



## REVIEW

# Review of National Academies of Science, Engineering, and Medicine (NASEM) Report, Integration of the Humanities and Arts with Sciences, Engineering, and Medicine: Branches from the Same Tree

**Katayoun Chamany**

*Eugene Lang College of Liberal Arts at The New School*

On May 7, 2018, The National Academies of Science, Engineering, and Medicine (NASEM) released a report, *Integration of the Humanities and Arts with Sciences, Engineering, and Medicine: Branches from the Same Tree*, which champions the integration of arts and humanities with STEMM (STEM + Medicine). An ad hoc committee, comprising 22 experts spanning education, industry, and policy, met over three years gathering best practices and hosting workshops and open meetings. The committee developed a consensus report and a compendium of more than 200 examples (<https://www.nap.edu/resource/24988/AH%20STEMM%20Programs%201010.pdf>), some of which are SENCER-related projects. Kristin Boudreau, Professor and Department Head of

the Humanities and Arts at Worcester Polytechnic Institute, is at the helm of SENCER's New England Center of Innovation and was a member of the committee charged with developing the consensus report.

The timing of this project and the publication of the report are of import. The project was launched on December 2, 2015, when Obama was in office and a strong focus on STEM education in community colleges was established as a priority. The December workshop, funded by the Andrew Mellon Foundation and hosted by the National Academies of Science Board on Higher Education and Workforce (BHEW) (<http://sites.nationalacademies.org/PGA/bhew/index.htm>), was attended by 110 artists, engineers, educators, policy makers,

and industry experts. The ensuing project garnered additional funding from the National Endowment for the Arts (NEA) and the National Endowment for the Humanities (NEH).

Despite cutbacks under the new administration, the project endured and included an investigation of a wealth of resources, models, and institutional examples of organizational and pedagogical change to determine how integrated learning can serve all students. Perhaps, now more than ever, given the growing chasms in our society, integrated learning is essential if we are to provide our students with the tools to address social change, and the findings of this report are useful. During the question and answer period of the meeting that launched this NASEM report, James Grossman, the Executive Director of American Historical Society, commented that "thinking about teaching in and beyond a discipline has to become as important as thinking about research in and beyond a discipline." He argues that the challenge of promoting interdisciplinary teaching may require educators and students to reconsider how they identify; that we need to rethink about ourselves (NASEM, 1:12 min time stamp).

The project was spearheaded by the BHEW and other divisions and units within the NASEM, with the specific goal of providing an evidence base for the integration of humanities and arts and STEMM to inform "new projects aimed at improving the understanding and application of STEMM toward the social, economic and cultural well-being of the nation and planet." The committee analyzed evidence to determine how STEMM experiences enhance the knowledge base of students studying the arts and humanities, so that they make sound decisions across all professional fields and contribute to a vibrant democracy. Likewise, the committee also analyzed evidence regarding the value of including arts and humanities perspectives in STEMM academic programs to produce more effective communicators, problem solvers, and leaders, who recognize the broad social and cultural impacts of STEMM. In both instances, the hypothesis being tested was that student populations could expand their skills of critical thinking, creativity, and innovation using these complementary perspectives and different ways of knowing to develop meaningful lives and careers (see Chapter 6 for examples).

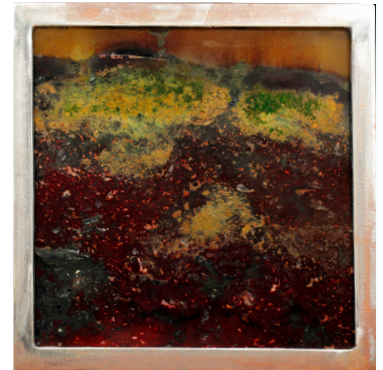
One example in particular stood out because of its effect on retention of the diverse student population served by the City University of New York (CUNY) community colleges. The Guttman Community College's two-semester City Seminar, fulfills the general education requirements of quantitative reasoning, critical thinking, writing, and reading and has a 27% completion rate as opposed to the 4.1% completion rate of other CUNY community colleges. They credit this success to their interdisciplinary approach, which meets all the general education requirements in one course, rather than distributing them among many.

