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Infusing the Arts into Science and the Sciences into the Arts: An Argument for Interdisciplinary STEAM in Higher Education Pathways

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Abstract
This article presents an argument for the integration of science into English courses in order to emphasize the usefulness of a Science, Technology, Education, Arts, and Mathematics (STEAM) education. The idea for this approach arose after the implementation of a divisional initiative to create learning communities with a STEM cohort of students called Student Persistence and Retention via Curricula, Cohorts, and Centralization (SPARC^3). The author's involvement in teaching a science-infused English course for this program inspired the argument that follows, which outlines why/how the sciences should learn from the humanities and why/how the humanities should learn from the sciences. The purpose of this approach is to outline how important it is for first and second year collegiate educators to teach academic communication, research, and logic in college English courses using provocative science topics and literature that addresses scientific themes. In seeing issues commonly thought of as "science topics" from a different perspective, the humanities help stress analytical thinking, in-depth research, and the importance of precise rhetoric and effective communication. In doing so, this approach provides students with the cognitive tools needed to get involved in scientific discourse, research, and debate through complex reasoning skills encountered through literature, philosophy, and ethics. This study confirms that a new approach to science and the humanities is both necessary and beneficial to collegiate education due to the new demands of the twenty-first century, and the attacks on science and science literacy.

Author/Artist Bio
Christopher W. Thurley is an English instructor at Gaston College in Dallas, NC. He currently acts as the English department's liaison to the science department and teaches an English course specifically designed for science majors which emphasizes the role of communication in science and the convergence of art and science. Mr. Thurley is currently writing his dissertation on the British author Anthony Burgess's time in America and the impact the US had on Burgess's life and work.

Keywords
Cross-curriculum, interdisciplinary, English, literature, STEAM, science

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The necessity for citizen-scientists in the twenty-first century is crucial in the age of anthropogenic climate change and increasing worldwide temperatures and human populations. If climate change, and the impending effects of its arrival, is not serious enough to stress this, then the soon-to-be crises regarding antibiotics, food supply, dwindling biodiversity, and a myriad of other topics should provide enough impetus. These difficult and complex issues, juxtaposed with growing numbers of people throughout the world with a limited knowledge of the sciences—one may be reminded of Carl Sagan's damning observation in 1989, in *Parade Magazine*—is a "prescription for disaster" living in "a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology" (Sagan, 1993, p. 1). There is a need for science educators of the upcoming generation not only to teach courses in their area of study and create new experts, but also to incorporate principles of effective communication of those skills in their curriculum as well as promote empathy and foster critical thinking through the power of literature in order for the sciences to remain focused on the humanitarian aspect of their findings and to achieve a broad and clear dissemination of knowledge through creative problem solvers (Mar, Oatley, & Peterson, 2009). It is for this reason that steering the focus of a college education toward Science, Technology, Engineering, and Math (STEM) is not enough—the arts need to be included in the equation so that students acquire the communication and critical thinking skills associated with literary analysis, reflection, explication, persuasion, and argument.

The idea of incorporating literature into the sciences isn't new, but it's one that is often forgotten and frequently ignored. Unfortunately, even with the current spokespeople and leaders in science knowledge, both the exposed and hidden, and the many avenues of knowledge the Internet has endowed to the world, as well as an increased focus on the art of science, communication, and logic, the rift grows deeper between the public and the science community every time a political candidate chooses not to talk about climate change, every time a snowball is thrown on the floor of the Senate, every time a celebrity mentions pseudoscience in an interview, or every time someone who claims to be a pundit of the sciences presents misinformation. A Pew Research Center report published in 2015 that investigated how science topics were understood by members of the American Association for the Advancement of Science (AAAS) and by the general public revealed massive differences regarding topics such as the safety of consuming Genetically Modified Organisms (GMO) [51 point gap], the human impact on the earth's climate [37 point gap], and the legitimacy of the ideas behind human evolution [33 point gap] with very similar discrepancies being revealed when the general public was asked whether or not scientists were in general consensus on these topics among their discourse groups (Funk, 2015, p. 6).

This gap makes sense in light of the problem of an over-abundance of information sources in the information age, which is why each and every time one of these outlandish television spectacles or online trends occur and a scientist, or group of researchers, doesn't stand up to combat the sporadic temerity of the ignorance that is fueled by misinformation and logical fallacies to correct it, revise it, explain it, and use that situation as a teaching moment, the rift widens and the issues become more divisive, more political—and the general public more unsure of the truth or over-confident in their abilities to do their own information-gathering on the

Internet. This result is due to the unfortunate corollary of the success of the sciences—an equal and opposite reaction—in producing many new avenues of communication to reach the general public, but unfortunately and paradoxically, this increase has not improved the art of communication or the effectiveness of delivering science information, but rather this increase in modes of communication has resulted in a cacophony of voices with limited experts lacking any type of hegemony and, more importantly, recourse or sense of responsibility when the fallacious nature of this unsupported skepticism is exposed. For every groundbreaking moment of progress that erupts out of the limitless possibilities and worldwide connectivity that modern technology provides, a similar negative impact offsets the entire benefit, echoing C. D. Darlington's oft-quoted statement that "every new source from which man has increased his power on the earth has been used to diminish the prospects of his successors. All his progress has been at the expense of damage to his environment which he cannot repair and could not foresee" (1970, p. 168). And because of this constant entropic equilibrium, the Internet has turned into a type of binary construction, a model of duality and bifurcation of productivity and counter-productivity, which is both a symbol of the success and progress of human ingenuity and a sign of the plebeian and corruptible nature of reality. This is why it is so critical in this day and age for there to be an emphasis on teaching the sciences, especially STEM. The aforementioned societal problems are likely what has prompted STEM's resurgence as well as the need to secure more diverse types of students for the roles of future researchers, problem-solvers, and thinkers—a goal and process better achieved through cross-discipline collaboration and learning cohorts.

