge, built for appropriate application in the future. And beyond the increase in meaningfully knowledge, *habits of knowledge enrichment* will begin to form, partly because it's so easy to do, but also because it's so much *fun* to find answers to questions you are curious about, and to feel the empowerment of being able to do it all by yourself. And the more it happens, the more it is likely to happen; the more things you have to link to, the more links that will be made and the more new ones that will be suggested. And on and on. Of course, having a ton of contextualized knowledge is just a part of a larger cognitive and social-cultural apparatus with which everyone needs to be equipped. But it's a heck of a start.

For the next generation of children who grow up assuming that knowing what they want to know, when they want to know it, is their birthright, it will become as natural as walking. An explosion of context-sensitive acquired knowledge. Do you remember the old science fiction B-movies from the 50s, where super-intelligent beings from other galaxies often came with hydrocephalic-appearing skulls to hold all their knowledge? Well, it's not too far-fetched to picture ourselves a generation away from such beings walking the planet – except they will be home-grown and have much more felicitous physiognomies than their imaginary sci-fi precursors.

Can you imagine what people will be able to do with so much knowledge (assuming ways are found to store, access, and adaptively harvest it)? I'm not sure I can. But I think it's a development that's on its way, so this is the time to start *talking* about it. What is going to be the impact of that many-fold increase in grounded knowledge? How do we teach people to search more effectively when they are building this exponentially expanded knowledge base, as well as dealing with what they find with greater critical acumen (an issue that is, of course, already being addressed in some quarters)? Perhaps more interestingly, how are we in the ed tech world going to get people ready to make good *use* of all that knowledge? The questions are endless. Perhaps the most important one: How does an order of magnitude (or more) increase in contextualized and interconnected knowledge, in the head or easily accessible a few mouse movements away, change the *fundamental nature* of knowing and doing? How will having that much and that kind of knowledge lead us to *think differently*?

Beyond incrementalism: Eyes on the sky, feet on the ground

And this radical expansion in grounded knowledge (and resulting change in the nature of knowing) is just one of *dozens* of huge changes – and *chances* - that are afoot. Right now it seems that our field of educational technology is playing from behind in trying to keep up with all of this. Hopefully, this column will be one of many places where we start to focus our attention a little farther toward the horizon, bringing together forward-looking but clear-headed scientists, designers, teachers and trainers. We will always look for evidence, but we also won't hesitate to move forward and lay the groundwork for the evidence-gatherers – though sometimes that ground will be advanced a bit further forward than empiricists usually find themselves. Some accommodations may be required.

Some people will want to place their bets on one-step-at-a-time, incremental approaches to the changing world of educational technology. There is no questioning the virtues of such sturdy ways of doing things, and we wish those folk well.....

Educational technology is no longer in a space where incrementalist thinking is an optimal strategy. It is a time when “next steps” must be replaced by “principled leaps.” We are ready for a revolution, and the purpose of this column will be to figure out what it might look like.

Though the changes ahead are likely to be of accelerating magnitude (imagine the next generation of children growing up immersed in nonlinear, digital, random access worlds from the earliest years), we have just now reached a crucial juncture. For the first time we are at a point that can be characterized as

having “*ambient findability*” (to use Peter Morville’s term). Even a few years ago we couldn’t say that point had been reached where one could assume that close enough to “everything” would be there that the Web would be the first place you would want to look (and maybe the *only* place). But we are there now. So the new game is underway, and the question of what we do – as learners and as teachers or trainers – in a world where clicking has become the way to knowing pretty much anything is one that must be asked right now.

But we can’t just talk about *finding*, because, as we will see, as useful as that is, the real action occurs when finding becomes integrated into a new process of iterative and organic *learning*. So the first thing that has to happen is that people have to be *aware* that the Web can be used for more than finding. Then they have to have the appropriate mindset (epistemic beliefs and preferences) to capitalize on the affordances of the Web to make possible just the kinds of new understandings and processes of discovery that the world has come to require.

First, then, we must briefly restate a basic premise of this column: we face the need to deal with an increasingly challenging world. Andy Hargreaves, in his book “Changing Teachers, Changing Times,” talks about how teachers’ lives are “packed with complexity and surprise.” But it’s not just in teaching that one hears such talk – it’s ubiquitous. In the business world one finds similar discussions (in the context of corporate training and the building of horizontal “learning organizations”), and the same applies in the military. Every realm of life and work has become replete with uncertainty, riddled by change, speckled by heterogeneity and irregularity where once there was a greater degree of uniformity. Or that kind of simplicity is what people perceived, imagined or *wished* were the case - and then too often acted on as if it were true. And even where things were always as complex as today, concern for that issue was never as salient as it is now – or at least was never *talked about* as much.

