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A Learning Community Retrospective Integrating Science and Literature

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A Learning Community Retrospective Integrating Science and Literature

Abstract

The author reflects on his 44-year career as a science instructor, during which he gradually implements new active learning strategies in the classroom and shifts to integrating science and literature in the teaching of learning communities. The author describes three learning communities to show how the disciplines of science and literature can be integrated in productive ways. The author is especially pleased that students became more active and productive learners and also appeared to demonstrate increased confidence and enjoyment of their learning community classes because the courses integrated cultural and scientific perspectives, and were interactive as well as personally and socially relevant.

Keywords

active learning, interdisciplinary, science, STEM

Cover Page Footnote

I wish to acknowledge Dr. Kim Hicks Professor of English in the Humanities and Fine Arts Division, who was my teaching colleague in the featured learning communities integrating science and literature.

I began my academic career at Holyoke Community College (HCC), located in western Massachusetts, by teaching general chemistry in the Division of Mathematics, Science, and Technology (MST Division). As a young 26-year-old Assistant Professor of Chemistry, I felt more like a student than a professor. I vividly recall being anxious and nervous in my initial class meeting, but I was also excited and enthusiastic because I was beginning a professional career doing what I loved doing: teaching! It was a challenging experience, one that required reflection and adjustments to pedagogy to maintain/improve student academic success and retention. I was always enthusiastic, and extremely well organized. I provided detailed blackboard lecture notes, illustrated principles of chemistry with molecular models and demonstrations, developed quantitative skills reasoning, demonstrated how to solve problems, developed handouts for supplementary practice problems, smiled and provided humorous anecdotes and puns, met students in my office for help sessions as needed, and remained personable and committed in promoting student success. But was that enough? I knew that I had to more fully engage students in the learning process but it took me over twenty five years before I significantly changed my entire pedagogical approach by integrating science and literature.

After teaching traditional chemistry for 12 years, I served as the Chairperson of the MST Division. During my years in middle management, I observed and evaluated divisional faculty teaching math and science. I soon learned that some faculty seemed less committed to pedagogy than others. I was discovering through my own personal observations why there was so much attrition in STEM (Science, Technology, Engineering, and Math) curricula. The instruction was authoritarian with little or no student participation. Course instruction was often dull and boring, with little or no class discussion. During this time period, I elected to enroll in theater courses, wrote one-act plays, performed on stage, and earned a degree in Arts and Science with a Drama Option. Theater energized me and inspired me to consider fusing Arts and Science together (as it should be). It was as if Eugene Ionesco of absurdist theater beckoned me to introduce him to the world of Niels Bohr, the Nobel prize winner in physics. Unknowingly, I stood on the threshold of embracing student active learning and interdisciplinary learning as my new ventures.

When I returned to full-time teaching, I became the HCC Coordinator for and active faculty participant in STEMTEC (Science, Technology, Engineering, Mathematics, Teacher Education Collaborative). STEMTEC was a 5-year teacher preparation grant, funded by a National Science Foundation (NSF) grant whose goals were to assist college faculty and K12 teachers to learn and adapt new pedagogic approaches in science/math courses. The grant was designed to encourage college students to pursue teaching careers in science/math. The key to success would require college faculty and K12 teachers to redesign their math and

science courses by using effective student-active learning strategies such as cooperative learning, seminar, interactive lectures, small group discussions, interdisciplinary learning, and new assessment techniques. A commitment to student active learning could help transform the classroom from passive, dull, and boring faculty-dominated lectures to collaborative learning that could become the new approach to teaching science. Collaborative learning is a process designed to create active rather than passive learning environments, shifting the responsibility to students for their own learning. Changing the focus to student active learning could be better achieved with small group work involving three or four students in discussion (rather than taking lecture notes) and by doing extensive take-home, open book exercises for evaluation rather than standard “fact recollection” in-class testing.

Integrating Science and Literature

From Spring 1997 to Spring 2012, I taught 16 learning communities that integrated science and literature. There were ten different themes, each with different literature and science integrations, none of which were taught more than twice. All the learning communities were team-taught by two faculty members, each from a different discipline, with a cohort of approximately 20 students. The course work was embedded in an integrated program of study that was developed, in detail, by the two faculty members.

