Starting Up: Teaching Creativity and Innovation at NYU Shanghai

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1. Education: Considering the Economic Imperative

It would be historically blind to suppose that creativity and innovation are new topics in the world of education.

Education --- for the affluent, at least --- in early twentieth-century Budapest makes a good counter-example. This is the world from which an extraordinary concentration of genius --- mathematicians Paul Erdős, Paul Halmos, George Pólya, and John von Neumann, physicists Leó Szilárd, Edward Teller, and Eugene Wigner, and engineer Theodore von Kármán --- arose. During this period, the father of Theodore von Kármán had been responsible for reforming the Hungarian educational system and had, in particular, founded a model school (the Minta) that "encouraged reasoning over rote learning and emphasized drawing examples from everyday life."[1]

This sounds very modern!

Nevertheless, we will entertain the hypothesis that the current pre-occupation with the terms "creativity" and "innovation" indicates some degree, at least, of well-founded concern about current educational models.

Much of the pre-occupation with these terms stems from the belief that a nation's economic well-being is highly dependent on its citizen's creative and innovative energies. The argument starts with the axiom that, in the era of a global economy, a well-functioning "national enterprise system"[2] in one nation must constantly improve in how it meets the world's needs and wants, lest it fall behind another nation's enterprises. The national educational system then plays a critical role in teaching citizens how to create and innovate in support of this improvement imperative.[3]

But this is not the only argument being put forward in favor of a central role for creativity and innovation in today's education. Without doubt, only the most thoughtless of privileged people would suggest that a sumptuous meal of ideas should be anyone's substitute for food, shelter, and other economic needs. Nevertheless, many would call it a sad world were education viewed purely as fuel for the economic engine.

Mark Edmundson, professor at the University of Virginia, writes: "[S]chools now educate the mind and not the heart. The curriculum has become arid and abstract. Preprofessionalism is the order of the day. What Keats memorably called 'Soul-making' is absent from current higher education."[4]

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[1] Budiansky, S., *Air Power: The Men, Machines, and Ideas That Revolutionized War, from Kitty Hawk to Gulf War II*, Viking, 2004, p.162.
[2] Smith, G.D., R. Sylla, and R. Wright, "The Diamond of Sustained Growth: Framework for the Study of Comparative Enterprise System Development," NYU Stern School of Business, 2006.
[3] In the U.S., the publication *A Nation at Risk: The Imperative for Educational Reform* (National Commission on Excellence in Education, 1983) first brought the notion of an education-economy link to widespread attention.
[4] Edmundson, M., *Why Teach? In Defense of a Real Education*, Bloomsbury, 2013, pp.xiv-xv.

Another qualification to thinking in terms of a simple arrow from education to economy comes from Ned Phelps, professor at Columbia. He writes: "To function, the modern economy feeds off a motivating economic culture as well as pecuniary incentives. High dynamism in a society requires people who grew up with attitudes and beliefs that attract them to opportunities that they expect will excite them with their novelty, intrigue them with their mysteries, challenge them with new hurdles, and inspire them with new vistas."[5]

So, even with economic outcomes in mind, it seems we must assess education in broad terms --- in terms of the novelty, mysteries, hurdles, and vistas it offers.

2. Education: Making Time and Space

Much of students' time in education is spent in acquiring information. Students go to class, where they dutifully record what the teacher at the front of the room is saying or writing. But there is limited opportunity for creative and innovative activities when recording information. These activities come into their own once there is an opportunity to put information to work. To foreshadow what we will say later, it is in the combining and recombining of disparate pieces of information that many experts have located the essence of creativity. Since innovation precedes from creativity, this is equally a pre-condition for innovation in its various forms.

