Is There A Political Argument For Teaching Evolution?

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Teaching science—a political question

Those of us in science education usually have an idealistic conception of what we do. We introduce students to profound ideas about how the world works. Science opens up new horizons. Even when we make gestures toward practicality, we emphasize that developing citizen capabilities in a modern world should be a central goal of education. And to accomplish this, we need to make the best knowledge available, as agreed upon by the best of our experts.

In practice, however, science education demands resources, and these resources are allocated by a political process in which the broadly liberal ideals of scientists and educators do not always command widespread agreement. Many scientific theories—most notoriously Darwinian evolution, but also much environmental science—challenge conservative religious and political beliefs. Therefore, resistance to science education is not unusual. And in the debate over science education, conservatives are more likely to emphasize deference to the beliefs of a community rather than the consensus of outside academic experts.

In that case, teaching science to a mass audience, in the manner scientists would prefer it to be taught, must be politically justified by appealing to interests held in common by a broad cross-section of the citizenry. This usually means a promise of direct economic benefits to individual students or the country at large. With theories such as evolution, however, such benefits are difficult to demonstrate, and therefore the publicly offered rationales for mainstream science education fail to convince many conservative constituencies.

Evolution education faces conservative Christian opposition in the United States, and conservative Muslim rejection in Turkey. Populist affirmations of religious knowledge and distrust of secular expertise are common themes in both Protestant and Islamic varieties of creationism. And in both

countries, debates over science education take place against a backdrop of unchallenged neoliberalism. Comparing the politics of science education in Turkey and the United States, then, can be illuminating. After all, public debates over science and religion are also political contests, and nowhere is this more apparent where there are educational consequences.

Popular resistance to evolution

The controversy over biological evolution is the leading contemporary example of institutional and intellectual friction between science and religion. Monotheistic religions, particularly in their conservative varieties, usually affirm some form of explicit supernatural creation, or at the very least some kind of intelligent design manifested in the history of life forms. Biology today recognizes no evidence of purposeful intervention in evolution, and mindless processes such as natural selection are considered sufficient to explain the history of life. Therefore, evolution finds greater acceptance among religious liberals who downplay traditional supernatural beliefs, and Darwinian evolution is a centerpiece in nonbelief inspired by science (Edis 2006). Popular atheist arguments very often claim support from biological evolution (Dawkins 2006).

In the United States, with its anomalously high religiosity compared to other technologically advanced countries (Norris and Inglehart 2011), opposition to evolution has been persistent, especially since the creationist revival of the 1960s (Numbers 2006). Creationism has very little presence among American educational and scientific elites; even the recent, more ecumenical and intellectually ambitious Intelligent Design movement has either been dismissed as a variety of religious creationism (Forrest and Gross 2007) or analyzed as a gross scientific failure (Young and Edis 2004). Nonetheless, creationism has a strong political constituency among religious conservatives, which constantly exerts pressure on American science education. Though the most ambitious initiatives to introduce creationism or Intelligent Design into public secondary schools have been blocked by the courts, legislative efforts favoring anti-evolutionary views are constantly renewed. Creationists have had some minor success at influencing state science education standards (Lerner 2008) and passing laws allowing for “critique of scientific theories” in education, with emphasis on theories considered controversial by political conservatives, such as evolution or

anthropogenic global warming (Rosenau 2009). In many conservative Protestant private schools, creationism has long been part of the curriculum.

While the American variety of creationism is most notorious, opposition to evolution is also a global phenomenon. It is not unusual to read news of creationism among Christians in South Korea, Russia, or South Africa, or Orthodox Jews in Israel (Numbers 2006). Buddhists (Lopez 2008) and Hindus (Brown 2012) occasionally express discomfort with Darwinian evolution because it excludes teleology, though they show little opposition to common descent—the notion that all living things on Earth share a common ancestor. Even Europe has recently been a scene for significant creationist activity, not just in conservative Christian enclaves but among Muslim immigrant populations (Blancke, Hjermitslev, and Kjaergaard 2014).

Both in terms of popular support and in terms of influence on public education, the most successful opposition to evolution appears in Muslim-majority countries (Edis 2007, Hameed 2008). The Middle East has a long history of rejection of Darwinian evolution, with significant effects on science education (Edis and BouJaoude 2013), and other predominantly Muslim regions such as South Asia also exhibit resistance to evolution (Riexinger 2009).

One common theme in the global resistance to evolution is the well-explored intellectual tension between supernatural beliefs and Darwinian evolution. But it is also clear that the public debate over creation and evolution is often also an intensely political contest. As the American and Islamic examples show, public opposition to evolution often surfaces as a reaction to the imposition of evolution on a religiously conservative population by means of state-supported science education.