Why integrate a lab science course with an English course? All HCC students earning an Associate’s degree must successfully complete two semesters of laboratory science and two semesters of English (College Composition). Not only do these learning communities fulfill HCC degree requirements, but they also transfer college credits to 4-year colleges and universities. College Composition I (ENG 101), Expository Writing and Research, is the first half of the college composition sequence and focuses on expository writing whereas Composition II (ENG 102) is the second semester course that focuses on comprehending literary works, thinking critically, and writing analytically. The emphasis is on writing critically about fiction, poetry, and drama. The writing class was paired with a Topics in Science course that is rigorously developed and may include chemistry, physics, biology, environmental science, oceanography, and geology. The integration of science with literature addresses the cultural divide described by C. P. Snow (1959) in *The Two Cultures and the Scientific Revolution*. Snow contended that, in western society, knowledge has been split into virtual non-integrative separation of science from humanities, a split that hinders solving the world’s problems and negatively impacts the future of education in society.

ENG 102 is particularly well suited in a pairing with a lab science course because traditional science courses are so content driven when taught alone that there is little or no time for extensive discussion, written analysis, seminar,

question and answer sessions, application of scientific knowledge to environmental concerns, and opportunities to explore and understand the differences between knowledge and speculations developed without supportive evidence.

By the end of the semester, the successful student was able to develop an appreciation for and insight into how literature reflects a culture's attitudes, values, and aspirations; develop an understanding of how we know what we know from scientific and literary perspectives; develop writing skills and the ability to write effectively about literature and science; develop literary analysis skills; apply scientific knowledge to global environmental concerns; and develop awareness of humanity's place in the universe.

As my HCC colleagues contend in "Reuniting the Arts and Sciences Via Interdisciplinary Learning Communities" (Liu, Maiolatesi, & Mino, 2013), literature can contextualize and "contemporize" science, thus acting as a cognitive and affective pathway for learning, applying, and transferring science knowledge to real world issues and problems.

How literature specifically enhances the teaching of science in learning communities in significant ways is illustrated in the following detailed descriptions of three learning communities: *Conservation, Connections and Change: Water and the Environment; Hazards and Disasters*; and *The Pleasure of Finding Things Out*. All three of these learning communities were developed as Honors Learning Communities with Kim Hicks of the Humanities Division.

Conservation, Connections, and Change: Water and the Environment

This learning community investigated how Earth's waters originated, how to best conserve and protect the planet's water, and how these questions have intrigued both scientists and artists for many years. The learning community used science to explore the literal and metaphoric meanings of water by studying water's chemical and physical properties and the ways humans have used and misused water as a natural resource. The science topics focused on acid rain, deteriorating water quality, the world's insatiable appetite for energy resources, and the impact of global warming and climate change upon water and the environment. The literature provided the opportunity to more fully consider political, economic, and spiritual meanings of water, water rights, values, and ethical issues, resulting in a more comprehensive analysis of the connections and change between water and the environment.

Specific questions guided our inquiry: How did Earth become a water planet? How reliable are the scientific theories about water? What exactly is water, and where did it come from? Do stories and myths about water's creation provide insights to its origins? Early Earth was a world without water, so how did it become a bountiful planet of continents, oceans, and atmosphere? Use of scientific and

literary resources allowed the learning community to have a deeper and more comprehensive analysis of water and the environment.

Water's protean nature enables it to be cleansing and empowering but also devastatingly destructive. We considered water's destructive ability by analyzing the story of the great flood as represented in Genesis, in the novel *Not Wanted on the Voyage* (Findley, 1984), and in the play *Let It Rain* (Christner, 1999).

A major core of the learning community focused on water rights, water wars, and global environmental issues. In this unit, we examined the scientific, political, and spiritual dimensions of global environmental issues: water scarcity, consequences of burning fossil fuels, global warming, climate change, and acid rain. We began our examination in the social/political world with *Water Wars* (Shiva, 2002), an analysis of the privatization of communal water rights. We then turned to *Urinetown*, a musical by Hollmann & Kotis (2003) that provides a unique perspective on water rights (and wrongs). The integrative nature of the learning community enabled the learners not only to learn science but also to learn about issues by reading, writing, seminar-ing, and discussing issues from multiple literary sources.

We also considered water issues on a more expansive scale. Since the Industrial Revolution, humans have discovered how to produce fossil fuel energy and nuclear energy to meet global needs. The gaseous by-products of burning fossil fuels have contributed to acid rain and global warming. We studied the science of acid rain, as well as its devastating consequences.

Finally, we turned to a major focus of heated public debate: the extent of global warming's effect on global climate and the environment. It is indisputably true that global climate is changing. *The Weather Makers* (Flannery, 2006) helped us understand both the science of climate change and its impact upon the water cycle. Octavia Butler's 1995 novel, *The Parable of the Sower*, provided us with a compelling vision of a future in which climate change and water scarcity cause social chaos.

In our final discussions, we looked to both science and literature for paths away from disaster and toward conservation and positive change.

