

STEM Education in the Age of “Fake News”: A John Stuart Mill Perspective

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“If a nation expects to be ignorant and free, in a state of civilization, it expects what never was and never will be.”

Thomas Jefferson, 1816

It is widely recognized that American society is deeply polarized along political and ideological lines, and the polarization has become increasingly adversarial, even hostile, in recent years. As my colleague and I have stated elsewhere, “The lack of engagement, understanding, and appreciation between people across these groups is stunning and potentially catastrophic.”¹ Such lack of understanding and deliberation on both sides, it seems, originates not only from an unwillingness to engage and a tendency to demonize and dismiss the other’s viewpoint, but also from a lack of the ability to discern true statements from false ones. The so-called “dumbing down” of America in the age of “fake news,” which is playing an increasingly significant role in shaping the current political culture, is disheartening. Since American democracy relies on a public that is capable of actively expressing ideas and participating in discussions with people who have different perspectives, a citizenry unable to deliberate rationally and meaningfully poses a great threat to its success.

Education in particular has been tasked with equipping youngsters to become contributing members of a democratic society. Specifically, math and science education has been the central place where students learn the skills to discern facts, process information, and draw conclusions and practice ways to search for true knowledge. Such an “art of thinking,” apparently, is vital for democratic societies to thrive. With the current strong nation-wide push for

STEM (Science, Technology, Engineering, and Math) education, and in the age of “fake news,” it may be necessary to investigate how STEM education has been designed and practiced if we want to advance the rational and critical capacities of students. I suggest in this paper that we may have placed too much emphasis on the instrumental purposes of STEM education, on its uses and functions for global competition, job security, and monetary gain, and not enough on learning the art of thinking and transferring such learning to students’ social and personal lives. A brief look at how STEM education is currently conceptualized clearly reveals an exclusively instrumental orientation. Drawing on John Stuart Mill’s ideas of liberal education and the central role of math and science education, I propose a guiding principle for STEM education as basic epistemic education so that it can play a more vital role in forming within citizens the habit of truth seeking and the ability for rational and critical thinking. As Jefferson’s quote makes clear, without knowledge and the intellectual ability to acquire knowledge, there will be no true freedom for a nation that pursues freedom.

THE AGE OF “FAKE NEWS” AND UNREASON

This is the age of “fake news.” The president of the United States has commandeered the term to dismiss news that he does not like or news that is unfavorable to him. His supporters follow suit and claim that the mainstream news outlets, in general terms, are agents of “fake news.” On the other side of the battle, commentators and academics respond that conservative websites and TV channels spread “fake news.” The actual meaning of the term “fake news”—news that lacks solid ground, springing out of proportion from incidents, or purely fabricated but presented as true—seems no longer relevant.

In this shouting match over “fake news,” two disconcerting trends become evident. The first is that, instead of people judging the likelihood of a statement’s reliability and provability, we see blind team-picking, the mindset that “what my team says has to be true and what their team says has to be false.” As Malhar Mali, a social commentator and the editor of *Arvo* magazine, notes, a sizeable portion of the population seems to be uninterested in checking out

whether a statement is based on facts or is possible or provable, but instead makes judgments based on a “we good, they bad” attitude.² This attitude, which Mali calls “tribalism,” is characterized by labeling statements in political terms and then dismissing them based on political allegiance. Such “tribalism,” he laments, has been “exacerbated by social media.”³ People are so swayed by their political positions and are so ready to accept whatever their team is saying that they have lost interest in “truth-seeking,” or even in just question-asking. Instead, they react, often with indignation, when facing a different viewpoint. Jonathan Haidt, a professor of moral psychology at NYU, recently tweeted: “I fear America has attained critical mass: an unstoppable process of reciprocally escalating outrage & disgust, justified via social media.”⁴ The predictable angry reaction to whatever the other side is saying is disheartening. The “absence of curiosity about other points of view, ... the unwillingness to give a hearing to contradictory viewpoints, or to imagine that one might learn anything from an ideological or cultural opponent,” says Susan Jacoby, author of *The Age of American Unreason*, “represents a departure from the best side of American popular and elite intellectual traditions.”⁵

