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A special issue exploring innovation in educational technology via connections with related disciplines

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contributing editors

Innovation Over the Edge

Introduction to Special Issue

Gordon Rowland
Guest Editor

Innovation: A key to success in an environment of increasingly global competition, and thus a high priority in decisions on funding and policy. An urgent need in the face of imbalanced availability, production, and consumption of resources. An essential ingredient to turning around educational systems that are by some metrics performing poorly. The claims can feel exaggerated, but the challenges are real.

We in the educational technology field can respond to the demand for innovation, at least in contexts that relate to education, training, and workplace performance, with a rich collection of processes and strategies. But underlying our efforts, and those of everyone who attempts to innovate, is the fundamental challenge of generating new ideas, new ways of doing something, and new tools and technologies. Where do new ideas come from? And how do they get from the first hint of a concept to an actual innovation?

Sometimes the new happens by accident or serendipity, like when spills resulted in vulcanized rubber and Scotchgard, when a spring knocked off a shelf led to the Slinky, or when something left out a bit too long led to the discovery of penicillin and the creation of Kellogg's Corn Flakes. Sometimes it takes a while to realize what the potential from an accident might be, for example, the accidental creation of a low-tack adhesive leading to Post-It notes, and the unusual properties yielded when boric acid and silicone oil react, leading to Silly Putty.

What is clear, though, is that these accidents and the individual discoverers who recognized new possibilities in them are the exception. Grand A-Ha! or Eureka! moments are rare, and the single genius inventor working tirelessly in isolation is largely a myth. Instead, the history of innovation is one of collaboration and competition among those who stand out for their passion and perseverance more than their genius, and of small steps—two forward, one back—patiently and intentionally building from known to unknown. This is the history of the light bulb, the telephone, the airplane, the television, plastic, the telescope, the internal combustion engine and the automobile, the computer and the Internet, and on and on.

What stands out especially is a sense that innovation, and its cousins, imagination and creativity, are not the domain of the few. They are processes that many can engage in, that particular approaches and techniques may facilitate, and in which skill can be developed. In other words, we can generate the new, what Nelson and Stolterman (2012) call the *expected unexpected*, by intention, by putting ourselves in a position to do so. For example, we can combine "hard-earned expertise with…unencumbered and trustful receptivity" (Grudin, 1990, p. 11), and we can find avenues for improvement by becoming more sensitive to the causes of failure (Petroski, 2001).

One of the most frequently proposed techniques for generating the new is to search for connections and relationships beyond those previously known—seeing a waffle iron and realizing how it might yield a lighter running shoe (Bill Bowerman, then Nike), or a heavy book supported by a birdcage and realizing the advantages of steel framed buildings (William LeBaron Jenney). In *The Act of Creation*, Koestler (1964) called this "bisociation," the combining of different frames of thought. We can see it in the recognition of what new technologies afford—the Web making possible the custom ordering and direct sales of Dell computers, eBay's online auction, and Amazon's online bookstore; and the combination of mass-produced moveable type, oil-based ink, and the agricultural screw press leading to Gutenberg's printing press. We can see it, also, in the expansion to applications not at all obvious at the outset, from industrial robots becoming entertainment in the Robocoaster, to what was originally designed purely for machine control becoming central to the computer—the microprocessor.

This special issue is about making connections, as a means to generate new ideas, and as a trigger for innovation. It came about from a confluence of three things: a belief that there is indeed a pressing need for innovation in educational technology, and that this is not simply an artifact of our inability to escape the perceptions of our own time; a hypothesis that we have become rather insular, as most disciplines do, and that a rich source of new ideas may be found in deeper connections with related fields; and, more immediately, a recognition from studying the history of innovation that none of the inventions, discoveries, and designs mentioned above happened solely by thinking "out of the box."

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The Box

The box is the typical, constrained way we have of seeing and thinking. We create the box when we define something and come to accept our definition as the thing. We fill the box when we distinguish our perceptions and experiences in terms of what is in and what is out. We reinforce the box when we make those distinctions without nuance or question. And then we see the world through the lenses and filters of our box.