Take your favorite example of creative discovery. Perhaps it is from 100 years ago, when Einstein put the idea of a ride in an elevator (a rather new technology back then) together with the idea of a journey to outer space (where humans have yet to travel), to come up with his theory of gravitation.[6] Perhaps it is in the present, when Tu Youyou was awarded the 2015 Nobel Prize in Medicine for her discovery of a treatment for malaria, found by combining the idea of modern techniques for screening compounds with an idea for herbal extraction based on a 4th-century Chinese text.[7] We can also think of examples of combining that speak to the inner world of the mind, not just to the outer natural world. Pick any of your favorite examples of inner combining --- perhaps, one is the painter Gauguin with his "dual image of himself as, on the one hand, a wolfish wild man and on the other, a sensitive martyr for art."[8]

The question, if it is granted that combination and recombination of ideas is an essential part of an educational proposition, is whether sufficient time and space are given to this activity in academic programs. The current calls for more attention to be paid to creativity and innovation in such programs are evidence that many people feel that more time and space need to be devoted in this direction.

Technology can help. The literary theorist Northrop Frye said: "The most technologically efficient machine that man has ever invented is the book." Books free students from the drudgery of having to be scribes, laboriously copying down what is written on the blackboard at the front of the classroom. Rather, this is what books ought to allow. The concept of the "flipped classroom" did not begin with video lectures, to be watched by students before class, but has been in existence as long as teachers have been assigning reading before class, so as to free class time for analysis, discussion, and practice.[9] What recent video technology does allow is improved flipping of the

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[5] Phelps, E., *Mass Flourishing: How Grassroots Innovation Created Jobs, Challenge, and Change*, Princeton University Press, 2013, p.29.

[6] The well-known physics lectures by Leonard Susskind of Stanford contain a good introduction; see http://theoreticalminimum.com/courses/general-relativity/2012/fall.

[7] See http://www.nobelprize.org/nobel_prizes/medicine/laureates/2015/tu-facts.html.

[8] Kang, C., "Paul Gauguin (1848-1903)," The Metropolitan Museum of Art, Institute of Fine Arts, New York University, 2015, at metmuseum.org/toah/hd/gaug/hd_gaug.htm.

[9] Work that has importantly influenced the modern flipped-classroom movement includes King, A., "From Sage on the Stage to Guide on the Side," *College Teaching*, 41, 1993, 30-35, and Mazur, E., *Peer Instruction: A User's Manual Series in Educational Innovation*, Prentice Hall, 1997.

classroom, where students can both listen to a lecture before class and see the lecturer point to text, math, graphics and the like while talking. The free or near-free price of video lectures also allows students to search through different videos for different presentations of a given idea, until they find a presentation that works for them.

The upshot is that, done right, technology frees up time for teachers and students to go beyond learning as information transmission, to learning as information usage.[10] It is in the use of information that opportunities arise for creative and innovative activity.

3. Education: Teaching Creativity and Innovation

It is a good idea when setting out to teach a topic to decide on some self-imposed limits. To set limits, it helps to set some definitions. Here are three relevant definitions, with no claim made to any particular originality in their phrasing:

i. creativity is using internal and external worlds to generate new ideas,
ii. innovation is using creative ideas to make new things or develop new processes,
iii. entrepreneurship is using innovative things or processes to establish sustainable new real-world activities.

These definitions bring out the natural progression from creativity to innovation to entrepreneurship. Nevertheless, within this natural progression, a distinction can be drawn between creativity and innovation on the one hand, and entrepreneurship on the other hand. Specifically, one might conjecture that the first two topics would fit quite easily within an educational milieu, while the third topic might require significant stretching of the usual educational model to make the real-world essence of entrepreneurship real in students' minds.

This rough demarcation (certainly not a rigid division) can be seen in the way many universities are configured in these areas. But, paradoxically, there is evidence that universities have moved faster to make entrepreneurship part of their offerings than to do the same with creativity and innovation. Indeed, there is a worldwide movement on the part of universities today to set up entrepreneurship programs and institutes, very often as a somewhat separate 'add-on' feature and built from somewhat standardized components.[11, 12]

Programs on creativity and innovation appear to be less widespread and less standardized, at least for now. This may be precisely because to work at all well, such programs have to be built in very close coordination with existing academic programs. It is to such an endeavor that we now turn.

