Toward 2040 and a Science of Being

"One planet, one experiment." —E. O. Wilson

Erich Fromm's classic *To Have or To Be?* (1976) distinguishes between two modes of existence. For Fromm, *having* is the state of ego-driven dehumanization toward which modern industrial society is oriented. In this deviant mode of existence, individuals ceaselessly chase illusory promises of happiness through acquisition and consumption. The *being* state, on the other hand, is one of experience free from ego which seeks to share, give, and sacrifice in unity with others and nature. In our educational system, *having* is reflected in institutions which package information in such a way that seekers are conditioned to try and possess it, as well as in students who understand learning as merely the process of collecting and regurgitating others' statements and ideas (Fromm, 1976, p. 18-28). In the mode of *being*, learners "come to life in response to what they hear," their engagement through receptivity and responsiveness prompts deeper meaning and connection-making (Fromm, 1976, p. 18-24).

Fromm retains a hopeful vision of future society based on being rather than having, challenging us to align with this vision through a proposed new science which seeks "not control over nature but control over technique and irrational social forces and institutions that threaten the survival…of the human race" (Fromm, 1976, p. 161). Over four decades after *To Have or To Be?*, we find ourselves in the midst of the Anthropocene characterized by rampant environmental degradation, disrespect toward both human and non-human life, and the paradoxical realization of our complete interdependence during a time of social distancing. The class of 2040 and, more importantly, our survival as a species will hinge largely upon our ability to shift higher education from a system of *having* to one of *being*.

When envisioning the future of STEM and higher education, we should consider the overarching dimensions within which knowledge is created and transmitted. For this we may look to the interdisciplinary Quintuple Helix framework developed by Carayannis and Campbell (2010) which combines and builds upon Gibbon's Modes of Knowledge Production (1994) and the Triple Helix Model of Etzkowitz and Leydesdorff (2000). These earlier frameworks identified the subsystems of academia, industry, government, and, later, society as part of the larger knowledge system. With the more recent addition of nature as this sixth subsystem ("helix") encompassing the others, however, we can visualize our environment as the "central and equivalent component of and for knowledge production and innovation" (Carayannis, Barth, & Campbell, 2012). This macro model may be scaled down to fit the individual campus or any place knowledge is produced and distributed. With it, let us consider the following:

First, we must transcend self-imposed limits in favor of a more holistic pursuit and diffusion of knowledge which values alternative ways of knowing, modes of inquiry, and pedagogies. The immediate future, as well as the one waiting two decades ahead needs more than advanced technical skills training, siloed thinking, and low retention rates; our students certainly need more in the present. For a more inclusive science, boundaries of every kind should be gradually phased out in favor of integration. The National Academies' *Branches from the Same Tree* (2018) issued a powerful call for this return to a more holistic approach to education, noting our progressive fragmentation along "artificial" disciplinary boundaries and calling for greater resource allocation toward "novel, experimental, and expanded efforts" to integrate the sciences with other disciplines. This trend toward holism echoes previous federal STEM education emphases such as *Vision in*

Change compiled by the American Association for the Advancement of Science which highlights core competencies for (biological) scientific literacy including: “The ability to tap into the interdisciplinary nature of science; The ability to communicate and collaborate with other disciplines;” and “The ability to understand relationships between science and society” (Brewer & Smith, 2011). These initiatives and the continued development inter- and transdisciplinary fields such as bioinformatics, neuroscience, and even gender studies illicit hope that a true *uni*versity rather than our current “multiversity” model (Donovan, 2016; Kerr, 1963) may be possible.

Similarly, venturing further into interdisciplinary space will naturally add breadth to depth, establishing new connections within the collective knowledge and promoting an ecosystem ripe for innovation. Simply reflecting upon the validity and arrangement of what we know as disciplines or distinct fields of study is a valuable exercise for all faculty and administration, but it may be of particular service to undergraduates whose ability to conduct high-impact, low-risk research provides an ideal cross-pollination vehicle for the fruition of novelty. While signs of integration policy development and emergence of diverse new knowledge forms emerging between disciplines are significant, they must be nurtured and allowed to thrive at the core of the institution, rather than remaining relegated to the periphery. They must also be presented as valid pathways for undergraduate exploration. This step in conjunction with more integrative curricula will serve to introduce students across disciplinary orientations to the larger scientific toolbox available to them outside of isolated established traditions. Furthermore, this may promote greater team-based multidisciplinary collaboration which closely mimics the current and, likely, future practices of science, engineering, and medicine (Hadfield-Hill et al., 2020; Thompson et al., 2017; Varpio & MacLeod, 2020).

Finally, shifts toward integration must occur within a framework of sustainability focused on *being* over *having*. A dissipative structure maintains a constant flow of energy, restoring and regenerating itself through autopoeisis. If this flow of energy reaches a point of instability, the structure is transformed into emergent new states of order as "Life constantly reaches out into novelty” (Capra, 2002, p. 14). Higher education can embrace this core concept of life, reorienting internal structures toward a vision of sustainability that will better serve STEM learners while honoring nature as both our source of and reason for knowledge seeking whose salvation or destruction will be mutually felt. “One step in the new direction will be followed by the next, and taken in the right direction, these steps mean everything” (Fromm, 1976, p. 184-185).

References

Brewer, C. A., & Smith, D. (2011). Vision and change in undergraduate biology education: a call to action. *American Association for the Advancement of Science, Washington, DC*.

Carayannis, E. G., Barth, T. D., & Campbell, D. F. (2012). The Quintuple Helix innovation model: global warming as a challenge and driver for innovation. *Journal of innovation and entrepreneurship*, *1*(1), 1-12.

Carayannis, E. G., & Campbell, D. F. (2010). Triple Helix, Quadruple Helix and Quintuple Helix and how do knowledge, innovation and the environment relate to each other?: a proposed framework for a trans-disciplinary analysis of sustainable development and social ecology. *International Journal of Social Ecology and Sustainable Development (IJSESD)*, *1*(1), 41-69.

Donovan, C. (2016). From multiversity to postmodern university. In *Routledge Handbook of the Sociology of Higher Education* (pp. 85-93). Routledge.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research policy*, *29*(2), 109-123.

Gibbons, M. (Ed.). (1994). *The new production of knowledge: The dynamics of science and research in contemporary societies*. Sage.

Hadfield-Hill, S., Horton, J., Kraftl, P., Balestieri, J. A. P., Vilanova, M. R. N., Dias, R. A., & Soares, P. V. (2020). Spaces of interdisciplinary in/congruity: the coming together of engineers and social scientists in planning for sustainable urban environments. *International Journal of Urban Sustainable Development*, 1-16.

Kerr, C. (1963). The idea of a multiversity. *The uses of the university*, *5*, 1-45.

National Academies of Sciences, Engineering, and Medicine. (2018). *The integration of the humanities and arts with sciences, engineering, and medicine in higher education: Branches from the same tree*. National Academies Press.

Thompson, M. A., Owen, S., Lindsay, J. M., Leonard, G. S., & Cronin, S. J. (2017). Scientist and stakeholder perspectives of transdisciplinary research: Early attitudes, expectations, and tensions. *Environmental Science & Policy*, *74*, 30-39.

Varpio, L., & MacLeod, A. (2020). Philosophy of Science Series: Harnessing the Multidisciplinary Edge Effect by Exploring Paradigms, Ontologies, Epistemologies, Axiologies, and Methodologies. *Academic Medicine*, *95*(5), 686-689.