The second trend, which is even more disquieting, is that a portion of the American public seems to be losing the ability to function rationally in a democracy, an ability that is essential for the operation of the system. It is troubling enough that we choose to believe what we want to believe, but to the extent that we still have a level of awareness of what we are doing, and perhaps at a certain point are interested in correcting our mistakes, the choices are still understandable or even acceptable. But if we are losing that awareness, if we are so bound by our beliefs that we are unable to see what we are doing, in other words, if we lose the ability to read critically and think critically, that is truly alarming. In the age of information technology, the sheer volume of information floods the internet and the public arena, and we are faced with the unprecedentedly daunting challenge of discerning what is reliable and what is fabricated. Frank Connolly, a senior editor of MindEdge Learning, says, “With so much information bouncing around the web, you’d think that a lot of Americans would be looking for ways to distinguish the truthful from the false. Alas, no

such luck.”⁶ Not many people are checking the sources, assessing the possibilities, looking for signs of fakery, considering attributions, or simply asking questions, leading to the phenomenon that what we choose to believe becomes what is real. Recent Pew research reveals that “nearly eight-in-ten Americans say that when it comes to important issues facing the country, most Republican and Democratic voters not only disagree over plans and policies, but also cannot agree on basic facts.”⁷ Our common ability to discern information no longer brings us the same understanding. Positionality changes reality.

This alarming trend does not apply just to an older population with hard-core political allegiances; it also applies to the younger, web-savvy population. A 2016 study by Stanford University researchers found that American students have a “dismaying” inability to tell fake news from real.⁸

More than 7,800 middle school, high school, and college students from 12 states participated in the Stanford study. “In exercise after exercise, the researchers were ‘shocked’ — their word, not ours — by how many students failed to effectively evaluate the credibility of that information,” NPR reporter Camila Domonoske states.⁹ “The students displayed a ‘stunning and dismaying consistency’ in their responses, the researchers wrote, getting duped again and again. They weren’t looking for high-level analysis of data but just a ‘reasonable bar’ of, for instance, telling fake accounts from real ones, activist groups from neutral sources and ads from articles.”¹⁰ As cited in Domonoske’s report, Sam Wineburg, lead author of the study, laments, “They didn’t ask where it came from. They didn’t verify it. They simply accepted the picture as fact.” Domonoske warns, “If the children are the future, the future might be very ill-informed” and the students’ lack of critical thinking ability is a “threat to democracy.”¹¹

Similarly, William Poundstone from *Psychology Today* notes that when young people in the street were asked simple questions by a camera crew (as is often done on TV late-night comedy shows, (e.g., Jimmy Kimmel Live!), they often respond with “supremely ignorant answers.” Poundstone concludes with one sentence: “Millennials are ill-informed.”¹²

Are we, as Poundstone suggests, getting stupider and stupider every

generation? Or is there something deeper in the culture that is causing the phenomenon? Richard Hofstadter's Pulitzer Prize-winning *Anti-Intellectualism in American Life*, published in 1962, was inspirational for many who tried to understand the underlying forces affecting American political culture, and now American lives. But Susan Jacoby suggests that beyond mere anti-intellectualism, "America is now ill with a powerful mutant strain of intertwined ignorance, anti-rationalism, and anti-intellectualism."¹³ She suggests:

During the past four decades, America's endemic anti-intellectual tendencies have been grievously exacerbated by a new species of semiconscious anti-rationalism, feeding on and fed by an ignorant popular culture of video images and unremitting noise that leaves no room for contemplation or logic. This new form of anti-rationalism, at odds not only with the nation's heritage of eighteenth-century Enlightenment reason but with modern scientific knowledge, has propelled a surge of anti-intellectualism capable of inflicting vastly greater damage than its historical predecessors inflicted on American culture and politics.¹⁴

As a result of this surge, she says, when "both dumbness and smartness are defined downward—among intellectuals and nonintellectuals alike—it becomes much easier to convince people of the validity of extreme positions."¹⁵ Consequently, conspiracy theories and all types of outrageous ideas and beliefs become part of the popular narratives.