Hence the debate over creation and evolution involves much more than scientific claims about the history of life. Both Muslim and Christian creationists state that their opposition to evolution is motivated by worries about morality, both because Darwinian evolution undermines the plausibility of traditional religious beliefs vital to communities and because sometimes evolution is perceived to directly support an ethos of violent struggle for existence (e.g. Morris 1974, Yahya 2002). But these moral concerns do not stand alone; they are often expressed in the context of a conservative political philosophy. In turn, supporters of evolution endorse its presence in education

not just because they trust science, but also because that trust takes shape in a context of ideals about the aims of education in the modern world.

Liberals and conservatives

The contest between creation and evolution is global, but the politics involved is characterized by local variety. Nonetheless, some common threads exist. Defenders of evolution in public education tend toward an establishment liberal point of view that trusts expertise, affirms public enterprises at a national scale, and keeps science and religion institutionally well separated. Creationists are more often conservative populists challenging a liberal establishment in education and demanding a more central role for religion in public life.

Focusing on the examples of Turkey and the United States will be helpful in specifying the liberal and conservative points of view about evolution education. Religious conservatives in the United States have been the driving force behind the Christian varieties of creationism and Intelligent Design, with considerable influence on Christian creationism in other countries. Turkey has had the most extensive history among Muslim countries with a degree of secularism in government, which in recent decades has been partly rolled back. Turks have taken a leading role in today's Islamic creationism, and popular creationist materials originating in Turkey, such as those under the name of "Harun Yahya," have attained international influence (Edis 2007, chapter 4; Riexinger 2008). Hence Turkey and the United States have been proving grounds for publicly offered rationales for the roles of creationism and evolution in public education.

First, then, a sketch of a liberal view—after all, a liberal approach has been most influential in shaping modern mass education, and scientists and educators typically take a secular liberal view about evolution education.

> **L1**. Liberals think that **natural science, as determined by the properly credentialed experts in science, is trustworthy.** Science represents our best reasoned collective effort to figure out how nature works.

L2. Liberals believe that a properly educated person should know something about science. **Science education is in the public interest.** Not only should the practical benefits of science and technology be accessible to everyone, but also all should be able to develop their capabilities of understanding how the world works. Liberal democracies depend on an informed electorate; citizens have to have a basic understanding of science to participate in many policy debates.

L3. For liberals, **science is a secular enterprise**. It provides public knowledge independent of religious faith, without interfering with religious commitments concerning non-empirical matters such as the ultimate nature of reality.

Conservatives sympathetic to creationism often see such a liberal perspective as an endorsement of heavy-handed state intervention in the ability of people in religious communities to live according to their faith. Conservatives emphasize the local convictions of communities and the spontaneous results of market transactions, rather than the impositions of expertise. Therefore, conservatives, especially conservatives who are skeptical about evolution, might favor a different list:

C1. Conservatives **trust the concrete products of technology, but are more reserved about abstract theoretical descriptions of nature**. Science can be overly ambitious.

C2. For conservatives, the role of science in education is more limited. Students are part of communities with organically developed ways of understanding the world, in which moral and spiritual ideals are interwoven with descriptions of the workings of the world. If students are to become productive members of their community, their education should instill the appropriate loyalties. **Claims of scientific expertise do not trump these local interests**.

C3. Conservatives do not agree that secularism is neutral regarding religion. To the extent that science is secular, **science is also not neutral concerning religion**, and therefore can be legitimately treated as an aspect of a rival ideology.

To make these sketches more concrete, a brief look at the historical context of public science education in the United States and Turkey will be helpful.

In the United States, mass public education has roots in the middle-class evangelical Protestant activism of the 19th century. Protestants, who enjoyed an informal establishment of their religion (Sehat 2011, Eisenach 2000), were concerned to socialize students, including the children of recent immigrants, into what they considered a distinctly American democratic way of life. They included Christianity of a supposedly nonsectarian Protestant variety in public education, prompting Catholic resistance. Many Catholics instead relied on an alternative network of private parochial schools and unsuccessfully attempted to secure public funding for their institutions.

As American Protestantism split between more liberal and conservative currents, and education became increasingly professionalized, matters of curriculum and instruction became a domain of expertise. Teachers, for example, had to acquire more demanding qualifications to enter their profession. Secular liberal philosophies of education, such as that expressed by John Dewey, acquired influence, particularly among more educated circles. This influence was limited, especially due to the way American public education is controlled not nationally, but by state and local authorities. For example, the famous Scopes trial of 1925 produced ridicule of conservative evangelical anti-intellectualism in urban and educated circles, but did not lead to significant improvements in the presence of evolution in science education. Nonetheless, education became a professionalized field with claim to special expertise, rooted in a universal—or at least national—conception of knowledge rather than the varying interests of local communities.