The Web has features that fortuitously position learners and teachers to help deal with a complex, rapidly changing, and uncertain world that increasingly requires individual autonomy in thought and action, a creativity of everyday thought we could never hope to enable with traditional technologies. The world doesn’t go in a line, and nonlinear modes of processing – like those found in optimal modes of Web use can help learners to grasp intricacies of knowledge and prepare them to adapt to the world’s unceasing twists and turns. We now have media for learning that flexibly conform to the contours of the world’s undulating landscape of knowledge and experience. And the same can be said about some specially built computer learning environments. For example, *Cognitive Flexibility Theory* has for twenty years been the basis for building hypermedia systems that curved and twisted to criss-cross knowledge landscapes.....

We have a chance to jump out of the box of compartmentalization. Out of the box of the “table of contents” that can not help but disperse crucially related ideas into distant chapters. Books aren’t written

like stars, with points that emanate at equal distances from some center, with some points shimmering more from one angle of view while others have more shimmer from a different perspective, and then with the star placed within a constellation of other stars so that each star is just another perspective-dependent shimmer (thus supplanting the often artificial and false Platonist notion that there is an essentialist knowledge “center”). Out of the box of an expository line of development that leaves too much of a given landscape of thought as an unexplored byway, on a curving road bypassed by the main highway, but really itself a main thoroughfare of thought from some alternative perspective.

And, perhaps most importantly, we have kids who have grown comfortable bouncing in different directions, from here to there. Whether it’s video games or MTV or their increasing involvement with the Web itself. I will argue that can be a very good thing because the *world* bounces in different directions, so you have to bounce in tandem to the world to avoid the risk of learning too reductively, and so that you can, when trying to apply knowledge adaptively to new situations (what is called *transfer*), be able to assemble what you know to fit the tasks and problems that the world presents to you. The key issue is getting children to use this skill of nonlinear processing in a focused way for educational gain, rather than as a mode of distraction. They will need to have their wanderings harnessed, tied together towards valid pedagogical ends – although the nature of the tie might be a somewhat looser one than we sometimes advocate in traditional education, and the ends might have a differently determined validity structure, one that fits the “ecology” of real-world knowing and knowledge application in ways that school assessments often miss.

Before proceeding, a disclaimer is in order: I am talking about an ideal way of using the Web (and other educational technologies) for learning. We all know that too often the Web is used simply to “find answers” and as a convenience that shuts down the need for deep thinking. More often than not, students (and teachers) lack skill in conducting searches and evaluating the results of what they find in searches (see the excellent review by Kuiper, Volman & Terwel in the 2005 *Review of Educational Research*). Here though, I will be talking about ways the Web can be used that are just the opposite – sophisticated searches that are fine-tuned over time as a function of what is found in preceding searches, all in the service of developing richer understandings based on credible sources, uncovering new directions you weren’t expecting to find, and with sufficient mastery so as to be able conscious attention to be directed at content rather than the mechanics of searching.

This more advanced way of using the Web for learning isn’t here yet for many people, and it tends not to be systematically taught; but it’s also something that is surprisingly easy to grasp – if you give it a chance, if you have some mentoring guidance, and if you *want* to do it and think you *need* to do it. (Fortunately, we also have new ways to more quickly and reliably change underlying ways of thinking – I’ll talk about those, too.)

Once an appropriate mindset for complex and nonlinear learning has been established, and a fair degree of expertise and automaticity on the mechanics of searching has been achieved (so that you can be thinking about what you are finding on the Web, rather than devoting cognitive resources to how you are using the Web), a remarkable process is set in motion. Successive refinements of searches set you finding new things, that in turn send you directly to other things via links, and then on to newly refined searches that re-initiate the process. Once set in motion, this sends you curving along the contours of the Web's landscape, so that you are actually criss-crossing the contours of *realities* (conceptual as well as actual), because the increasing 'pixilation' of the Web maps those realities in increasing degrees of fidelity – so riding the Web increasingly becomes a direct, immersive riding of the contours of knowledge and contemporary experience (which is *lived* increasingly on the Web, as well as being represented there). Of course, some of those realities are merely virtual, and the Web will never be a substitute for actual experiences, but that could always be said about any tools used in education that didn't involve direct interactions with the world. There is a whole lot more reality on the Web than in a textbook.