On the one hand, the box helps us make sense and understand things. It helps us cope with uncertainty. It keeps us safe. It can even make us feel smart. For example, educational technology is a box, as are all disciplines and fields, and belonging in that box can contribute to our identity and self-esteem. It gives us legitimacy as professionals. It gives us a domain of concern, in which to conduct inquiry, develop new knowledge, and apply what we've learned. It gives us others with similar interests with whom to talk.

On the other hand, the box can block our vision. It can lead us to see what we want or expect to see, and to unconsciously think our perspective of reality *is* reality. It can keep us from appreciating differences and thus from learning. It can become a cage or prison, reducing our ideas and our choices. For example, as we increasingly specialize in fields and disciplines like educational technology, we may lose sight of the whole, be pulled away from systems thinking (Robinson, 2011), and ignore the complexity and interdependence of the world around us (and ourselves). Borrowing from Winston Churchill and Marshall McLuhan, we build the box, then the box builds us.

Out of the Box

In order to move forward, grow, and learn, we need to free ourselves from the limitations of our typical ways of seeing and thinking, and to open our minds to new perspectives and ideas. Robinson (2011), echoing Abraham Lincoln, calls this "disenthralling" ourselves from the perspectives that have guided us in the past, moving beyond the "ideas to which we are devoted but which may no longer be true or relevant" (p. 3). The popular phrase for that is, of course, "thinking out of the box."

The phrase "out of the box" is thought to have originated with the famous puzzle created by Henry Ernest Dudeney of a 3X3 grid of dots and the challenge to connect all of the dots with four straight lines without the pen leaving the paper. To solve the puzzle, one needs to realize that the lines can extend beyond the grid, in other words, realize that the dots create an artificial boundary that constrains how we think about the task. To solve the puzzle one needs to literally *draw outside the box*. Thus, "out of the box" implies thinking creatively, and recognizing when constraints and boundaries are artificial. Notice that contrary to its typical usage today, in its origin "out of the box" did not mean disconnected; it meant literally connected but outside of what was seen as the boundary, as relevant.

There are many approaches to thinking creatively, for example, De Bono's lateral thinking, Gordon and Prince's synectics, Barker's innovation at the verge, and a wide range of techniques for design, that is, for contexts where a new and useful artifact is sought. The latter might represent a subset of design methods or an aspect of design thinking.

De Bono's (2013) techniques for lateral thinking involve a change of direction, rather than trying harder in the same direction; a change in concepts and perceptions, changing the pieces rather than playing a game with existing pieces; a move across patterns in the brain; and escape from local optima to seek out more global optima. Gordon and Prince's (Gordon, 1961) synectics are essentially metaphorical processes to reduce inhibitions and open one's mind to new possibilities. They involve "making the familiar strange and the strange familiar." And literally hundreds of techniques for enhancing creativity are articulated within compilations of design methods (e.g., Curedale, 2012; Kumar, 2013) and under the umbrella of design thinking (e.g., Brown, 2009; Cross, 2011; Martin, 2009).

But when one carefully reads the stories of great discoveries and innovations, and examines the examples cited along with approaches to creative thinking, it becomes clear that today's popular use of "out of the box" can be deceptive. Great ideas rarely emerge in some random space anywhere outside conventional thinking, and departure from that thinking is necessary, but insufficient.

Over the Edge

More frequently than the result of a leap into the complete unknown, great ideas tend to be just around the corner, out of sight, in a connection that we haven't yet made, in seeing the object of our attention from another perspective, in a false assumption that has limited what we think is relevant. The new idea may be waiting for us not across the universe but just over the horizon, over the edge of the surface we are standing on. This is the story of the cotton gin, the telegraph, the movie projector, and all of the technologies mentioned above. It is a story not of ideas magically appearing, but of an intense search for connections being ultimately rewarded, for example, a search for how a similar goal was accomplished or how a similar problem had been solved in another domain, or seeing how an existing technology or a new development in one domain might be applied in another.