The Cold War led to a more explicit imposition of expertise on science education, including unprecedented national-scale education policies. As a response to events such as the launch of Sputnik in 1957, American science education was overhauled to be able to compete with the communists. Biologists took the opportunity to make sure evolution appeared properly in the life science textbooks. This imposition of expert consensus took place relatively easily. Politics in the post-World War II United States had come to be dominated by a "liberal consensus," where conservative political thinkers were resigned to an almost permanent minority status. Liberal jurists

dismantled the remains of the informal Protestant establishment, technocrats administered Keynesian economics, and large corporate bureaucracies sought a modus vivendi with unions. Control of education by experts was part of this secular liberal trend.

By the early 1970s, the liberal consensus was unraveling, partly because the experts left in charge by Cold War liberalism had made some disastrous decisions in contexts such as the Vietnam war. More importantly, there was a potent conservative backlash. As secondary education in the natural and social sciences was made to more fully reflect the views of credentialed experts, the modern young earth creationist revival provided a response (Numbers 2006). Opposition to evolution became an issue for conservative Protestant activism.

Creationists pressed for laws that would allow "equal time" for creation and evolution in the classroom. It soon became apparent that while such laws could be passed by local legislatures, the courts would inevitably strike them down as a violation of the First Amendment to the US Constitution, which, when interpreted from a liberal perspective, provides for church-state separation. Still, community pressure on public schools in religiously conservative localities often meant inadequate coverage of evolution. Moreover, the movement toward private Christian academies reacting against desegregation in the American South provided a channel for a creationist education. Many conservative Protestants found themselves in a position similar to Catholics a century ago: frozen out of a public education system controlled by elites unresponsive to their cultural concerns, partly relying on a parallel alternative educational system, and resentful of the taxes they continued to pay to fund public education.

The religious conservatives objecting to evolution did not think of themselves as opposing science. American conservatism, no less than liberalism, has usually been captivated by the "technological sublime" (Nye 1996); its hero figures prominently include inventor-entrepreneurs. In conservative religious circles science—equated with practical technological products—has usually been understood to support divine design and American ingenuity (Gilbert 1997). Creationism has drawn much of its social support from upwardly mobile people from religious backgrounds moving into positions where technology is critical to earning a living—there would be little motivation for

constructing an elaborate pseudoscience such as creationism without a strong need to harmonize traditional religion with a modern technological context (Eve and Harrold 1990).

And yet, religious conservatives have also found themselves continually frustrated by conflicts with a liberal establishment. They often have some respect for the notion of expertise, since they value authority: American creationists are notorious for craving and flaunting doctoral degrees, which occasionally turn out to be fake; contempt for the experts in academia goes together with efforts to found alternative institutions such as Liberty University. But by and large, experts are liberals, and hence the enemy. A common conservative populist view is, as Texas School Board of Education chair Don McLeroy put it, that "Somebody's gotta stand up to experts" (TFN 2009). Conservatives consider "government" a liberal instrument of interference in peoples' lives, but also broaden their defense of local community values by adopting a strong ethno-religious nationalism. And education, for such conservative populists, is primarily an instrument for reproducing community ideals.

The Republican Party—the more conservative of the two major political parties in the United States—continues to reflect such a standpoint. The Republican Party Platform of 2012 rails against "liberal elites [who] try to drive religious beliefs—and religious believers—out of the public square" (GOP Platform 2012, p.19), favors privatization of education in the name of "consumer choice" (p. 42), and charges that "Ideological bias is deeply entrenched within the current university system" (p. 43). The 2012 Platform of the Republican Party of Texas, like many state party platforms, is more explicit in advocating ethno-religious nationalism in order to support "American Identity Patriotism and Loyalty," and states that "We believe theories such as life origins and environmental change should be taught as challengeable scientific theories subject to change as new data is produced," using the currently popular language to avoid outright creationism with its associated legal difficulties (Texas GOP 2012, p. 12). This ethno-religious nationalist strain in American conservatism has become even more visible with the Trump presidency.

Liberals, including most science and education professionals, have naturally defended their territory against conservative political advances. In the United States, this defense has started with

the courts, which have consistently blocked explicit creationism from public science education. In effect, liberals have used elite, nondemocratic judicial institutions to frustrate populist demands and enforce deference to the prerogatives of an expert class. Defenders of science education insist that science is not a democracy—the current state of science is defined by consensus within an expert community.

Blocking anti-evolutionary views from science education, however, depends almost entirely on the First Amendment, not the scientific consensus. Therefore, the American liberal defense of evolution is legally, as well as culturally, invested in arguing that evolution is religiously neutral, and indeed no threat to religious faith (Scott 2004). In practice, this has meant arguing that *proper* religion is compatible with modern science: religion that defers to science about empirical matters, religion as understood by liberal theologians who comfortably move in academic circles. But this results in favoring an elite interpretation of religious tradition—referring to a class of religious experts who are often distant from the beliefs of ordinary religious people—in order to define acceptable religion. This is hardly the sort of argument that can appeal to conservative populists who distrust experts.