Once this point is reached, the very nature of learning is changed. Consider the acknowledgment that Morville (who I mentioned earlier) offered in his wonderful book *Ambient Findability* at the end of the list of people he is thanking for their help: "Finally, I thank the Web, which connects me to countless sources of inspiration, and perpetually changes both my journey and my destination." As you are going through this *ongoing process* (dynamic and unceasing), what it is that you are "studying" changes, evolves. Your searches are changing partly because 'what' you are searching for changes. The Web *teaches you* what the 'subject' is that you are trying to learn about. So you search differently, taking off from where you end up at a given time to next places that are at conceptually-oblique angles from the point of departure. Learners develop an *organic* relationship with the material they are learning from: in rapid turnover time, what they are trying to learn is affected by what they are finding, and that in turn affects what they are looking for (and how they look for it), until an *equilibrium* is reached – an accommodation between *you* (including what you already know and what you are coming to know), your *task*, and the *world*, as dynamically mediated by the Web (hopefully invisibly as experience and expertise in Web use is achieved). In Cognitive Flexibility Theory I have called this point of accommodation a "schema of the moment." When the world won't permit the wide application of *enduring* schemas, then temporary and dynamically evolving schemas to fit current needs – schemas of the moment - are *the best you can do*. And all of this dynamic adjusting is done at an accelerating pace that wildly outstrips the adjustments that are possible in traditional learning.

After you've done this enough and encountered increasingly frequent positive reinforcement in the doing (the Web is very generous in that regard!), you start turning to the Web habitually with such a mindset of openness and receptiveness. When that happens, learning becomes naturally tailored to the

curving and intersecting contours of the world because learning is following the world you are now open to.

The process by which the Web and similar learning environments achieve this kind of ongoing *inspiration* that drives an onward thrusting process of organic learning is what we will take up next.

This column has been about a revolution in the underlying knowledge structures that *prefigure* thought, a revolution caused by widespread immersion in a nonlinear, random access, digital world of media.

Summarizing, the argument is McLuhanesque:

1. New media are making possible a new cognitive message. It's all about digital, random access, nonlinear, multiplicitous, noncompartmentalized, context-dependent, fragment-assembling, image-laden, juxtapositional thought. It's not just that we do more of this kind of processing, it's that it's very likely restructuring our minds to *expect* to do it, for it to be the *norm*. And that's a very big change in how we *pre-structure* thought, in the nature of the schemas that build our schemas, in the *lenses* we use to see the world. So this new cognitive message is not just an incremental change, but rather a cognitive paradigm shift *potentially* of the same epochal proportions as the advent of language, of writing, and so on. In other words, this kind of thing does not happen very often to our species.

2. This new cognitive message is just the one we *need* because the world - of life and work - has gotten so much more complex and ill-structured and is changing so fast.

3. We haven't been able to deal well with complexity - can't deal well with it individually, because too many people prefer to "think simple," or educationally, where we have never been very good at teaching hard stuff, like preparing people for transfer, for knowledge application in situations unlike those they have been in before and different from the conditions of initial learning.

4. Circling back to #1, the very features of the new media that change the predispositional nature of our thought are also exactly the nonlinear tools we need to support and promote more complex learning and the fostering of an increasingly essential cognitive flexibility. The new media can make complexity cognitively tractable, and they can do it in a way that kids who grew up with MTV and video games and the Web find perfectly natural.

5. Thus, new generations may be coming to increasingly think in a way that is at the same time: A) natural for them (they think like that all the time for fun - now what was natural and fun can be harnessed for education, training, etc.), B) is cognitively supported, and C) is just what they *need* in order to deal with the complex world around them, not to mention to get a job in a modern corporation, for example. The world is changing; the media are changing in ways that fit the hopscotching contours of the

world better than the old media did -- and, as a result, people will change, just as they did when they got language and when they got books.

Hard to imagine how it wouldn't happen. But what about stories?

So, first, let me say that *I* can't imagine how it wouldn't be happening. Try growing up on the web and have that not change the fundamental nature of how you think. Try growing up processing rapid successions of images, each packed with meaning, and have that not change the fundamental nature of how you think. Try growing up knowing everything you need to know, when you need to know it, in a grounded context of natural curiosity (so it sticks), and have that not change the fundamental nature of how you think. And on and on.

But won't it always come back to what we've always wanted, a good story? Should we not mess with success? I am indeed saying that what was, won't be, can't be. But we'll still want stories, right? You bet. When we all started reading and writing, we still had stories, yes, but we had a lot more - look at all that has happened in the last few hundred years that could not have happened without widely available text. As so many have argued, we don't think in quite the same way as before we had print (and, I would argue, wouldn't have wanted to). So we'll have stories, but we're also going to be tearing them apart and recombining them on the fly, assembling situationally appropriate new stories as needed, and helped every step of the way by the new media.

So we're surely talking about some new mix of what worked before, along with the new, right? Sure. But mix the old with *this* new – media that are nonlinear and instantly interconnectable, enabling the formation of context-sensitive collage-like representations in a cognitively tractable amount of time – and the thinking is not just old + new, it's totally new. Why would we want to use this wonderful new opportunity to just do a better job of achieving old goals when we could be getting somewhere new that we need to go? That sounds to me like selling ourselves short, especially when the affordances of these new media might be just what we need to help people to deal with the complex and changing world they have so much trouble dealing with, whether they are doctors or teachers or students of history or just people trying to figure out life as it comes. Especially when these new media affordances might have the capability to actually get people ready to be situationally adaptive in ways they need to be but their inherent desire for rigid, fixed, prepackaged thinking prevents them from being?