This sort of work is often said to occur at "the edge," with a connotation of danger and uncertainty. The cutting edge and the bleeding edge are at once exciting and risky. We can peer over the edge without falling, and maybe see others on firm ground, but we do need to step forward into the unfamiliar. And when we do, we can gain

a better appreciation of existing connections and make new ones. We can see possibilities, and realize we are standing at the verge of something new and different. We can gain a clearer sense of the whole, for example, by recognizing that the edge is a distinction (sensitivity to which Bohm, 1998, describes as central to creativity) and that it may lead us to appreciate new dimensions of a multidimensional box. Looking below the surface, we can see if underlying structures are similar—the heart of systems thinking—and learn from how that structure is manifested elsewhere. We can gain a better understanding of the edge itself, maybe even redefine it.

My colleague Jason Hamilton and I started talking about "thinking over the edge" when we were developing a short course on creativity. We repeatedly found the concept "out of the box" unsatisfying in terms of explaining creative processes, accounting for historical precedent, and helping students develop their creative skills. We came to see the table we worked at, and our laptop and tablet computers sitting on top of it, as parts of a box that was limiting our own creativity. It was when our eyes and our hands and our thoughts crossed the edge of that table—not randomly but with an intentional examination of our immediate surroundings, like objects on the shelves and scenes outside the window—that we found new ideas. We continually came to see what was on the table, for example, our instructional goals, learning activities, and so on, from different perspectives as a result. Ideas and perspectives weren't "off the table"; they were over the edge, available to us as sources of inspiration and connected in ways in which we had not previously been aware. The edge became part of our language, as a conceptual tool that helped us simultaneously to get out of the box and to connect the new to it, which had the fascinating result of continually modifying our perspective of the box itself.

We found the concept of "edge" compelling for another reason, also. As a local systems thinking educator, Derek Cabrera, pointed out to us some years ago, in network and graph theories, the edge is a connection between pairs of vertices or nodes. For example, the lines and arrows between concepts on a concept map or between parts and sub-systems in a system model are edges, and, as this implies, the edge has meaning. A line on a well-prepared concept map doesn't just indicate a connection; it indicates the nature of that connection. An arrow on a learning hierarchy means subordinate skill; on an algorithm it means procedural step.

The second, and even more important, point Derek made to us was that edges can become nodes. For example, if we think of disciplines as nodes, and the edge between them as interdisciplinary work, that work can lead to new fields and subfields. Combining methods of inquiry, theories, practices, and so on from education and psychology led to educational psychology. Combining a range of fields like education, communications, and psychology gave us educational technology. On our maps, ed psych and ed tech have become nodes.

This is an evolutionary process, and one that we can at least partially guide, making it a conscious evolutionary process (Banathy, 2000). That is, we define the nodes and the edges, and we can repeatedly redefine them, essentially redesigning our box. It is also a generative and transformative process, in which interconnection creates something new and special.

Thinking Over the Edge

But how do we consciously help ourselves and others think over the edge? As implied above, the popular conception is that to obtain a great new idea we need to shake off all the baggage of what we know or think we know, totally free our minds of preconceptions, and eliminate constraints. That's not true, and it's a poor description of a creative process. Rather than complete freedom, we need reasonable constraints to guide us in what, at least in retrospect, we come to appreciate as beneficial ways. Dudeney's puzzle required that the pen not leave the paper. We find beauty in a stream not just from running water, but from how the rocks and trees and soil at the water's edge shape the water's flow. The composer Igor Stravinsky (1947) put it this way: "My freedom will be so much the greater and more meaningful the more narrowly I limit my field of action and the more I surround myself with obstacles. Whatever diminishes constraint diminishes strength. The more constraints one imposes, the more one frees one's self of the chains that shackle the spirit."

