Breaking the Rules: Bringing Calculus into the Humanities Classroom

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Abstract: Calculus in an honors humanities course offers students of different learning styles, interests, and aptitudes an opportunity to understand and appreciate the full range of the humanities, including natural science and mathematics. Students investigate the intellectual history and development of the calculus by reading work by and about Gottfried Wilhelm von Leibniz and Sir Isaac Newton. Without having to understand any of the mathematics, students explore the rich intellectual debates that characterize the late seventeenth century and in so doing help bridge the traditional STEM-non-STEM divide that exists today.

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Humanities courses offer honors programs interactive spaces where honors students with every kind of advanced learning style and disciplinary preference can engage with our Western tradition. In my honors humanities courses, I have designed a unit that challenges these spectrums by having students investigate the intellectual history and development of the calculus by reading work by and about Gottfried Wilhelm von Leibniz and Sir Isaac Newton, its co-inventors.

By reading the writings of both men, students come to see how they developed their ideas of the calculus—the concepts of a rate of change over time—without having to understand any of the actual mathematics. They also get to dive headlong into the rich intellectual debates that characterize the late seventeenth century. Understanding in such debates requires no more than a basic grasp of high school algebra and geometry, which surprises students as much as it boosts their confidence.

The goal is to broaden student's understanding and appreciation of the full range of the humanities, which encompasses both natural science and mathematics. If our humanities classes only favor higher-order thinking and writing exercises that focus on synthesis and judgment to the detriment of definition, method, and categorization in the STEM disciplines, then not only will many STEM students be left out of the full extent of the honors learning loop, but non-STEM students will as well.

Reading Newton, students witness the mind of a true gifted thinker, following Janice Szabos's famous heuristic in "Bright Child, Gifted Learner" almost to the letter. Annmarie Guzy uses Szabos's dichotomy in her recent essay in a special issue of *JNCHC* devoted to gifted learning in honors and suggests that honors courses favoring one learning method over another often put a significant portion of our honors population at a disadvantage (11). She suggests using Szabos's distinction more like a spectrum than a dichotomy between opposing ends. The same case can be made with respect to the STEM and non-STEM divide as well, as Thomas F. Nelson Laird et al. argued (23). Gifted learners are the curious students with bright minds who also tend to do poorly in school out of intellectual boredom. These students, Szabos explains, tend to perform well on standardized tests but only excel in subjects that interest them (18). By reading some of the contemporary biographical works on Newton, students see a gifted honors thinker. Newton's writings on calculus are haphazard and out of conceptual order. Like a gifted learner, he learned what he needed to know in order to accomplish the tasks he set out for himself, but he failed most of his subjects in school.

In Leibniz, students see the other common honors learning style of the high-achiever in coursework and on tests. Reading not only Leibniz's own work but contemporary biographies of him as well, students see a master curve-breaker at work, digesting and processing the concepts of limits and rates of change the way any student of mathematics would, one step at a time. Following Szabos's list of high-achieving traits, Leibniz conquered every intellectual pursuit that was placed before him just as high-achieving students tend to do.

I pair these sets of readings with an analysis of one of their artistic contemporaries, Giovanni Battista Gaulli. Students examine his masterpiece, *The Triumph of the Name of Jesus*, which was showcased the year that Leibniz published his first paper on the calculus. Gaulli's ceiling fresco in the Church of the Gesù in Rome is a triumph of the artistic technique of *quadratura*—the uniting of perspective in painting and architecture through a sophisticated

use of projective geometry, creating a three-dimensional visual effect on the two-dimensional vault of the church ceiling. That the basic curve studied by both Newton and Leibniz at the time was called the "quadrature," students come to realize, is no coincidence. They come to see calculus as an epistemology, a way of knowing and understanding that was employed by many of the mathematicians and artists of the late seventeenth century.

Bringing some conceptual mathematics and science back into the honors humanities curriculum shows students a multi-faceted approach to solving difficult problems in our ever-growing world of intolerance. Calculus defies oversimplifications and forces students to accept that even mathematics offers no absolute approaches to a given problem, only complementary ones. In reading the intellectual history of the calculus through its inventors, students come to see that STEM skills are as integral to artistic production as intuitive leaps of faith are to STEM discoveries like calculus.

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