One may wonder what has caused the unfortunate trends. In the 1960's, Hofstadter identified the "appalling phenomenon" of the "irrationality of the college-educated mob"¹⁶ as part of the political source, and more recently some have complained about the uncritical acceptance of "fashionable theories and 'politically correct' dogmas,"¹⁷ but most recent observers have pointed at the Republican party's use of anti-intellectualism as a strategy to mobilize its voter groups. Not only portraying the Democratic party as the party of elites, ideologues, who hold a cultural agenda contrary to conservatives' "traditional" and populist values, the Republican party has also nominated a series of presiden-

tial candidates who may be described as the least intellectually curious.¹⁸ Thus anti-intellectualism has become a central part of the rhetoric of Republican pseudo-populism. As Jacoby notes: “One important element of the resurgent anti-intellectualism in American life is the popular equation of intellectualism with a liberalism supposedly at odds with traditional American values. The entire concept is summed up by the right-wing rubric ‘the elites.’”¹⁹ Doubtless, such anti-intellectualism is also fed by some academic intellectuals’ strategy of “branding and banishing” their conservative opponents and their moving away from the image of intellectuals as described by Hofstadter, as those who live “*for* ideas” rather than “*off* ideas” and whose thinking is marked by “disinterested intelligence, generalizing power, free speculation, fresh observation, creative novelty, radical criticism.”²⁰ As historian Fred Siegel has quipped, intellectuals once talked of speaking truth to power, but now they speak power to truth.²¹ Our political and social culture seems to be moving further and further away from what Jacoby described as the “vibrant and varied intellectual life essential to functional democracy.”²²

STEM EDUCATION

The teaching and learning of rational and critical thinking skills and the cultivation of the habit of truth seeking seem essential to countering such anti-intellectualist and anti-rationalist trends. In recent years, there has been a nation-wide push for STEM education. Resources are reallocated, and educators are called to focus their effort on producing the nation’s next generation of scientists and engineers. As the place where the teaching and learning of the art of thinking is concentrated, and in the context of the “dumbing down” of America in the age of “fake news,” it is important to see how STEM education is practiced and whether such practices help rebuild the vibrant and varied intellectual life Jacoby was speaking about. Has it been teaching the essential thinking and information processing skills as part of the education of the person and the citizen? Unfortunately, a quick review of how STEM education is currently conceptualized reveals an exclusively instrumental orientation. There is hardly any language mentioning STEM for education for personal growth,

for social and civic lives, or for democracy. STEM education is conceptualized only for career needs, economic gain, or global competition.

In a 2007 “National Action Plan for Addressing the Critical Needs of The U.S. Science, Technology, Engineering, and Mathematics Education System,” prepared by The National Science Foundation, STEM education is justified as follows:

In the 21st century, scientific and technological innovations have become increasingly important as we face the benefits and challenges of both globalization and a knowledge-based economy. To succeed in this new information-based and highly technological society, students need to develop their capabilities in STEM to levels much beyond what was considered acceptable in the past... Business and industry leaders, governors, policy makers, educators, higher education officials, and our national defense and security agencies have repeatedly stated the need for efforts to reform the teaching of STEM disciplines in the Nation so that the United States will continue to be competitive in the global, knowledge-based economy.²³

The language emphasizing the instrumental significance of STEM education is everywhere. A website devoted to “Engineering for Kids,” under the title “Why is STEM Education Important?” has these answers:

According to the U.S. Department of Commerce, STEM occupations are growing at 17%, while other occupations are growing at 9.8%. STEM degree holders have a higher income even in non-STEM careers. Science, technology, engineering, and mathematics workers play a key role in the sustained growth and stability of the U.S. economy, and are a critical component to helping the U.S. win the future. STEM education creates critical thinkers, increases science literacy, and enables the next generation of innovators. In-

novation leads to new products and processes that sustain our economy ... It is clear that most jobs of the future will require a basic understanding of math and science ... STEM education is critical to help the United States remain a world leader. If STEM education is not improved, the United States will continue to fall in world ranking with math and science scores and will not be able to maintain its global position. STEM education in school is important to spark an interest in pursuing a STEM career in students.²⁴

