

The benefits of thinking like a scientist - C. E. Larson: The benefits of thinking like a scientist - and why VCU is at risk

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VCU CURRICULUM

Our modern world, everything that surrounds us, is built on a foundation of theories that are used to successfully make predictions. The acquisition of this knowledge was painstaking.

VCU is in the final stages of revising its General Education (Gen Ed) requirements. While the specific course choices are yet to be announced, the draft outline requires, for instance, little-to-no math and science, and no U.S. history or government.

The proposed curriculum not only appears to be unrigorous and unfocused, but the main problem is that it is implicitly anti-science, at a time when we need to produce graduates - and citizens - who are critical thinkers, and can think like scientists, no matter what discipline they study.

The proposed curriculum needs to be re-evaluated.

I am an associate professor of mathematics and applied mathematics at VCU. The proposed curriculum changes will have no direct effect on my department. Let me emphasize that I am not a philistine science cheerleader - but someone who also has an advanced degree in the humanities (philosophy), and who highly values his own liberal arts education.

On the face of it, the new curriculum seems benign - and every General Ed curriculum everywhere also involves some hodge-podge of courses. But the new VCU curriculum might become a public and national embarrassment for VCU. And VCU might lose students to schools perceived as having more rigorous curricula. It could make our VCU graduates less attractive to other graduate programs and employers.

VCU would be better off focusing on preparing students who can collect relevant data, evaluate and reject theories (in every area of their lives), and propose new ones.

VCU graduates need to be intellectually humble, open to all relevant ideas, ready to discuss any and every alternative. We should have a curriculum that clearly states these goals.

Our modern world, everything that surrounds us, is built on a foundation of theories that are used to successfully make predictions. Newton's laws, Maxwell's laws, and quantum mechanics are predictive theories that have enormous material effects on our lives. The acquisition of this knowledge was painstaking, accumulated over centuries of small successes, failed theories, new evidence, and the development of better theories.

Every scientist knows how much we don't know, how humbling scientific investigation is, how much farther we need to go.

Our society has real problems. There are always political choices to be made - and no magic fixes can be expected from scientific discoveries. That said, all of our choices involve predictions. We hire new school superintendents because we predict they will do better (in some sense) than competing candidates. When they don't, we revise our hypothesis (and fire that person).

We choose a system of government because we predict that it will satisfy more of our goals than alternative systems. When it doesn't we revise the system (or the laws or constitution).

The more information we have, the more possibilities we can imagine; the more experience and data we have, the better predictions we can make.

This is what it means to think like a scientist. It is not that you are right by virtue of being a scientist - you're not. It's that you are used to being wrong and you try your best.

VCU's proposed General Education requirements don't specifically mention "critical thinking" - but they should.

Skeptical ways of thinking need to be specifically encouraged. I once took a social justice class that seemed exciting at the time. I thought we would talk about problems and possible solutions - and address them. But the course was, in fact, taught by a teacher with very specific views. Questions were actively discouraged, and the students were just expected to repeat the teacher's views.

This happens in disciplines where there is less of a tradition of being wrong - and less of the intellectual humility that is part of the practice of the sciences.

There is only space here to mention a single offending guideline from VCU's proposed General Education

curriculum: "Recognize how knowledge is constructed differently in various communities" Knowledge of course is knowledge. But there are fashions in academia that suggest that the most important kinds of knowledge are somehow not universal, and that there is no "truth" to scientific laws.

One of these trends, alluded to in this curriculum guideline is "social constructivism" or the "social construction of knowledge." The main idea here seems to be that, because people discover scientific laws, the discoveries must be somehow dependent on the backgrounds (cultural, political, etc.) of the scientists who made them.

It is certainly true that scientists make up the language they use. (For example, whether a neutron is called a "neutron" or something else is a choice - which becomes a convention).

Insofar as scientific language and practices are conventional, there is something true here in social constructivism - but specific claims (that can be substantiated or falsified by evidence) of social constructionism are rare. Insofar as social constructionism is the backdrop for the rejection of "truth" - especially scientific truth - the new VCU General Ed guideline promoting it is pernicious.

A better guideline here would be to recognize how knowledge is universal, and acquired only slowly over time, with great effort, by serious and thoughtful researchers across the planet.

It has been argued that the anti-science of social constructivists is the intellectual foundation for the rejection of vaccines, the rejection of global warming research, conspiracy theories regarding school shootings and 9/11, and our extreme political division.

I once talked to someone who worked in NASA's public outreach office who answered citizen questions; she told me the majority of the questions she got were about whether the moon landing was real!

We need to train VCU students to find the truth - not that truth is community-dependent - and how to effectively discuss issues. The moon landing either happened or it didn't. There is nothing "constructed" about this.

The VCU General Education curriculum guidelines should require classes that will result in critical thinkers and scientific evaluators of evidence. It should, for instance, require a statistics and computer science course. These are perhaps more foundational than the traditional natural sciences (biology, chemistry and physics).

Statistics is fundamental to critical thinking, any discipline that involves numbers, and many important decisions that citizens and political leaders face. Very few things have single or clear causes: almost nothing is black and white, almost nothing in biology or human interactions involves single causes. Almost every experiment leads to a discussion of "statistical significance."

Similar arguments can be made for basic computer science - it is telling that there is a nationwide push to teach

elementary school kids about what programs are and how computers work, but only a single passing mention in VCU's curriculum guidelines.

VCU has an opportunity to remake its curriculum to be a model for other universities, to have a curriculum that reflects its diverse student body and produces citizen-learners who are prepared to think in provably successful ways, to effectively think of ways to make change, and to use evidence to argue their points of view.

We owe it to our amazing VCU students to give them such an education, to give them the tools to think up, advocate for, and produce real change. To do this they will need to think like scientists.

VCU's provost, the chief academic officer, is Gail Hackett. She will soon make final decisions regarding this new curriculum. Her office is currently accepting comments about the General Education curriculum proposal.

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Caption:

Apollo 17 astronaut Gene Cernan salutes the Stars & Stripes on the moon in December 1972. Truth is often not relative.

Jack Schmitt, NASA, Gravitas Ventures

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