The history of Turkish science education, though very different in the details, consistently highlights similar themes of tension between religious communities and secular experts. The label "liberal" is not easily transferable, because in Turkey many of those who describe themselves as liberal are more akin to "libertarians" or "classical liberals" in the United States. Yet in both countries such liberals emphasize free markets and tend to ally politically with religious conservatives Nonetheless, a dichotomy between liberal and conservative views remains analytically helpful.

Modern education in what is now Turkey began with modernization efforts in the crumbling Ottoman Empire. The first few Western-style schools for Muslims were oriented toward military training, while traditional education continued as a disorganized and religiously focused effort involving madrassas and small-scale local arrangements where boys would be taught to recite the Qur'an.

The successor to the Ottoman Empire in the 1920s, the Republic of Turkey, took a radical modernizing direction. The republicans, largely based in the military and the remains of the imperial bureaucracy, had enjoyed a Western education, and considered secular education to be key to lifting the population out of poverty and achieving a status on a par with European nations. They brought education under centralized state control and emphasized the unity of instruction, abolishing the traditional networks of religious schooling. In effect, education became the province of experts, where the best practices were modeled on Western Europe and the aims of education were determined by a Turkish nationalist ideology (Koç 2006). Science enjoyed a high reputation as the foundation of Western military and commercial advantages, and ideas such as biological evolution straightforwardly found a place in the curriculum.

Reliance on state-imposed expertise extended to matters of religion. The Turkish republicans are often misleadingly described as strict secularists, but the centrality of Islam to the identity of the citizens of the new Turkish Republic was never in doubt. The republicans had their ideas about *proper* religion, which was not the traditional Islam of Sufi orders, rural piety, or the class of religious scholars. The true religion appropriate for Turks had no use for any such debased superstitions—while preserving Sunni ritual practices and core supernatural beliefs, proper religion was to become an agent of modernization. Therefore, the Republic attempted to bring religion and religious education under state control as well. Even today, religion in Turkey remains a matter of state, where religious functionaries are government employees.

The mostly conservatively religious population of Turkey naturally resisted the imposed interpretation of proper religion. Versions of traditional religious structures and education flourished underground, even giving rise to theologically conservative, populist, but also modernizing currents such as the very influential Nur movement, which was initially criminalized by the republicans in power (Edis 2007, chapter 3). And after the first decades, the revolutionary fervor of the early republic subsided. Conservative administrations accepted republican structures of government, but also provided outlets for popular resentment with state-imposed education and interference with religion. Of particular importance are the Imam Hatip schools, intended for vocational training of religious functionaries such as imams. They soon developed into a parallel education system based on Sunni Islam, taking in students vastly outnumbering possible posts, and

even included females who are excluded from clerical positions. This parallel religious educational establishment enjoyed considerable grassroots support from conservative populations, deflecting occasional revived republican hopes to reunify education.

Resentment against state-imposed ideology and claims of expertise remained a major theme of religious conservatism, but after a military coup in 1980, religious conservatives began to enjoy more direct access to state power. Post-coup Turkey exhibited increased dominance by the business class (Ozan 2012) and efforts to forge closer alliances with religious populists; the mid-1980s also witnessed the first penetration of Turkish public education by an Islamic version of creationism partly derived from American Protestant examples (Edis 1994).

For a while, Islamist politics retained an edge of opposition to the regime, but with the formation of the Justice and Development Party (AKP, from its Turkish initials), which has been in control of the Turkish government since 2002, religious populism has been fully integrated with a neoliberal, business-dominated political system. Creationist references are now common in Turkish secondary school textbooks (Yalçınoğlu 2009), and education policy is guided by ethno-religious nationalism.

Within Turkish conservatism, opposition to liberal elites is less often expressed in terms of the anti-government rhetoric familiar from the United States. Instead, conservatives emphasize an ongoing conflict in Turkey between bureaucratic and military elites entrenched in the state on one hand, and a traditionally devout and free enterprise oriented population at large on the other. Turkish conservatism, then, appears as a democratic, democratizing ideology that reconciles the state with the population (Göle 2000). Instead of an elite commanding expertise taking a tutelary role to prompt a recalcitrant population to modernize, conservatives say that they trust the market or political structures responsive to local community interests.