4. Education: Designing the Additive and the Combinative

If the best way to teach creativity and innovation is not a settled matter, then one is certainly free to make one's own pitch for how it might be done. Here is a minimal proposal. Teaching creativity and innovation should involve, at the least:

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[10] The time that then becomes available may be deployed in the physical classroom or in a virtual online classroom.

[11] For a survey, see Valerio, A., B. Parton, and A. Robb, *Entrepreneurship Education and Training Programs around the World : Dimensions for Success*, World Bank, 2014. A very common developmental tool used in entrepreneurship programs is the Lean Launchpad; see Blank, S., "Why the Lean Start-Up Changes Everything," *Harvard Business Review*, May 2013, at https://hbr.org/2013/05/why-the-lean-start-up-changes-everything/ar/1.

[12] A caveat: Our definition of entrepreneurship refers to establishing "real-world activities" and is not restricted to establishing organizations (whether for-profit or not-for-profit). Ideas put to work --- in the fields of physics or medicine, or in the world of the arts, as in our earlier examples, or in business, or elsewhere --- constitute the essence of entrepreneurship according to this definition. Many entrepreneurship programs have a business-oriented mandate.

a. an additive component, to ensure that students have a broad and varied range of educational encounters, differing in topic, modality, location, and more;
b. a combinative component, to ensure that students learn and practice how to take ideas they have acquired from these encounters and combine them to make new ideas and new objects.

Some comments on three particular words in this proposal. First, the word "encounter" is chosen to make clear that we are not saying simply that a student should take a range of courses. We are also talking about different forms of learning and different contexts for learning. Corresponding to the teachers' adage "How we teach is what we teach," there should, perhaps, be the students' adage "How we learn is what we learn." This is part of the philosophy under a. above. Next, the word "combinative" in b. means (1) tending or able to combine, or (2) resulting from combination (Merriam-Webster). Both senses work for us. The combinative component in b. can be about developing a sensibility towards combining ideas. It can also be about the outcomes of such combining. Finally, the word "object" includes, of course, both non-physical ('symbolic') and physical outcomes of combinative activity.

There is a long pedigree when it comes to putting combinative thinking at the heart of creativity. This type of thinking is identified in several frameworks that have been developed to describe the creative process. In one well-known framework, due to psychiatrist and prominent creativity scholar Albert Rothenberg, it is given the name "Janusian thinking."[13] The writer Arthur Koestler famously coined the term "bisociation." To bisociate means to "join unrelated, often conflicting, information in a new way."[14] Our term "combinative thinking" is based on common terminology in the creativity literature.[15]

The bite in combinative thinking comes from putting together not simply distinguishable ingredients, but ingredients that were not previously thought of as capable even of being put into a close, let alone a productive, relationship to one another. This is why an additive component precedes the combinative component in our teaching proposal. Many students naturally seek opportunities to take courses, and, more generally, to learn beyond their primary discipline or major or interest. But it is the duty of those who educate to create effective ways for students to enhance their education in this fashion. We need to be expert in knowing which additional topics, modalities, and locations will give students the most generative opportunities for subsequent combinative thinking.

The traditional sciences and humanities curriculum of U.S. universities has worked in this direction, even if, traditionally, its purpose would be stated in very different language. But nothing stands still and, as a result both of challenges and opportunities, there is active debate at the moment about what form such curricula should take in the 21st-century.[16] Opportunities for curricular evolution are to be found under all three of the categories of topic, modality, and location just mentioned. To take

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[13] "Janusian thinking --- the capacity to conceive and utilize two or more opposite or contradictory ideas, concepts, or images simultaneously --- is discussed in relation to its role in the creative process in art, literature, architecture, music, science, and mathematics" (Rothenberg, A., "The Process of Janusian Thinking in Creativity," *Archives of General Psychiatry*, 24, 1971, 195-205). Janusian thinking is one of three cognitive creative processes Rothenberg posits, at least as far as scientific creativity is concerned; see Rothenberg, A., *Flight from Wonder: An Investigation of Scientific Creativity*, Oxford University Press, 2015. He also posits several accompanying emotional processes.