The language used to promote the goals and purposes of STEM education indicates a stark lack of attention to the cultivation of rational and critical thinking and the habit of truth seeking as part of a liberal and civic education. Just like Johann Neem’s criticism of the Common Core, STEM education is “designed to serve the human capital needs of today’s economy, not the personal needs of human beings nor the civic needs of our shared democracy.”²⁵ Neem warns: “It will take a fundamental rethinking of why we educate before we can once again place the personal and the civic alongside the economic and revive the democratic purposes of our common schools.”²⁶

MATH AND SCIENCE EDUCATION AS EPISTEMIC EDUCATION: A JOHN STUART MILL PERSPECTIVE

Perhaps it’s time to rethink math and science education not only for global competition and monetary gain, but as part of the basic epistemic education where students learn to seek and process knowledge as part of their way of existing in the world. While we have become so accustomed to the instrumental language and conceptualization of STEM education, more than 150 years ago, John Stuart Mill, in his Inaugural Address as Rector at the University of St. Andrews, painted a completely different picture of the purpose and processes of math and science education. In Mill’s view, math and science education is an “indispensable” part of general or liberal education because it provides the foundation for any high order of intellectual life. “Men are men before they are

lawyers, or physicians, or merchants, or manufacturers; and if you make them capable and sensible men, they will make themselves capable and sensible lawyers or physicians.”²⁷ Math and science education is important not because we can use it to find a job or to make money, but because it provides the training and discipline essential for the proper functioning of a human being. A revisit to Mill’s ideas and perspective may provide a starting point for us to rethink math and science education as a basic epistemic education.

Mill argues that from math and science education, we first obtain a basic sense of the world we live in, its laws, and the facts that we have to work with or work upon. Such elementary knowledge of the world is essential for the public because without such a basic understanding of the world, we can fall prey to irrational and outrageous opinions. Mill says, “Unless an elementary knowledge of scientific truths is diffused among the public ... [the people] are the ready dupes of charlatans and impostors. They alternate between ignorant distrust, and blind, often misplaced, confidence.”²⁸ Lack of a basic understanding of the laws and facts of the world may be the reason we still have a surprisingly large number of people believing things such as “the earth is flat.” The outrageous gossip and conspiracy theories believed by a large number of the population may be another indication that the public does not have a basic sense of the world’s laws and facts. Although a significant percentage of the American population is college-educated, the basic knowledge they learned at school has to be transferred to their private and civic lives, as Neem has emphatically suggested, so they can ascertain what is possible and perhaps provable, and what is beyond reason.

In Mill’s view, the most constant work we have to do throughout life is the ascertainment of truth, and the paths and methods of “getting at truth, and the tests of truth” come from observation, experiment, and reasoning, which are learned most effectively through scientific instruction:

We are always needing to know what is actually true about something or other, ... we all require the ability to judge between the conflicting opinions which are offered to us as vital truths; ... to form a rational conviction on great questions of

legislation and internal policy, and on the manner in which our country should behave to dependencies and to foreign nations ... All through life it is our most pressing interest to find out the truth about all the matters we are concerned with. If we are farmers, we want to find what will truly improve our soil; if merchants, what will truly influence the markets of our commodities; if judges, or jurymen, or advocates, who it was that truly did an unlawful act, or to whom a disputed right truly belongs.²⁹

Mill claims that the processes by which truth is ascertained have been most critically and completely performed by the physical sciences, the area to which much of STEM belongs. Scientific education teaches the art of thinking. “As classical literature furnishes the most perfect types of the art of expression, so do the physical sciences those of the art of thinking.”³⁰ Since we are limited in our direct perception, we depend very much on external evidence and on the rigorous processes learned from scientific instruction to discover truth, and scientific instruction teaches us through modeling, learning the rules, and practicing. Only through these processes can we obtain a certain level of confidence in the verifiability of our beliefs.