An example of this in designing is problem framing (Cross, 2011) or problem setting (Akin, 1994), and the designs we create are largely impacted by how we frame or set the problem. The same can be said of scientific research, another creative activity. We don't make a new discovery, create a new design, or innovate simply by getting out of the box. We need constraints, external and/or artificial, within which to work, constraints that shape our paths in productive ways. We benefit from goals, criteria, and so on. For simple, well-structured, routine problem solving those constraints might come from a procedure or technique. For more complex, ill-structured problems—perhaps including all situations where we seek innovation—there is no formula or model that guarantees success, and no magic to be performed. Rather we need to create and immerse ourselves in conditions that do get us out of the box, but at the same time constrain our departure or divergence in productive ways.

These ways might involve introducing certain stimuli, like powerful triggering questions along the lines of "What if Q?" as opposed to principles of the form "If X then Y." They might include tools to interconnect the research and design components of an inquiry (Rowland, in press). They might employ analogies and metaphors, and the methods mentioned earlier: lateral thinking, synectics, and bisociation. A good example is biomimicry, which involves studying nature as a source of inspiration

for solving human problems (e.g., Benyus, 2002). Examining the results of evolutionary processes has led to buildings that work like trees, bullet trains that run more silently because their front ends are shaped like Kingfisher beaks, carpets that resemble a forest floor, with interchangeable pieces and thus the more sustainable practice of replacing only those sections that are most worn, and on and on (e.g., Designboom, n.d.). Biomimicry imposes the constraint of a search process delimited by the results of evolution. It looks over the edge from the description of a human problem to nature's solutions. (In the Systems Science article of this issue, see Troncale's extension of this concept to "systems mimicry.")

In this way, moving over the edge rather than floating off in space may be a useful constraint, and gathering at the edge may be a powerful approach—which brings us back to how innovation happens. Nearly always it is the result of an intense collaborative and competitive process, and thus a conversation among individuals who have different ideas, different approaches, different viewpoints, and so on. Barker (2013) seeks to promote this in terms of "combining ideas with those you meet at the verge." Similar in principle are various forms of design conversation (Banathy, 1996) and dialogue (Bohm, 1990; Isaacs, 1999). And we can see this principle underlying the Club of Rome and other think tanks, the Pop!Tech conferences, which are described as "a global community of innovators working together to expand the edge of change" (2013), and the initiative to create global agoras (e.g., Christakis & Bausch, 2013). Each recognizes that new answers to complex challenges are more likely from the interchange of ideas across boundaries and over the edges of our boxes.

The Special Issue

In a way, this special issue is an illustration, one that is not specifically bound to the concept of over-the-edge thinking, but an illustration of the potential of such interchange, in particular, the potential of purposefully seeking connections across related fields as a source of ideas that might lead to innovation. Using as simple a method as I could imagine, I asked scholars in six fields that are historically related to educational technology to briefly describe what they consider to be the most exciting current work being done in their fields. Then I asked scholars in educational technology to consider what that work might imply for our field.

More specifically, I identified a group of approximately seven top scholars each in the fields of ***Communications, Computer/Information Science, Design, Organizational Science, Psychology,*** and ***Systems Science.*** I asked these scholars two questions:

1. *What work are you aware of currently being done in your field that you find especially exciting and imaginative? Who is doing it?*
2. *How might the work you described change our understanding? Of what in particular? For example, what assumptions does it challenge?*

I then compiled the responses and asked the educational technologists to reflect on implications and, wherever possible, to generate new ideas for our field. I offered them these questions to guide their responses:

- *What might this work mean for us in educational technology, either for a specific area or the field as a whole?*
- *What new idea(s) does this suggest?*
- *What important question(s) does it raise?*
- *How might we pursue developing the idea(s) or answering the question(s)?*
- *If our understandings and assumptions were to change in the ways described, in what direction(s) might that lead us?*

I asked them to think beyond today and tomorrow, and to allow themselves the freedom to dream of what might be possible far in the future.

I then offered the scholars in the other fields an opportunity to comment, if they wished, on others' contributions, especially on the potential implications that the educational technologists had shared.

