The *Original* "Integrative STEM Education" Definition: Explained

—Mark Sanders, Professor Emeritus, Integrative STEM Education, Virginia Tech March 17, 2015

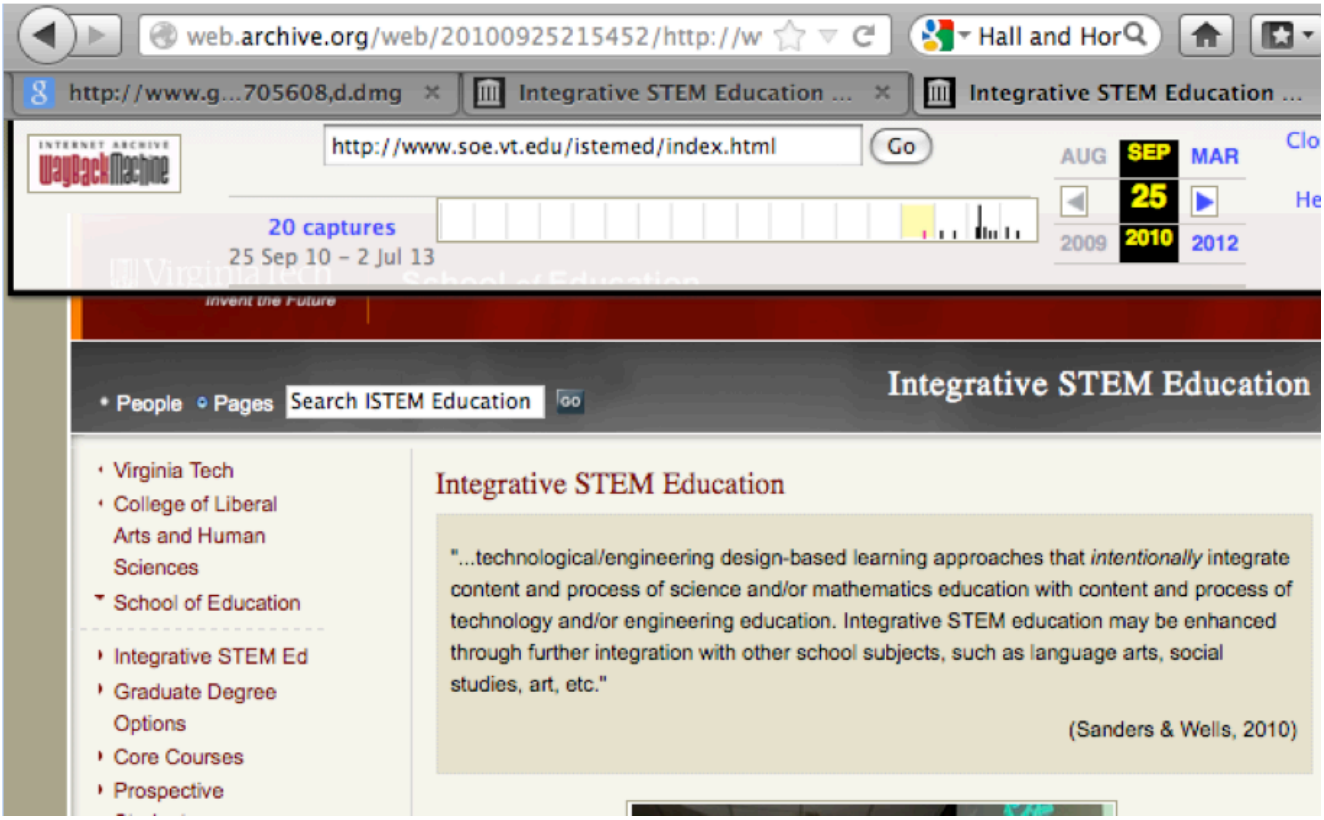
My work with integrative STEM education began in 1990 with the NSF-funded *Technology, Science, Mathematics Integration Project*, for which Jim LaPorte and I served as Co-PIs from 1990-1996… and has continued since. When central administration at Virginia Tech decided, in 2003, to phase out all undergraduate teacher education programs, including ours, I proposed (to administrators (in 2003) the idea of launching a new "STEM Education Graduate Program." They supported that idea by granting our program (me) a new tenure-track position, which led to our hiring John Wells (in 2005) for the purpose of co-developing the "STEM Education" Graduate Program I had suggested two years earlier.