Mill further explains that through learning mathematics we learn the most important means of reasoning. “It is chiefly from mathematics we realize the fact that there actually is a road to truth by means of reasoning; that anything real, and which will be found true when tried, can be arrived at by a mere operation of the mind.”³¹ Mill notes that when people argue confidently about something in the outside world, there is a “mode of investigation,”³² a way to check their establishment of premises and their conclusions by observation and deductive reasoning. Mathematics habituates us to the “principle precautions” for the safety of our beliefs. “Our first studies in geometry teach us two invaluable lessons. One is, to lay down at the beginning, in express and clear terms, all the premises from which we intend to reason. The other is, to keep every step in the reasoning distinct and separate from all the other steps, and to make each

step safe before proceeding to another; expressly stating to ourselves, at every joint in the reasoning, what new premise we there introduce.”³³ In this way we are enabled “to detect at once the exact place where paralogism or confusion gets in: and after sufficient practice we may be able to keep them out from the beginning.”³⁴

Mill notes that the study of mathematics helps us understand the connections and coherence in our thinking. “It is to mathematics, again, that we owe our first notion of a connected body of truth; truths which grow out of one another, and hang together, so that each implies all the rest; that no one of them can be questioned without contradicting another or others, until in the end it appears that no part of the system can be false unless the whole is so.”³⁵

While mathematics supplies us with a “typical example of the ascertainment of truth by reasoning,” the other physical sciences teach us how to combine reasoning, experiment, and observation to ascertain laws and principles governing multitudes of other facts and “there is no intellectual discipline more important than that which the experimental sciences afford.”³⁶ Mill argues that as human beings, we all attempt to draw inferences from experience, “yet hardly any one, who has not been a student of the physical sciences, sets out with any just idea of what the process of interpreting experience really is.”³⁷ Most people are happy to think that they have got an experiment when a fact occurred once or twice and are already “well on the road towards shewing that the one fact is the cause of the other”:

If they did but know the immense amount of precaution necessary to a scientific experiment; with what sedulous care the accompanying circumstances are contrived and varied, so as to exclude every agency but that which is the subject of the experiment—or, when disturbing agencies cannot be excluded, the minute accuracy with which their influence is calculated and allowed for, in order that the residue may contain nothing but what is due to the one agency under examination; if these things were attended to, people would be

much less easily satisfied that their opinions have the evidence of experience; many popular notions and generalizations which are in all mouths, would be thought a great deal less certain than they are supposed to be.³⁸

Learning such as this lays the foundation of experimental knowledge that helps us to go beyond “mere vague discussion, where one side finds as much to say and says it as confidently as another, and each person’s opinion is less determined by evidence than by his accidental interest or prepossession.”³⁹ While in our civic lives, we often allow our political beliefs to be derived from our direct experiences, Mill argues that a political conclusion, if it is to have any practical value at all, cannot be arrived at by direct experience, which often only serves to confirm what we like to believe. A familiarity with scientific experimentation will at least inspire in us “a wholesome scepticism about the conclusions which the mere surface of experience suggests.”⁴⁰

Such cultivation of the art of thinking, I suggest, is precisely what is needed in the contemporary political and cultural environment. An emphasis on the training and discipline of the mind, a cultivation of the habit of truth seeking in personal and civic lives, in other words, the teaching of math and science as an epistemic education, it seems, is absolutely essential if we want a functional democracy.

FINAL NOTES ON LIBERTY IN DEMOCRACY

For Mill, a long-time advocate of individual liberty, the most formidable tyranny against individual liberty in a democratic society is not the government but the social tyranny that originates from the “feeling in each person’s mind that everybody should be required to act as he, and those with whom he sympathizes, would like them to act.”⁴¹ Such a feeling of imposition is often justified by a sense of self-evidence and thus is carried out with a lofty self-assurance. For Mill, social tyranny is particularly dangerous because “it leaves fewer means of escape, penetrating much more deeply into the details of life, and enslaving the

soul itself.”⁴² But liberty is an absolute necessity for the free development of individuality and it seems only a habit of truth seeking and the ability to think rationally and critically can help the individual fight against such self-justifying and self-evident social tyranny. Just as Jefferson’s quote makes clear, there will be no freedom for a nation without knowledge and the intellectual ability to acquire knowledge.

1 Guoping Zhao and Benjamin Bindewald, “Tolerance and Free Speech in Education: A Habermasian Approach,” *Philosophy of Education 2018*, ed. Megan Laverty (Urban, IL: Philosophy of Education Society, 2019).

2 Malhar Mali, “Fake News and Tribalism: Your Team Does It, Too,” *Areo*, February 20, 2017, <https://areomagazine.com/2017/02/20/fake-news-and-tribalism-your-team-does-it-too/>.