A closer look at the charge of the NASEM committee suggests that on a national level we are finally beginning to address the criticisms of social science and humanities scholars regarding the 1945 report titled *Science: The Endless Frontier*. This report championed the unfettered advancement of STEM with no attention given to the valuable insights provided by humanities and social science perspectives. Vannevar Bush, Director of the Office of Scientific Research and Development, authored this six-chapter report as a response to President Franklin D. Roosevelt's request to expand the goals and benefits of science beyond its wartime focus on the military. Additionally, the report argued that science learning should be more accessible and that scientific research should be more transparent to the American public. The report led to the establishment of the National Science Foundation, with the goal of ensuring national security, economic progress, and cultural growth, akin to the current charge by BHEW.

Some of the criticisms of the *Science: The Endless Frontier* report are contained in a collection of papers published by scholars in the humanities and social sciences on the 50th anniversary of its publication. Highlights appear in *Science the Endless Frontier: Learning from the Past, Designing for the Future* ([https://cspo.org/legacy/library/090729F3GD\\_lib\\_BushconferenceHi.pdf](https://cspo.org/legacy/library/090729F3GD_lib_BushconferenceHi.pdf)), which presents papers from a conference series held between 1994 and 1996 and includes responses and updates to the Bush Report, arguing that a lack of integrated knowledge would mean the demise of a STEM-centric approach to learning. Similarly, in "Is it possible to just teach biology?" (Horton & Freire, 1990), educational philosopher Paulo Freire and founder of the Highlander School Myles Horton also argue that to teach STEM

**Wightman, Jenifer. Gowanus Canal. Portraits of NYC. Steel, glass, silicone, eggs, newspaper, chalk and mud from the Gowanus Canal, Brooklyn, NY. 15"x15"x2". Installed on Governor's Island for the Swing Space Residency hosted by the Lower Manhattan Cultural Council, NY, NY. September-December 2012. One-week and three-month images alongside three-month image printed on textile. Copyright Jenifer Wightman. ([www.audiblewink.com/gowanusbox.html](http://www.audiblewink.com/gowanusbox.html))**

Jenifer Wightman, a scientist and artist, creates "color fields" that combine methodologies from art (Mark Rothko's color fields) and science (Winogradsky biochemistry columns) to showcase ecological succession, biodiversity, and resilience of bacteria growing in a Superfund site. Wightman writes about her process using traditional formats such as the peer-reviewed journal research article where she describes her scientific method, and supplements this with drawings, journal entries, images, and process photographs. Her approach to integrating art, humanities, and science mixes content and method. Her artwork, videos, and articles are used as resources for courses in the first-year core curricula at Parsons School of Design, Eugene Lang College for Liberal Arts at The New School and Science+Art+Design workshops hosted by the New School for the community. Students apply this project to their learning about water quality testing using color detection for microbial metabolites, sustainable dyeing of textiles with microbial pigments, and visualization techniques that use light and biological processes to make the invisible visible.



without social context is a mistake. At the NASEM meeting to launch the *Branches* report, some committee members remarked how these sentiments led to Leadership in Science and Humanities opportunities funded by the Fund for the Improvement of Postsecondary Education (FIPSE) and the NEA in the 1990s, which were not sustained but must now be renewed.

The NASEM report recognizes those early criticisms and acknowledges that change is underfoot. The evolution of their charge is apparent with its emphasis on looking at integration as a two-way phenomenon that will improve the cultural well being of not only the nation, but also the planet. Over the last thirty years, curricular resources for integrated learning have moved beyond the social sciences to include the necessary perspectives that are central to the arts and humanities. The STEAM (STEM +Arts) and STEAMD (STEM+Arts+Design) movements take steps in that direction, with concrete collaborations and multi-institutional efforts underway. Examples include the Vertical Integrated Projects Initiative (VIP), with a strong focus on research, innovation, and design; Creativity Connects (<https://www.arts.gov/50th/creativity-connects>), funded by the NEA in 2016, which connects academic institutions with community partners, businesses, and artists; and the Bridging Cultures initiative