[14] Koestler, A., *The Act of Creation*, Hutchinson, 1964 (p.113 in 1976 edition). For an excellent discussion, see See Popova, M., "How Creativity in Humor, Art, and Science Works: Arthur Koestler's Theory of Bisociation," 2013, at Brain Pickings, https://www.brainpickings.org/2013/05/20/arthur-koestler-creativity-bisociation/.

[15] See Hennessey, B., and T. Amabile, "Creativity," *Annual Review of Psychology*, 61, 2001, 569-598.

[16] See, e.g., Lagemann, E., "The Challenge of Liberal Education: Past, Present, and Future," *Liberal Education*, 89, 2003, at https://www.aacu.org/publications-research/periodicals/challenge-liberal-education-past-present-and-future.

one example, is computer-intensive data visualization a topic for a program on creativity and innovation, or to be considered as a new form of representation and communication for inclusion in a 21st-century version of a sciences and humanities curriculum? We do not think much hinges on the answer. What matters is that we are on the alert for adding to the educational journeys students undertake --- and, in particular, that we are on the alert for adding in ways that, to use mathematical language, increase the dimensionality of the educational space in which students travel.

Now that we have talked about how students can assemble educational components that offer the possibility of creative combination, we can come back to learning about the combinative component. There is the extensive academic literature on this activity.[17] There are examples of inspiring people from whom to learn. There is, crucially, self-generated exploration and practice of this idea.

5. Education: Arguing From the Personal

In my research, I work in game theory, which is a mathematical language for describing the interplay of competition and cooperation that makes up many interactions --- among humans and other animals, at the level of cells and even genes, and among other entities. So, game theory can be thought of as an exploration in combinative thinking --- in putting the very different concepts of competition and cooperation together!

To return to where we started, game theory was initiated in a 1928 paper by John von Neumann,[18] one of those twentieth-century Hungarian geniuses we mentioned at the beginning. To be clear, game theory was only one of von Neumann's wide-ranging and profound mathematical triumphs. Peter Lax, a leading mathematician who worked with von Neumann, has described him as "the most scintillating intellect of the 20th century."[19]

The subtle interplay of competition and cooperation is already at work in von Neumann's 1928 paper on game theory, and he expanded on this interplay in his monumental 1944 book *Theory of Games and Economic Behavior*, written with Austrian economist Oscar Morgenstern.[20, 21] It is tempting to want to see the influence of that newly reformed early twentieth-century Hungarian educational system --- a system that "encouraged reasoning over rote learning and emphasized drawing examples from everyday life"[22] --- in helping the student John von Neumann on the journey to the great heights of creative combination he attained.

We will see how the various forms and reforms of educational enterprise being set in motion today will fare in instilling a philosophy and practice of creativity and innovation in our twenty-first century students.

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[17] See Hennessey and Amabile op. cit..

[18] Von Neumann, J., "Zur Theorie der Gesellschaftsspiele," *Mathematische Annalen*, 100, 1928, 295-320. English translation by Bargman, S., "On the Theory of Games of Strategy," In Tucker, A., and R.D. Luce (eds.), *Contributions to the Theory of Games*, Volume IV, Princeton University Press, 1955, 13-42.

[19] Lax, P., "John von Neumann: The Early Years, the Years at Los Alamos, and the Road to Computing," *SIAM News*, March 1, 2005, at https://www.siam.org/news/news.php?id=39.

[20] Von Neumann, J., and O. Morgenstern, *Theory of Games and Economic Behavior*, Princeton University Press, 1944.

[21] For a history of the origins and development of game theory, see Leonard, R., *Von Neumann, Morgenstern, and the Creation of Game Theory: From Chess to Social Science*, 1900-1960, Cambridge University Press, reprint edition, 2012.

[22] See Footnote 1.

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