3 Ibid.

4 Jonathan Haidt, Twitter post, January 26, 2017, 9:58 a.m., <https://twitter.com/JonHaidt>.

5 Susan Jacoby, *The Age of American Unreason* (New York: Vintage Books, 2008), xix.

6 Frank Connolly, “Fake News Isn’t New, It’s Americans’ Inability To Read Critically That’s Alarming: A Healthy Skepticism is Always in Order,” Huffpost, March 30, 2017,

https://www.huffingtonpost.com/entry/there-has-always-been-fake-news-its-americans-inability_us_58dd1dc3e4b0fa4c09598694.

7 John Laloggia, “Republicans, Democrats Agree: They Can’t Agree on Basic Facts,” Pew Research Center, August 23, 2018, <http://www.pewresearch.org/fact-tank/2018/08/23/republicans-and-democrats-agree-they-cant-agree-on-basic-facts/>.

8 Camila Domonoske, “Students Have ‘Dismaying’ Inability To Tell Fake News From Real, Study Finds,” NPR, November 23, 2016, <https://www.npr.org/sections/thetwo-way/2016/11/23/503129818/study-finds-students-have-dismaying-inability-to-tell-fake-news-from-real>.

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10 Ibid.

11 Ibid.

12 William Poundstone, “The ‘Dumbing Down’ of America: Real or Not?,” *Psychology Today*, August 15, 2016, <https://www.psychologytoday.com/us/blog/head-in-the-cloud/201608/the-dumbing-down-america-real-or-not>.

13 Jacoby, *The Age of American Unreason*, xx.

14 Ibid., xi, xii.

15 Ibid., 298.

16 Richard Hofstadter, *Anti-Intellectualism in American Life* (New York: Vintage Books, 1966), 13.

- 17 *The Weekly Standard* (18 September 1995), 60, quoted in Robert Westbrook, “Anti-Intellectualism in American Life Revisited” (paper presented at The University in the Public Eye, Yale University, September 29, 1995), <https://urresearch.rochester.edu/institutionalPublicationPublicView.action?institutionalItemId=2520&version-Number=1>.
- 18 Jacoby, *The Age of American Unreason*.
- 19 *Ibid.*, xviii.
- 20 Hofstadter, *Anti-Intellectualism in American Life*, 27.
- 21 Fred Siegel, “The Skeptic,” *Reviews in American History* 21, no. 1 (1993): 139–143.
- 22 Jacoby, *The Age of American Unreason*, xi.
- 23 National Science Board, “Nation Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System,” National Science Foundation, October 30, 2007, <https://www.nsf.gov/pubs/2007/nsb07114/nsb07114.pdf>.
- 24 “Why is STEM Education So Important?” *Engineering for Kids*, February 2, 2016, <https://www.engineeringforkids.com/about/news/2016/february/why-is-stem-education-so-important-/>.
- 25 Johann N. Neem, “Does the Common Core Further Democracy? A Response to ‘The Common Core and Democratic Education: Examining Potential Costs and Benefits to Public and Private Autonomy,’” *Democracy and Education* 26, no.1 (2018), 4.
- 26 *Ibid.*
- 27 I did not take the liberty of changing Mill’s wording, but I acknowledge that his masculine language is sexist in today’s context; John Stuart Mill, “Inaugural Address at St. Andrews,” in *Classic and Contemporary Readings in the Philosophy of Education*, ed. Steven M. Cahn (New York: Oxford University Press, 1867/2012), 186.
- 28 *Ibid.*, 195-196.
- 29 *Ibid.*, 196.
- 30 *Ibid.*
- 31 *Ibid.*, 197.
- 32 *Ibid.*
- 33 *Ibid.*
- 34 *Ibid.*
- 35 *Ibid.*
- 36 *Ibid.*, 197-8.
- 37 *Ibid.*, 198.
- 38 *Ibid.*
- 39 *Ibid.*, 197
- 40 *Ibid.*, 198.
- 41 John Stuart Mill, *On Liberty* (Kitchener, ON: Batoche Books, 1859/2001), 10.
- 42 Mill, *On Liberty*, 9.