We launched that "STEM Education" graduate program in 2006. By 2008, I was convinced "STEM Education" was (and always would be) a hopelessly ambiguous phrase, and therefore felt we absolutely needed to rename our "STEM Education" graduate program and develop a tight operational definition of the central idea underlying our program, in hopes of preventing the sort of hopeless ambiguity that ruined the term "STEM education" from ruining our new program name as well.

I suggested a handful of adjectives (interdisciplinary, integrated, etc.) and new program names before John agreed to "Integrative STEM Education"(integrative" had come to me when I heard a radio ad for "Virginia Integrative Medicine," and John liked "integrative" because Lee Shulman had been using "integrative" in his work, which I struck me as an added bonus). So, I drafted and revised a half dozen definitions of integrative STEM education, with feedback from John on each subsequent revision. It took us a couple of weeks before we agreed upon the *original operational definition* of "integrative STEM education" that appears below. Although I immediately posted that definition on our Integrative STEM Education Program Web site (in 2009), I usually cite that original definition as "Sanders & Wells, 2010, because the original 2009 version was replaced on our Program Web site with a nearly identical "Wells & Ernst" version shortly after I retired, and because the "Internet Archive" version of the original definition (see Figure 1 and http://web.archive.org/web/20110807171941/http://www.soe.vt.edu/istemed/index.html) makes that original Sanders & Wells 2010 definition easy to cite.

> **Here is the text of the original definition of "Integrative STEM Education,"** which also appears in Figure 1:
>
> "Integrative STEM Education refers to technological/engineering design-based learning approaches that intentionally integrate content and process of science and/or mathematics education with content and process of technology and/or engineering education. Integrative STEM education may be enhanced through further integration with other school subjects, such as language arts, social studies, art, etc. (Sanders & Wells 2010)"

Figure 1: This is a screen capture of the original (Sanders & Wells) "integrative STEM education" definition as it appeared on our Program Web site in 2010. **Note the credit and date in the lower lower right corner.**



It is my hope that those who write about "integrative STEM education" will cite my role in the development of the original definition of "integrative STEM education" rather than omit my name from that formative story altogether, cite definitions of integrative STEM nearly identical, or other definitions and explanations they might encounter on the Web or elsewhere.

For more robust explanations of "integrative STEM education," see:

Sanders, M. (2013). Integrative STEM Education defined. In *National Dropout Prevention Center/Network Newsletter*, *24*, (1), 6. http://www.dropoutprevention.org/sites/default/files/newsletters-v42n1-2013.pdf [and http://hdl.handle.net/10919/51617]

and

Sanders, M. E. (2012). Integrative STEM education as best practice. In H. Middleton (Ed.), Explorations *of best practice in technology, design, and engineering education, Vol. 2* 102-117. Griffith University, Gold Coast, Australia. https://vtechworks.lib.vt.edu/handle/10919/51563

After reviewing those two publications, consider the following:

Mark Sanders' Integrative STEM Education-related Works

(chronological: 1992-present)

Note: This list is in progress. If you cannot access one or more of these publications, contact me at markmail@vt.edu. Thanks. (March 17, 2015)

LaPorte J. E. & Sanders, M. E. (1992, October). Addressing the process/content dichotomy through the Technology, Science, Mathematics Integration Project. In *Proceedings of the Technology Education Symposium XIV,* (pp. 52-56). Millersville, PA: Millersville University.

LaPorte, J. E. & Sanders, M. E., (1993). The T/S/M integration project: Integrating technology, science, and math in the middle school. *The Technology Teacher, 52*(6), 17-21. https://vtechworks.lib.vt.edu/handle/10919/51623

Sanders & Wells: Integrative STEM Education Definition published on Virginia Tech's Integrative STEM Education program website, 2009-2010.