Even with such differences of emphasis, however, the political philosophy guiding Turkish conservatism has taken on an American coloration. The rise of the AKP reflects this increased Americanization of political Islam in Turkey. Political theorists associated with the AKP partly claim inspiration from a European Christian Democratic tradition, but their animating thought

derives largely from Anglo-American conservative political philosophy (Akdoğan 2004), including conservative critiques of European Enlightenment-derived conceptions of reason (Özipek 2011). Indeed, some recent Turkish conservative literature presents a political outlook that is hard to distinguish from that of the Republican Party in the United States (e.g. Akyol 2011). This is not merely a matter of rhetorical convenience. As Greek political scientist Christos Teazis observes, "the Islamist movement in Turkey was only able to strengthen and express itself as part of a process of democratization (Americanization). Therefore, in this process American institutions have been adopted and applied in every respect" (Teazis 2010, p. 188). So a convergence of conservative thinking about education in Turkey and the United States is not surprising.

The response to conservative dominance from the Turkish equivalent of the liberal establishment in science and education has been ineffective. Starting in 1997, the most visible form of creationism in Turkey has been an internationally exported product of private enterprise, operating under the name of "Harun Yahya" (Edis 1999). Scientists and educators, including the Turkish Academy of Sciences, strongly opposed Yahya's wave of creationism (Sayın and Kence 1999). However, they phrased their objections in terms of the universal standards of scientific expertise, and worse, presented themselves as defending the secular nature of the Turkish state. By appealing to politically discredited ideals such as secularism, they ensured their failure.

The AKP period has further entrenched conservative disregard of scientific expertise. The Ministry of Education has retained creationist material in the curriculum, ignoring academicians petitioning for the removal of unscientific material (Kotan 2006). Furthermore, the AKP government has asserted more control over scientific institutions; for example, restructuring the Turkish Academy of Sciences to remove its independence, and preventing a cover story honoring the two hundredth birthday of Darwin in a popular science and technology magazine published by the Scientific and Technological Research Council of Turkey (Abbott 2009).

Clearly, the political contexts in which the creation-evolution contest takes place are similar in Turkey and the United States, though there are also important differences such as the comparative weakness of the liberal position in Turkey. The general views summarized by L1-L3 and C1-C3 can usefully characterize broadly liberal and conservative approaches in both countries.

This is not to say that every point of view can be shoehorned under a liberal or conservative heading, or that either camp is perfectly unified. For example, biologist Jerry Coyne challenges L3 from a more hardline secularist position, arguing against the notion that evolution is compatible with religious supernatural beliefs. He considers monotheism to be a key motivation for rejection of evolution, and suggests that science education needs to confront this aspect of religion rather than reassert liberal pieties about the separate spheres of science and religion (Coyne 2012). However, while the liberal model of separate spheres for science and religion is intellectually dubious, it also remains a politically indispensable device to smooth relationships between scientific and religious institutions (Edis 2006). When Turkish academics publicly defend evolution, they usually see no alternative to taking a similar position, endorsing liberal theological stances and advocating separate spheres (Aydın 2007).

The liberal emphasis on expertise in L1 is also not shared by all. A left-wing critic might observe that academic expertise often is pressed into the service of existing arrangements of power. The expertise of neoclassical economists, for example, is socially more consequential than that of natural scientists, and reflects a practice that is insensitive to empirical failure and exhibits possibly pseudoscientific traits (Keen 2011). Liberals have represented neoliberalism with a technocratic emphasis, while conservatives have stood for neoliberalism with full spectrum dominance of the business class. However, while a left-wing critique of expertise may be interesting, it is of doubtful relevance. After all, the United States and Turkey are both countries where the political left is practically inconsequential.

Conservatives are also not necessarily united. Conservatives who set aside religion and are more concerned to defend markets and neoliberalism need not have any sympathy for creationism. Such conservatives' interest in education policy tends to focus on efforts to privatize education and to break teachers unions. Indeed, currently in the United States privatization is probably a more important issue concerning education than the entrenched stalemate over evolution. But in practice, both in Turkey and in the United States, a privatization agenda strengthens the hand of creationists, both because of political alliances between religious and business-class conservatives, and because private and parallel educational systems already harbor plenty of distrust toward evolution.

Moreover, conservatism that does not emphasize religion has an anti-science record of its own, as seen in the examples of corporate-orchestrated denials of the harm of smoking and global warming (Oreskes and Conway 2010).

Therefore, *where the creation-evolution dispute is concerned*, a liberal-conservative dichotomy summarized by L1-L3 and C1-C3 continue to frame the political context in Turkey and the United States. And it is hard to negotiate a compromise: too much that is important is at stake. For example, even when backing away from strict secularism and praising the social cohesion and moral grounding religion provides, a prominent liberal philosopher such as Jürgen Habermas cannot let go of an ideal of natural reason. He therefore grants scientific expertise a privileged position, arguing that "religious citizens must develop an epistemic stance toward the internal logic of secular knowledge and toward the institutionalized monopoly on knowledge of modern scientific experts" (Habermas 2008, p. 137). But it is hard to see why religious conservatives should agree. Trust in scientific institutions is not automatic, and even in an Islamic context, conservative distrust draws on sources as eclectic as postmodern critiques of scientific knowledge (Aydın 2008). Furthermore, given their political dominance in the United States and Turkey, conservatives might not be as motivated to seek a compromise.