Hazards and Disasters

No matter where we live, we must cope with the effects of natural hazards and disasters. In the *Hazards and Disasters* learning community, we explored natural threats such as volcanoes and earthquakes, as well as those generated, in part, by human activity. We examined patterns of events on earth surface, patterns in topography, locations of volcanic features, plate motions, and earthquake and volcanic data to discover which factors contribute most to catastrophic destruction and how major geologic activities affect climate and air quality. The class text for

the science of earthquakes and volcanoes was *Natural Hazards and Disasters* (Hyndman & Hyndman, 2008).

We also examined the potentially disastrous consequences of humanity's insatiable appetite for energy: deteriorating air and water quality, global warming, climate change, and nuclear contamination. The class science text for human generated hazards and disasters, *Chemistry in Context* (Eubanks & American Chemical Society, 2006), was supplemented by the most current report from the Intergovernmental Panel for Climate Change (IPCC).

Given the destructive power of earthquakes, floods, cyclones, and volcanoes, what sane person would choose to live in their paths? Yet millions have made, and continue to make, this choice. We can understand causes, predict their frequency, prepare for their consequences, and cope with their aftermath in a variety of ways. We can predict and mitigate the consequences of a natural disaster, but moving out of the danger areas is often not considered. In the literary texts, fictional or real characters may be our most viable source of information as to why millions of people choose not to move out of hazardous areas.

The Pleasure of Finding Things Out

As members of this learning community, we explored how we know what we know and how humans affect and are affected by decisions in a complex world with many possibilities. We explored how humanists and scientists depend upon supportive evidence in the development and implementation of ideas and considered the problems encountered in the process.

As we move from childhood into adolescence and beyond, it's all too easy to lose our sense of joy and wonder about the world. We learned why the sky is blue, why the sun rises, and why swimming in the ocean is easier than swimming in a lake. We engaged in a refreshingly enthusiastic view of the world and its workings.

"Beginner's mind" is characterized by openness to experience and a freshness of vision most commonly associated with children but is attainable by people of any age. It's a state of mind commonly associated with well-being and mental health. The joy and wonder of children's learning about the things around them exemplify the state of mind that provides the inspiration for "the pleasure of finding things out." As children, we discover the world anew each day, and our experiences seem unique. We read excerpts from several texts in which scientists, science educators, and psychologists talk about this pleasure. We also explored *Primary Science, Taking the Plunge* (Harlen, 2001) and *A Beginner's Guide to Scientific Method* (Carey, 2012).

We read a graphic novel, *One! Hundred! Demons!*, by Lynda Barry (2002), in which a woman reconnects with her younger self; a collection of nature poems; and a piece of detective fiction, *The Curious Incident of the Dog in the Night-time*, by Mark Haddon (2004), featuring a young detective with a unique worldview and

a superbly logical brain. Other texts that provided insight into the magical world of discovery included *Flow: The Psychology of Optimal Experience* (Csikszentmihalyi, 1991/2008), *Where Good Ideas Come From* (Johnson, 2010), and, of course, *The Pleasure of Finding Things Out* (Feynman, 1999).

The pleasure of learning, knowing, and discovering requires both scientific knowledge and literary analysis. It also requires incorporating the results of analysis and comparisons from a diverse field of academic endeavor, essentially a “third” integrative course. That is why the three learning communities that have been discussed—*Conservation, Connections, and Change: Water and the Environment; Hazards and Disasters*; and *The Pleasure of Finding Things Out*—not only create a far better understanding of the scientific method, environmental science, geology, plate tectonics theory, oceanography, chemistry, and atomic theory but also promote a better understanding of literary, political, and spiritual considerations.

Conclusion

Creating learning communities that promote an interdisciplinary approach to teaching college science and literature to liberal arts students has generally resulted in dramatic improvement in student academic performance. It is noteworthy that 80% of 147 students enrolled in Learning Communities that I have taught with my colleagues at HCC earned grades of A, B, or C.

A common practice for our learning communities is to request students write anonymous end-of-semester course evaluations to be placed on reserve at the HCC library for new students to read at the beginning of the following semester. I would like to conclude with three student voices that are representative of many students taking LCs over my years of teaching.

Student 1: Together we all would become scientists, poets, storytellers, philosophers, and scholars. Not only in the classroom, but in everyday life itself. . . My advice to new learning community students is to read, listen, think, and share. Embrace new topics with an open mind and put some effort into exploring your world from different views.

Student 2: I love this class. One of the reasons is because this class is much more interactive than just being given a book. In this class, our opinion seems to matter. I feel that the professors want the students to discuss every aspect of what we are doing. By having us do work in small groups and using class discussions, I learn more.

Student 3: The course helps open our eyes to different cultural beliefs that make absolute sense!! The subjects that were discussed and led into our finals are science subjects that will be affecting our children, their children, and so on! TEACH ON!

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