Lastly, taking a good suggestion from the publisher, I asked six *Educational Technology* Contributing Editors to examine the six articles and consider themes and directions.

The results that you will find in the articles of this issue are fascinating. As the Contributing Editors demonstrate, there are dozens of connections across fields, new areas to explore, and new research questions that are explicitly stated or implied. The participants did a masterful job of seeing relationships and generating ideas. In some areas there are also prompts to reconsider what we think we know, for example, areas where our perceived connections to other fields may not be as strong or informed as we might believe. So, seeking inspiration by simply bringing people together and asking them to exchange ideas and think about connections—imposing what I considered potentially useful constraints—was quite successful. Hopefully, innovation in our field will follow, and that was the primary goal of the issue.

From the experience of bringing the issue together and writing this introduction, I can see implications that relate to process and to the concept of over-the-edge thinking, also. For example, with respect to the latter, Jason and I have just begun to consider the nature of *the* edge and how that might impact creative processes. Testing the *over-the-edge* concept ourselves, we may find a useful connection to the emergence of higher forms of complexity at the edge of chaos (e.g., Lewin, 2000).

What I am left with overall, though, is the strong impression that if it is this productive to simply share ideas through a brief electronic exchange (in this case, e-mail and Google docs), then just think of what we could do through deep, extended conversations with our

colleagues in other fields. One participant suggested the Delphi Method. AECT's research symposia come to mind, also. Another option might be the kind of conversations sponsored by the systems science community (e.g., the Asilomar and Fuschl conversations), which in many ways model Banathy's (1996) concept of design conversation and Bohm's (1990) description of dialogue. Perhaps that dialogue could interweave various complementary approaches to inquiry conducted within multiple domains, for example, philosophy (what should be), research (what was and is), design (what might be), and politics/governance (what will be)—as well as the edges between them, for example Clegg's Idea Work and what Buchanan describes as "public sector design" (both in this issue). The value of cross-disciplinary exchange is certainly not new; there are many precedents I am not mentioning; and the point of the issue is not to coin a buzzword. Rather, my hope is simply that we are reminded of how insular our field can become, and how innovations may be waiting for us just over the edge.

A final and important acknowledgment: In case it is not obvious, there is no innovation in the issue. We merely began the process of conceptualization, which could lead to innovation, if readers take the ideas here, and with passion and persistence build on and run with them.

My thanks to all those who gave generously of their time, energy, and creativity to participate. To be fair, I named the project "innovation over the edge" in my communications with them, but I did not share anything more precise about what I meant by that phrase. Consequently, from their participation, no endorsement of the "over-the-edge thinking" concept should be inferred. I will list them in each article by the disciplines they represent, but so that readers can appreciate the enormous breadth of expertise and experience, the group included: Jeremy Bailenson, Madhu Beriwal, Barbara Bichelmeyer, Ken Birman, MJ Bishop, Susan Blackmore, Elizabeth Boling, Richard Buchanan, Patrice Buzzanell, Alison Carr-Chellman, Alexander Christakis, Stewart Clegg, Fred Collopy, Nigel Cross, Stanley Deetz, Marcy Driscoll, David Durling, Nadya Fouad, Diane Gayeski, Xun Ge, Andrew Gibbons, Debora Hammond, Michael Jackson, Ton de Jong, Jerome Kagan, Roger Kaufman, Greg Kearsley, Stephen Kosslyn, Tiffany Koszalka, Alexander Laszlo, Anthony Marker, Reuben McDaniel, Jr., Ian Mitroff, Gareth Morgan, Harold Nelson, Charles Owen, Patrick Parrish, Michael Posner, Jennifer Rexford, Tim Roughgarden, Margo Seltzer, Neil Selwyn, Dave Snowden, J. Michael Spector, Jim Spohrer, Robert Sternberg, Erik Stolterman, Kathleen Sutcliffe, David Tewksbury, Robert J. Thompson, Len Troncale, Joseph Turow, Anna Valtonen, Irene Vissher-Voerman, and Brent Wilson.

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