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Can Science Survive Without the Humanities? A Forgotten Creative Reciprocity!

The Academy of Arts and Sciences made the following statement in the Executive Summary of their 2013 *The Heart of the Matter* report: "Scientific advances have been critical to the extraordinary achievements of the past century and we must continue to invest in basic and applied research in the biological and physical sciences. But we also must invest more time, energy, and resources in research and education in the humanities and social sciences." We completely agree and further contend that the study of the humanities is vital for imaginative and innovative thought, particularly in the biological and physical sciences.

In modern standard curriculum, the "arts and sciences" has gradually disengaged and become the arts *or* sciences. In fact, the current Next Generation of Science Standards (NGSS) contains no link to the humanities in its elemental "Three Dimensions" (Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts). However, this contemporary disengagement may have left the sciences without a natural component for deeper, more intuitive modes of thought that the humanities offer. The same 2013 *The Heart of the Matter* Executive Summary also insists that "The humanities and social sciences are not merely elective… They go beyond the immediate and instrumental to help us understand the past and the future." This statement illustrates that it is the humanities, in large part, that have traditionally provided a component for intuitive insight and innovative connections across disciplines and time.

Of course, it is not our intent to criticize the lack of inclusion of the humanities into NGSS' guiding principles, because it is not just the sciences that are suffering from the present loosening of the bond between the arts and the sciences—the disengagement puts both subjects at a disadvantage. Some of the greatest scientific achievements originated from innovators with a balanced foundation of the arts *and* sciences (a few of which we will go into below), as the humanities are integral to adding context and creativity to a scientific education while the sciences provide an equally important empirical and philosophical framework to the humanities. We firmly acknowledge that it is this *reciprocity* that broadens our thinking and paves the way for a comprehensive education.

Understanding the challenge in reviving the art-science reciprocity and putting it into practice, we formed a small group of college educators and leaders tasked with providing positive, effective methods and strategies to reunite the two subjects. Our group is named *S.H.A.P.E. SHIFTERS*, wherein Science, Humanities, Arts, Philosophy, and Education (*S.H.A.P.E*) are revitalized and naturally reintegrated throughout the curricula across disciplines. We classify the current and revitalized approaches to education as the *Or Approach* (arts "or" sciences) and the *And Approach* (arts "and" sciences). As a group, we have developed six strategies to revive the *And Approach*, titled "The Inspirational Six" (The i6). The i6 are Animate, Originate, Rejuvenate, Stimulate, Deus Ex Machina, and Tell the Story, each of which is explained below.

ANIMATE

Meaning and Purpose: To make the subject lively and entertaining for student and teacher; to energize the topic through historical, contemporary, relevant, and unorthodox examples.

One way of animating a subject is to have students act out the role of protagonist or antagonist in a selected account or text and defend the character's ideas as he or she would. This way, students become the person of discussion rather than experiencing the person, their concepts, or ideas from a distance. An historical example of this is Galileo's choice to pen a theatrical play highlighting the differences between Aristotelean and Galilean definitions of motion rather than writing a scientific paper on the distinctions. Galileo's *Dialogues Concerning Two New Sciences* (1638) is written in the form of a Platonic Dialogue between three main characters: Salviati, Sagredo, and Simplicio. The Aristotelean antagonist, Simplicio (a tongue-in-cheek name), defends his theory of motion against the modernistic protagonists, Salviati and Sagredo, who are representatives of the educated population. Galileo's final work, in the form of a dramatic play, laid the foundation upon which all contemporary science rested until the end of the last century. Additionally, the play demonstrates a valuable model for "animating" subjects of study for students in a lively and entertaining way.

ORIGINATE

Meaning and Purpose: To reveal original sources of emergent thinking from different disciplines; to encourage original thought.

Revealing historical examples of original thinking and its impact exposes students to the interdependence

across arts and sciences, as well as its influence on our modern world. Such accounts can inspire students to engage in original and creative thinking to discover new possibilities. For example, Beethoven's loss of hearing pushed him to develop alternative hearing methods and devices. One of his methods was to clench the end of a stick between his teeth and press the other end to the piano, allowing him to "hear" through the vibrations in his jaw. This later led to a communication system, called the interphone, which was used on all American WWII aircraft. Today, using vibrations to "hear" is the basis of Bone Conduction Headphones, hearing devices recently introduced as an alternative to traditional headphones.

REJUVINATE

Meaning and Purpose: To breathe new life into tired ideas; to reinvigorate the connection between sciences and humanities; to reclaim enthusiasm for knowledge.