Why teach evolution?

In the present political climate, liberals feel more pressure to provide a rationale for their views of education. Teaching everyone evolution requires a political argument that can appeal to a broad constituency.

One possibility is to reassert the ideal of a liberal education. A liberal democracy depends on a well-informed citizenry practiced in the skills of critical thinking. So liberals often argue that the process of education must develop these capabilities of citizenship, culminating in a higher education centered on the liberal arts, particularly the humanities (Nussbaum 2010, Folbre 2010).

In the United States, there is a steady stream of books by academics defending liberal education—because it is embattled. These books seamlessly blend into the literature exposing the erosion of support for public education. Public higher education, for example, has been defunded, partly

because of a successful conservative assault on its implicit political ideals. Directly and indirectly, professionalism and communities of expertise have been undermined (Newfield 2008, pp. 257-63).

But such observations also expose the difficulties in defending a liberal education. A liberal education is, at least in part, intended to produce a liberal outlook, including deference to appropriate expertise. In Turkey, old-line republican critics of the present education system often invoke the ideal of the early Turkish Republic to overcome tradition in order to produce a modern generation, understood in liberal terms contrasted to conservative religiosity (e.g. Koç 2006). To conservatives, all this awakens suspicions of liberals using state power in futile attempts to remake human nature. Not everyone approaches education from a hardened liberal or conservative point of view. But merely reasserting ambitions to mold students into liberal citizens need not appeal to the uncommitted.

An emphasis on science might be more attractive, since science still has a reputation of being practical and nonpolitical. Few would object to science literacy as an object of education—science literacy should be useful. Moreover, scientific literacy is part of a more general cultural literacy. Even today's popular culture, no less than high culture, includes references to ideas such as evolution. It would be to the advantage of students to understand such references, even if they personally reject evolution as an explanation for the history of life.

Perhaps. But it is not entirely clear what "science literacy" means, and scientists and educators have a history of expecting too much in this regard. Modern science depends on broad conceptual frameworks such as relativity, quantum mechanics, or Darwinian evolution. Learning natural science, it would seem, requires students to engage with such conceptual frameworks. Otherwise, students end up collecting a set of "scientific facts" like stamps, not developing a picture of the world that is truly informed by science. Nonetheless, that is usually what happens. The conceptual frameworks that inform modern science are *difficult* to appreciate: they are counterintuitive and often require considerable intellectual maturity, not to mention some mathematical background, to grasp. In contrast to more everyday and religious ways of thinking, science demands profoundly unnatural ways of thought (McCauley 2011). Therefore, if scientific literacy requires an understanding of science that goes beyond collecting facts, it is very difficult to achieve beyond a

small percentage of the population that has a professional involvement in science or technology (Shamos 1995).

Popular conceptions of evolution, even among populations that do not share a conservative religious suspicion of evolution, reflect such difficulties. As biologists have long observed (e.g. Gould 1989), evolution is popularly imagined to be progressive, with an inherent direction. Such conceptions also support a description of evolution as a purposeful, divinely guided process. And so the Intelligent Design version of creationism, for example, can position itself as a reasonable point of view that accepts much of evolution, especially if it is presented as an explanation for the origin of life or the sources of biological information (Meyer 2009). A theologian can claim that Islam has no difficulty with evolution, but defend a version of guided evolution that sidelines blind Darwinian mechanisms, and also assert that evolution applies to mere animals, not humans (Ateş 1991). Grasping how biologists understand evolution does little for cultural literacy, since broader cultural notions of evolution are shaped in large part by concerns that have little to do with science.

It is perhaps more realistic, given resource constraints, to expect mass science education to foster an appreciation of science rather than any robust science literacy (Shamos 1995). But this mainly restates the liberal hope that education will produce trust in proper expertise. Constituencies that are not committed to liberal views of expertise need more to be persuaded that mass instruction in evolution is to their advantage.

What, then, does a student gain from being subjected to science education? In the United States and Turkey today, education is often considered an instrument for individual economic advancement. Education is an investment in human capital, in anticipation of future earnings. There is considerable pressure from the business community to reform education, by privatizing, imposing accountability in the form of standardized testing, and becoming more efficient with fewer resources. But reformers never call for less science and mathematics. After all, students will be going into a complex, technology-driven economy. Some competence in science, then, becomes important in order to achieve a decent economic position. Providing an inadequate background in central scientific concepts like evolution would impose a handicap on students.

Even if such an argument has some plausibility, however, it need not support evolution as a vital component of mass science education. Knowing something about evolution might be relevant if there is a large demand for basic science skills in the labor market. This is not the case.