Sanders, M. E. (1993). Science and technology: A new alliance. *Science Scope, 16*(6), 56-60. https://vtechworks.lib.vt.edu/handle/10919/51622

Childress, V., LaPorte, J. E., & Sanders, M. E. (March, 1994). The technology, science, mathematics integration project: Technology, science, and mathematics teachers working together. *TIES Magazine, pp. 30-35.*

LaPorte, J. E. & Sanders, M. E. (1995). Technology, science, mathematics integration. In E. Martin (Ed.), *Foundations of Technology Education: Yearbook #44 of the Council on Technology Teacher Education*. Peoria, IL: Glencoe/McGraw-Hill, 179-219. https://vtechworks.lib.vt.edu/handle/10919/51614

Sanders, M. E. (1996, June). *Connecting science and technology education: An American perspective*. Invited keynote talk presented at the Science and Technology Education Conference '96, University of Hong Kong.

LaPorte, J. E. & Sanders, M. E. (1996). *Technology, science, mathematics connection activities*. Peoria, IL: Glencoe/McGraw-Hill, 400pp.

Sanders, M. E. (1996, January). *Technology, science, mathematics integration project*. Paper presented at the second Jerusalem International Science and Technology Education Conference, Jerusalem, Israel.

Sanders, M. E. (1996). Scenarios for the "technology standard." *Journal of Technology Education. 7*(2), 2-4. *https://vtechworks.lib.vt.edu/handle/10919/8596*

Sanders, M. E. & Binderup, K. (2000). *Integrating technology education across the curriculum*. Reston, VA: International Technology Education Association.

Sanders, M. E. (2003). Interdisciplinary approaches to teaching technology education. In K. Helguson and A. Schwaller. (Eds.). *Selecting instructional strategies for technology education: Yearbook #52*

of the Council on Technology Teacher Education. Peoria, IL: Glencoe/McGraw-Hill, 65-86. https://vtechworks.lib.vt.edu/handle/10919/51615

Kipperman, D. & Sanders, M. E. (2007). Interdisciplinary approaches to the science, technology, engineering and mathematics education agenda. In D. Barlex & N. Balwin (Eds.), *Design and technology: The next generation*. London: Nuffield Foundation.

LaPorte, J. E. & Sanders, M. E. (2008*). Technology: Engineering & design applications*. Woodland Hills, CA: Glencoe/McGraw-Hill.b300pp.

Sanders, M. E. (2008). STEM, STEM education, STEMmania. *The Technology Teacher, 68*(4), 20-26. https://vtechworks.lib.vt.edu/handle/10919/51616

Sanders, M. E. (2013). *Integrative STEM Education: Retrospect/Prospect*. Invited keynote paper presented at the EpiSTEME-5 Conference, Homi Bhabha Centre for Science Education, Mumbai, India.

Sanders, M. E. (2013). Integrative STEM Education defined. In *National Dropout Prevention Center/Network Newsletter*, *24*, (1), 6. http://www.dropoutprevention.org/sites/default/files/newsletters-v42n1-2013.pdf [and http://hdl.handle.net/10919/51617]

Sanders, M. E. (2012). Integrative STEM education as best practice. In H. Middleton (Ed.), *Explorations of best practice in technology, design, and engineering education,* Vol. 2, 102-117. Griffith University, Gold Coast, Australia. https://vtechworks.lib.vt.edu/handle/10919/51563

Sanders, M. E., Lee, H., & Kwon, H. (2011). Integrative STEM Education: Contemporary trends and Issues. *Korean Journal of Secondary Education Research*, 59(3), 729-762.

Sanders, M. (2015). Integrative STEM Education in the U.S: Retrospect / Prospect (Lengthy draft in editing process.)

Sanders, M. E. (2015) The *Original* "Integrative STEM Education" Definition: Explained. https://vtechworks.lib.vt.edu/handle/10919/51624