An important branch in the road

The “selling ourselves short by shooting for the old goals” argument is an important one. We're at exactly that point of choice where we can either aim for old goals or pay attention to where the technologies are providing new affordances that kids growing up are quite used to working with, and try to find new goals and solutions for new times and their new demands.

None of this is meant to imply it's going to be easy. But some of it will come naturally, from growing up on the Web and being surrounded by so much nonlinear media in a world that started out nonlinear before our stories and books and schools straightened that messy world out into a line. If we are to master landscapes of knowledge, we better do more than follow the river that runs through it, unless that river somehow touches a lot more than ports. (Note the stretching of the linearity metaphor to cover curving, meandering rivers. It's not necessarily "the line" that matters, but Wittgenstein's "single thread" that touches all. It's going through one way, one time, that's the problem.)

I will argue against those who say it is too easy, that it gets people to close down their understanding as soon as they find what they're looking for. Instead, I find just the opposite, at least with the Web, where there is an opening up, not a closing down. You can't get people to stop once they get started - the more they find, the more interested they become - and then the more they want to keep looking. The contours of thought on a subject emerge much more quickly than they used to, helping with the cognitive work of *nonreductive integration* of ecologically diverse strands....

I will argue against those who say we don't have ways of dealing with this Post-Gutenberg Mind, and the new ways of learning and teaching and training that go along with it. I'll offer *Cognitive Flexibility Theory* as one overarching framework that harmonizes precisely with the Post-Gutenberg Mind.

And I will argue against those who say that the Web will leave people with unintegrated knowledge, too many missing pieces, too many worthless side-trips. I say it's just the opposite, at least *potential*. Because of the speed and well-directedness of the hopping around you can do on the Web, it becomes cognitively much easier than it used to be to integrate relevant information, draw in the side-threads, represent the big picture non-reductively. Integration won't be easy (as David Weinberger among others has pointed out), but it has the potential to *eventually* become easier than it is now. More missing pieces will be filled in. And the side-trips may turn out to have been the whole point, enabling an ongoing creativity in everyday thought we never imagined possible.

Where it starts:
Prefigurative knowledge structures - the ideas that underlie ideas

.... And what is that different thought going to look like? The answer starts with the changes that have occurred in society, the demands those societal changes have made on learning, and the way new technologies and their affordances provide possible responses to those demands. The societal and technological changes should not be pulled apart, because they shape each other, they co-evolve. To capture their joint impact on learning, I will refer to *socio-technological change*.

The key elements of societal change are related to increasing complexity, uncertainty, and change. New technological media have qualities that can potentially support learning for more complex, uncertain, and changing times. But to do so will require a different *style* of thought that is related to two key elements of new technologies: their *random access* nature and their support for something approaching *simultaneity* of processing. It is not just the specifics of thought and knowledge representation that will have to change, but the underlying knowledge structures that *determine* what *kind* of specific knowledge gets built. I and my colleagues have called these structures *prefigurative schemas* (following Hayden White), because they pre-shape or “prefigure” the specific structures of thought, making some forms of knowledge more possible and others unlikely. They are the schemas that shape and direct the building of schemas, as well as the contours of perception in the first place. And it is these prefigurative schemas that are still rooted in old ways of knowing that must change for the new socio-technological framework to find its match in new learning. Random access media and closer to simultaneous processing of information will lead to the structures of thought identified in the next section (e.g., knowledge structures characterized by nonlinearity, multiplicity, and so on).

Unfortunately, this topic has not received as much attention in academic fields like cognitive science and educational psychology as it should, and that may be one reason it hasn’t surfaced as much as needed in educational technology.....

The core themes of the new mode of thought

Again, the claim is that the socio-technological complex of needing to deal with rampant change and situational and conceptual complexity, combined with the affordances of digital, random access media, will privilege new underlying modes of thought we have called prefigurative schemas (which also might be called - with greater or lesser degrees of accuracy - worldviews, ways of thinking, habits of mind, meta-structures of thought, etc.). Here is a listing of themes of this new mode of thought:

Nonlinearity

Multiplicity

Openness

Context-dependency

Event-centeredness - the central role of real-world events, examples and occurrences (rather than abstract conceptual knowledge – concepts will still be important, but they will more often become

less privileged than actual occurrences, serving practice and knowledge application rather than being the desired end-point of learning in themselves)

Interconnectedness of events

Concept-combination

Novel, situation-sensitive idea play and knowledge assembly (rather than retrieval of prepackaged knowledge)

Finally, the result of thinking in these ways will be a predisposition to “think complex,” to *expect* complexity, to look at a situation and then look again expecting to see more, to say “it depends” – in sum, to say “it’s not that simple.”