The trajectory of the United States for the last three decades has been toward a low wage service economy for the majority of the population. Even a college degree is increasingly unnecessary for the jobs Americans actually occupy; the tendency is toward precarious employment and service jobs, the majority of which demands little education that is related to science or technology (Kalleberg 2011). In STEM (science, technology, engineering, mathematics) fields, which are often described as keys to economic competitiveness, even though the United States is lagging in comparison with East Asian countries, there are signs that there is a strong overproduction of STEM graduates compared to the jobs available (Brown, Lauder, and Ashton 2011, chapter 3).

Both liberals and conservatives in the United States have acquiesced in the offshoring of not just routine manufacturing but highly skilled technological jobs. And for decades, liberal celebration of "symbolic analysis" work (e.g. Reich 1992) has led to an emphasis on education as a panacea. In practice, rhetorical support for education has been a way to shift responsibility to individuals to cope with a neoliberal economy that offshores analytic jobs as easily as shop-floor manufacturing employment (Brown, Lauder, and Ashton 2011). Mass science education, with or without evolution, is not as relevant to the economic future of the United States as is often assumed.

Turkey, as a middle-income country that is rarely at the cutting edge of developing technologies, faces different demands. Manufacturing industries have become stronger in Turkey, benefiting from offshoring from Europe and exploiting cheap labor and suppressed unions. Like many developing nations, Turkey has emphasized applied science and engineering; indeed, engineering fields have typically enjoyed greater social prestige than basic science, which provides few career opportunities aside from teaching. The engineering opportunities that exist do not concern cutting edge innovation; as in most countries, the bulk of engineering work is in unglamorous areas such as maintenance (Edgerton 2007). In any case, knowledge of evolution has next to no relevance to economic life. It is hard to see, in these circumstances, how creationism in Turkish schools can have any adverse effect on either individual economic prospects or national performance.

In that case, why is there agreement—including among creationists and business-class conservatives—that science education is a good thing? In part this is because science education still provides a vital service. Some conservative critics of public education point out that investment in education is rarely directly justifiable in market terms. Instead, while education may not impart skills, educational credentials *signal* the presence of desirable characteristics (Caplan 2018). Science education may well partly function in a similar manner: it acts as an intelligence test. A student who does well with science signals to prospective employers that she has developed some capabilities to handle abstract, often mathematical model-based ways of thinking. These are marketable skills in a complex economy. But while science education performs some of this training and selecting admirably, it is not the only means to achieve the same goals. Today, training in dead languages, classical literature, or Quranic interpretation might no longer provide a good enough demonstration of relevant skills through mastery of a useless subject.

A full coverage of important science is not the only way to add an element of quantitative reasoning to a demonstration of academic discipline. In Turkey, some notable religious communities have put emphasis on helping pious students achieve academic success. One of the best known has been the Gülen movement, an offshoot of the Nur movement, which is deeply involved with promoting creationism in Turkey (Edis 2007). Until their recent clash with the AKP and purge from power, Gülenists have also been famous for their schools, in and out of Turkey, where they emphasize skills relevant to upward mobility. This includes mathematics, and a thorough grounding in the routine facts and formulae of science. Their students have performed well in standardized tests. The Gülenist experience suggests that if doing well on tests, economic success, and an ability to negotiate a world shaped by information technologies is the object, mass education in evolution is not relevant (Edis 2016).

Focusing on the linkage between science and technology is, in fact, not a very promising way to defend evolution in science education. To a scientist, an idea like evolution is indispensable because of its intellectual power—how it helps everything in biology make sense. But the conservative approval of technology comes with a tendency to disaggregate the concepts of science and subordinate them to the practical purposes of technology. Learning about chemical reactions

or electrical phenomena is not, in this context, similar to learning about evolution or the climate. All of these are important for understanding the universe, and a deepening perspective on science also reveals fascinating connections between all scientific ideas. But if mass education is driven by technology-centered needs, what is scientifically vital can become practically irrelevant.

It is then perhaps unsurprising that communities engaged in natural and applied science have distinct internal subcultures. Applied scientists—engineers and medical doctors, contrasted with physicists and biologists—are statistically much more likely to be politically and religiously conservative (Gambetta and Hertog 2007). And a political environment that emphasizes the economic benefits of applied science is not necessarily also supportive of research and education in the basic natural sciences. Increasing pressure to secure corporate funding also channels research efforts in a short-term applied direction. In the United States, many scientists today worry about an environment that demands immediate practical applications, where funding is less likely to be forthcoming for economically apparently useless areas such as astrophysics or the physics of fundamental particles and forces (Scheie 2012). In Turkey, there has been comparatively little opportunity to engage in basic science to begin with, so scientists are at least spared worries about further budget cuts.