Rejuvenating the important connection between the sciences and humanities can be accomplished by sharing impactful accounts of how the arts have influenced scientific discovery. Here is a wonderful example: modern science is *precisely* influenced by the writings of Lucretius, a Roman poet and philosopher who lived during the first century B.C.E. His poem, "On the Nature of Things," revived Thales' (an even older, pre-Socratic philosopher) idea that natural questions have natural answers. This text breathed new life into old idea and replaced the longstanding philosophy that natural questions have only supernatural answers. This intellectual shift later lent directly to the Scientific Revolution of the 17th century.

STIMULATE

Meaning and Purpose: To inspire innate curiosity, shifting from passive listener to engaged participant; to stimulate the senses and the mind.

In order to stimulate our students, we lead our classes on what we call "The Aristotle Walk." Together we tour the campus grounds and instruct students to observe their environment through the lens of Aristotle, the great philosopher and scientist. Students then break into groups and are asked, many for the first time, to question and speculate why so many of Aristotle's taxonomies (ancient classifications that include geological and biological similarities and differences) still work so well today. The tour concludes in science laboratories to further explain how Aristotle's ideas began what has ultimately culminated in modern science.

DEUS EX MACHINA

Meaning and Purpose: To introduce diverse, non-obvious ideas from the arts and sciences as solutions to complex problems.

The Latin phrase *deus ex machina* derives from classical Greek and Roman theatre and translates to "a god from a machine." The term was first used to describe the dramatic convention of using a crane to suspend an actor playing a god at the end of plays. The crane allowed the actor to mimic how a god might swoop in and swiftly resolve a seemingly unresolvable plot, though the phrase is most representative of an unexpected person or thing that presents a solution to an ostensibly insoluble problem. *Deus ex machina* is a technique still apparent in modern problem solving, though not necessarily by employing a god or a machine. Ockham's Razor, for example, is a principle that has successfully resolved many unanswered questions to complex problems by "shaving away" unnecessary variables and premises standing in the way of resolution. In practical classroom application, we lead our students in an activity where they must account for an apparently mysterious phenomenon that, in actuality, has a logical or empirical explanation, such as magnetic attraction and repulsion.

TELL THE STORY

To optimize conditions for learning in my courses, I've deMeaning and Purpose: Much of what we teach has a fascinating story behind its discovery. Discover that story and share it! This humanizes lessons, making them relatable and easier to follow, and also helps students better absorb information.

Rather than simply defining the difference between alternating electrical current and direct electrical current, tell the fascinating story of Nikola Tesla and Thomas Edison to make the subject interesting and memorable. Tesla and Edison, once partners in their work, became powerful rivals in the battle over how America would receive electricity. Tesla, partnered with Westinghouse Corporation, was a proponent of alternating current, while Edison, who helped form General Electric, argued for direct current. The men's reputations and millions of dollars were at stake. Edison claimed Tesla's alternating current was dangerous, going so far as to influence the design of the electric chair so it operated on alternating current in order to argue that a method used for death did not belong in homes. It was a grim demonstration, but fortune would soon smile upon Tesla. Westinghouse and General Electric competed over a contract to power the first all-electric World's Fair in 1893. Westinghouse won because alternating current was much cheaper than direct current. When President Grover Cleveland switched the lights on at the World's Fair, people from around the globe witnessed hundreds of lights using alternating current. They also witnessed Tesla, wearing thick rubber soles, as he stood on stage and allowed two million volts to pass through his body. People were awed. The Fair was such a fantastical sight that author L. Frank Baum used it as inspiration for the Emerald City in *The Wizard of Oz*. In the end, Tesla's alternating

current won the greater electric battle when General Electric eventually switched over to alternating current.

As educators, each of us have personally used one or more of the strategies from The i6 at some point in our teaching careers. But while reflecting on our own academic experiences and aggregating this list, we raised the question of why, exactly, the teachers we each remember most fondly have become our role models. We discovered that the teachers we admire are those who have mastered the methods, strategies, and techniques we have collected into The i6. These teachers stand out because they enlightened us to the full potential and breadth of their courses by weaving subjects together rather than allowing them to remain compartmentalized. Fresh life is unearthed in the world around us when we understand how subjects work in tandem, and the exploration of new connections gives rise to prolific creative leaps in the humanities and sciences. Awaken the innate curiosity of your students and cultivate new, creative ways of thinking and learning by using The i6 as a guide for reigniting the reciprocity of the humanities and sciences in your classroom.

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Want to learn more, directly from the authors? "Can Science Survive Without the Humanities? A Forgotten Creative Reciprocity!" will be broadcast as a webinar next week on Thursday, January 31. Visit www.nisod.org/webinars/upcoming-webinars to register now.

You can also contact any of the three authors at info@shapeshiftedu.com.

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