(<https://www.neh.gov/divisions/bridging-cultures>), launched in 2012 by the NEH. That two of these successful programs—Georgia Tech VIP (<http://www.vip.gatech.edu>) and Montgomery College Global Humanities Institute (<https://cms.montgomerycollege.edu/globalhumanities/>)—have connections to SENCER is no surprise

Though curricular resources are emerging, a quick review of the archived video footage of the meeting that accompanied the launch of *Branches from the Same Tree* reveals two things. Committee Chair David J. Skorton, Secretary of the Smithsonian, chuckled multiple times as he revealed that the committee was governed from the ground up, reflecting the horizontal nature that often accompanies interdisciplinary learning. He claimed to have little authority to rein in the committee members, and instead allowed their collective expertise to guide the process. The second interesting reveal is that the committee found little research in the way of "controlled" studies regarding how integrated learning influences student learning outcomes. In response to an attendee's question regarding challenges (see Chapter 4 and the video link [[http://sites.nationalacademies.org/PGA/bhew/branches/PGA\\_185825](http://sites.nationalacademies.org/PGA/bhew/branches/PGA_185825)]), Chair Skorkin mentioned the number of confounding variables that are part of each



student's life and make controlled studies impossible. In Chapter 4 of the report, the authors also remark that implementation of integrated courses can involve multiple variables that are difficult to tease apart or control, as they are distributed across different institutions and adapted/adopted by different faculty members. Moreover, the integrated course is not always a single treatment or intervention, but instead involves multiple factors, such as content, methodology, pedagogy, and assessment. Despite the limited evidence, the committee members believe that what they have seen is promising for students at two-year and four-year undergraduate institutions, as well as those in graduate programs. Ashley Bear, the NASEM Study Director, feels that evidence gathered from the responses to the "Dear Colleague Letter" provide a rich collection of different methods and approaches to showcasing student learning, as do the comments gathered from employers and alumni, which are encapsulated in Chapter 6 of the report.

In Chapter 3 of the *Branches* report, "What is Integration?" the authors are careful to point out that disciplinary knowledge without synthesis does little to support the understanding of emergent ideas. Stephen J. Kline's work on multidisciplinary learning is cited and his attention to emergence reminded me of another important piece of work, by David Edwards, arts scientist and author of *Artscience: Creativity in a Post-Google Generation* (2009). Kline and Edwards advocate thinking more creatively about how arts, social science, and natural sciences can lead to new ways of doing and thinking. Yet many examples of integration remain at the level of service to one or the other discipline, which the report describes as "superficial." For example, many courses seek to use the arts to communicate scientific knowledge or practice, or they use scientific methods to illuminate art practices as seen in art conservation. As the chapter illustrates, integration is a developmental process. As one moves from multidisciplinary to interdisciplinary to transdisciplinary, the emergent practice, method, or ideas can transform and morph an existing discipline or field, or produce a new one, or use a wholly different integrated approach to addressing a crisis, as seen with Mary Beth Hefferman's work on the PPE Portrait project, which is designed to address the lack of humanistic interaction in highly contagious infectious disease treatment centers (p. 13 of the report).

Many attendees at the meeting that launched the report's publication on May 7, 2018 were interested to learn of any potential opposition to the proposed integration model. Committee Member Bonnie Thorton-Hill remarked that many of the best models could be found outside traditional department structures, in institutes and centers. Because investment in infrastructure to support these initiatives may be a significant hurdle for some institutions, many authors of the report and attendees at the meeting saw this as an opportune time for the federal government to take the lead and stimulate implementation and research through funding streams and new initiatives. Further, the committee stressed the need to refrain from draining disciplinary resources but instead to build upon them. Another concern raised by attendees was how this work would be valued in promotion and tenure reviews, federal funding, and national accreditation standards, and some suggestions designed to address these inquiries are provided in Chapter 5 and on pp. 7–8 of the summary report.