There is one large caveat to this argument or approach to education, one which will be the crux of this paper's discussion; this ardent promotion of STEM must not ignore one of the key obstructions facing contemporary society's problem with understanding science—the communication and dissemination of scientific knowledge for mass consumption for a potentially lay audience. The endeavor of mass communication for mass consumption and understanding will not only need to place an emphasis on how efficacious a message is, but these communicators must also employ a certain level of imagination to inform the general public, which is why STEM is nothing without incorporating the arts into the equation—essentially producing a more useful acronym, STEAM. Notwithstanding, the sign of a healthy and growing society should, in the twenty-first century especially, be judged by its civilians' intelligence and abilities in the sciences, but equally, and as it has been judged, recorded, and remembered throughout all of human history, by its production of art. Additionally, the collaboration between these two fields should result in paradigm-shifting findings because of the ingenuity brought forth through the union of imagination and knowledge.

The infusion of STEAM into higher education curricula is not a new topic, and it is a topic that such brilliant voices as Steven Pinker and others have been trying to tackle for decades, so the goal of this article is to simply contribute to a pool of many great ideas and great thinkers who have contemplated this issue, but with a recent resurgence in the dangers associated with poor communication of scientifically led aspects of society—vaccines, GMOs, and anthropogenic climate change, just to name a few—the topic of science communication and the many rhetorical devices employed intentionally and unintentionally to distort en masse comprehension of these subjects has caused at the very least a revival in the interest of how science information is acquired and how accurate those acquisitions are and why more educators should start thinking about using a similar method to the one explained in this paper. Quite frequently over the last half decade, there have been publications about science communication that have focused on diction influencing perception, detecting bias, assessing debates regarding science topics, and discerning consensus for politically-charged science debates that have appeared in news outlets, scholarly publications, and demographic reports. This resurgence is both a side effect of modern times regarding the influx of misinformation brought in through the Internet and a positive outcome of renewed, albeit not necessarily valid, skepticism of certain scientific topics. This has ensured that studies are correct, while also revealing an opportunity to polish and refine findings and the approaches to these findings.

Few educators would argue that a first-year writing program specifically designed to instill critical thinking across both literature and contemporary science debates, with an end goal of creating “a citizenry with minds wide awake and a basic understanding of the way the world works” (Sagan, 1993, p. 4), is a bad idea. If the art of communication is desired more and more as the paths for communication continue to increase, then it makes sense that everyone should be working to improve this skill, and future scientists should have an even more severe impetus to seek these skills. Andrew Solomon recently published an article in *The Guardian* outlining the importance of communication in the study of medicine by explaining that the interaction between physician and patient “is part of the cure [because] there is some evidence that people who can speak more fluently receive better medical care; patients deprived of language are often subject to abuse” (Solomon, 2016, par. 2). He goes on to argue that the “division between humanism and science is recent, an Enlightenment idea, a Cartesian duality, and like many such ideas, it served at first to advance a discourse it may now impede” since both the expert and the laymen use “twin vocabularies for the same reality” (Solomon, 2016, par. 4). That disconnect needs to be remedied and the fissures need to be mended. Communication is at the heart of this argument and higher education curriculums need to work to bridge this gap. With communication comes philosophy, literature, and the need for discourse to scaffold knowledge.

Above all else, students should be introduced, acquainted with, and pushed into the realm of discourse during their time in higher education, regardless of what that discourse is or of their ability to effectively contribute. They need to see how knowledge is built and how the world around them constructively works through problems so that they may also get involved in the conversation. It should be the job of all educators to introduce this idea to students, regardless of the area of study, which is essentially a mode and purpose inherent within the structure of the scientific method which was recently used in a second-semester English course at Gaston College with a cohort of students majoring in the sciences, not "as a set of rules of procedure or standards of judgement, but as a form of discourse involving certain strong commitments on the part of those who participate" (Bereiter, 1994, p. 8). The program, entitled Student Persistence and Retention via Curricula, Cohorts, and Centralization (SPARC^3), also has requirements for continued acceptance in the program and has their students participate in other classes within the same cohort during their time at Gaston College. The course was designed to explore the ideas of dialectics, rhetoric, fallacies, and logic, as is expected for the course, but to then apply these critical thinking skills to literature that alludes to matters of scientific import, such as "Rappaccini's Daughter" by Nathaniel Hawthorne and "Tomorrow and Tomorrow and Tomorrow" by Kurt Vonnegut. In doing so, students are confronted with how science and art collide and influence one another. The process is a symbiosis that allows students to engage with material at a deep intellectual level, which transmutes into their attempts to argue their ideas in research papers which explore contemporary scientific debates. They soon realize the difficulties of effective communication, but they have the cognitive tools needed to be reflexive and fix their own theses, approaches, findings, and opinions, as well as the ability to formally critique and respond to the ideas of others.

Instructors, institutes of higher education, and students must all participate in this growing and building of knowledge and discourse that is at the heart of interdisciplinary models of reinvention and integration. Students, and indeed the teachers tasked with the duty of informing them for the betterment of their societies and the world, need to see all sides of the equation that involve retention, comprehension, analysis, and communication because this higher-order cognitive goal cannot be achieved via slim passageways but rather through diverse channels exposing that “coherence sits at the intersection of science and art” (Solomon, 2016, par. 10). In fact, it may very well be that humanity is dependent upon educators’ abilities to teach their students through this new mode.

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