Perhaps what was most refreshing about the attendees and the authors of the *Branches* report was the diversity of disciplinary perspectives, lived experiences, cultural and ethnic backgrounds, and attention to the changing nature of our student populations. Many of the examples presented in the chapters and mentioned at the meeting highlighted the ways in which integrated learning can lead to the development of sound decision-making, empathy, and awareness and tolerance for different ways of knowing and different points of view. These approaches align with the SENCERized approach to teaching and learning.

I would like to end this review with the compendium of more than 200 examples (<https://www.nap.edu/resource/24988/AH%20STEMM%20Programs%201010.pdf>) that is provided as a supplement to the *Branches from the Same Tree* consensus report and the "Gallery of Illuminating and Inspirational Integrative Practices in Higher Education" (<https://www.nap.edu/read/24988/chapter/16>). The latter includes boxes and images scattered throughout the report, as well as a large collection appearing at the end of the report offering images and descriptions of artistic and humanistic scholarship, education, and practice that have been inspired, influenced, or supported by STEM knowledge, processes,

and tools. A few SENCER projects are included in the compendium; some notable exceptions are highlighted below.

In keeping with the proposed next steps presented in the *Branches* report, Gillian Backus and Rita Kranidis, SENCER Leadership Fellows, have launched a STEM-Humanities Consortium effort (<http://ncsce.net/sencer-leadership-fellows-lead-community-input-on-stem-humanities-consortium/>). I encourage our SENCER community to take up the charge of contributing to this effort and to think carefully about how best to organize a multi-institutional research effort to assess the effect of integration on student learning, as described in this report. A list of possible research questions to drive such projects appears on p. 92 of the report.

### Some examples:

- ♦ **From SENCER Hawaii** (<https://sencerhawaii.com/about-us/>): Traditional Hawaiian values align closely with SENCER's ideals and objectives for sustainability and stewardship of our community; curricular resources draw on ethics, culture, and history.
- ♦ **From SENCER Northern Virginia Community College** (<http://www.nvcc.edu/news/press-releases/2014/the-creative-mind-art-science.html>): "The Creative Mind: The Intersection of Art and Science."
- ♦ **From SENCER College of Liberal Arts Auburn University** (<http://ncsce.net/on-campus-auburn-students-research-impact-of-music-on-health-outcome>): The impact of music on health.

## About the Author



*Katayoun Chamany* is the Mohn Family Professor of Natural Sciences and Mathematics at Eugene Lang College of Liberal Arts at The New School and a Senior SENCER Leadership Fellow. She is the author of *Stem Cells Across the Curriculum* which has been selected as a SENCER model course. She is the recipient of the John A. Moore Award for Science as a Way of Knowing from the Society of Integrative and Comparative Biology and the William E. Bennett Award

for Extraordinary Contributions to Citizen Science from the National Center for Science and Civic Engagement.

## References

- Edwards, D. (2009). *Artscience: Creativity in a Post-Google Generation*. Cambridge, MA: Harvard University Press.
- Horton, M., & Freire, P. (1990). *Is it possible just to teach biology?* In Bell, B., Gaventa, J., & Peters, J. M. (Eds.), *We make the road by walking: Conversations on education and social change* (pp. 102–109). Philadelphia: Temple University Press.
- 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*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/24988>. (Video link to Meeting held on May 7, 2018. (<https://livestream.com/NASEM/events/8162141/videos/174486427>) Q &A is rich in ideas for implementation and next steps.)
- Wightman, J. (2012). Winogradsky Rothko: Bacterial ecosystem as pastoral landscape. *Journal of Visual Culture*, 7(3), 309–334. Retrieved from <http://journals.sagepub.com/doi/abs/10.1177/1470412908096339>
- Wightman, J. (2012). Gowanus Canal Timelapse. Retrieved from <https://vimeo.com/62655839>
- Wightman, J. 2012. Winogradsky Rothko: Bacterial Ecosystem as Pastoral Landscape. *Journal of Visual Culture*. 7(3):309-334. Link <http://journals.sagepub.com/doi/abs/10.1177/1470412908096339>
- Wightman, J. 2012. Gowanus Canal Timelapse. Link Video of dynamic bacterial sculpture and her website for Gowanus Box-Set. <http://www.audiblewink.com/gowanusbox.html>