Such a climate is not good for the teaching of evolution, as it is hard to point to immediate practical applications of evolutionary biology. There has been some recent interest in Darwinian medicine, where an evolutionary perspective provides insight into disease processes and aspects of human physiology (Stearns and Koella 2008; Gluckman, Beedle, and Hanson 2009). And yet, as advocates of Darwinian medicine themselves point out, evolution is virtually ignored in medical education, even though at the same time some medical institutions have been quick to incorporate scientifically dubious emphases on religion (Sloan 2006). At best, evolutionary thinking has not yet demonstrated its full promise in medicine; it certainly cannot provide a rationale for a mass introduction to evolutionary biology.

If all this is correct, the prospects for evolution education in Turkey and the United States are uncertain. Political arguments for teaching evolution are weak. Public science education in its present form bears the marks of a past when a liberal conception of expertise was politically much

stronger. In the past decades, conservatives have dismantled a liberal legacy in many aspects of public life. Science education may well follow.

There may, however, be a more limited argument for evolution education that has better prospects. There is one area today which is at the cutting edge of science, has an applied orientation that promises many opportunities for commercial exploitation, and draws suspicion, even opposition, from religious conservatives. This is biotechnology. Reproductive technologies, stem cell research, and cloning already draw condemnations from a conservative bioethical perspective. Manipulating life at a fundamental level threatens common conservative monotheistic views regarding the integrity and created moral purpose inherent in human biological nature. Moreover, the possible applications of new biological knowledge may compete with the supernatural compensators religions provide (Bainbridge 2007).

This is not to say that research in biotechnology is directly informed by evolutionary biology. The connection with evolution comes through the fact that religious conservatives cool toward evolution also usually think that biotechnological research should be restricted. The cutting-edge science immediately relevant to biotechnology is not best suited for secondary schools. But if a state or locality teaches evolution with little public controversy, this signals an environment that is more receptive to biotechnological research and hospitable toward biotech companies. Whether it also indicates a more general favorable disposition toward science is immaterial. High technology can coexist with scientifically dubious ideas; Silicon Valley, for example, is notoriously a locality where New Age flavors of pseudoscience flourish. Acceptance of evolution specifically signals a cultural environment that lacks the conservative religious resistance toward biotechnological ambitions.

So there is at least one limited context in which evolution education can indirectly serve business interests. Such examples cannot sustain an argument for the presence of evolution in mass education at nationwide scales. But even countries where religious conservatism is influential, such as Turkey and the United States, include religiously more liberal populations. The conservative tendency to defer to local standards and to privilege markets also provides opportunities for more liberal communities to conduct education their own way. By teaching evolution, they will signal

their religious liberalism and comparative secularity, which will attract and repel a different mix of business enterprises compared to communities that signal their traditional religiosity.

Business as usual

This analysis assumes continuing business dominance of politics in the United States and Turkey, and religious conservatives' continuing ability to exploit the consequent loss of power of communities of expertise institutionally dependent on a liberal state. This assumption seems safe. But it may also be worthwhile to speculate on the condition of the scientific community, even if it can no longer control science education.

If the United States follows the Turkish lead in degrading the presence of evolution in education, American science will suffer, but not greatly. The scientific community is based in higher education plus corporate and government laboratories. These are somewhat isolated from secondary education. If applied science receives even further emphasis, this will only be a reversion to the historical norm. Before World War Two, the reputation of American science was that while it was strong in applications, it was weak in theoretical and conceptual development. And even after American science took over a position of global leadership, support for science depended on the services it provided for military and commercial ends. The immediate future prospects for science may include some loss of status and autonomy due to the weakening of liberal institutions and a tighter focus on military and commercial needs. But this is not a radical change: American science will continue, regardless of the state of public science education. This includes research in evolutionary biology. Very few people ever do natural science; it will be enough for a few to become curious and learn what they need in their higher education even if secondary science education deteriorates.

Turkey already emphasizes applied science and engineering, and treats basic science as a luxury. Setting aside evolutionary biology, Muslim countries in general already contribute very little to basic science in areas such as physics (Hoodbhoy 2007). Turkey's efforts to improve its position in the modern world depend on applied science. This may mean a lag in absorbing technologies based on the latest in condensed matter physics or stem cell research. But even that should not be

exaggerated. In a global economy, no country can long monopolize commercial advantages due to any area of research.

Nonetheless, a scientific enterprise more distant to education and more focused on immediate applications would also be a diminished, truncated form of science. Subservience to market values and acting as a support system for applied research is far from what motivates scientists. Science is certainly not cheap, and so the resources devoted to science need some political justification. But at their best, scientific institutions deliver more than a basis for fancier gadgets and more powerful bombs. They also allow scientists to act on values and motivations that are internal to science. Scientists care deeply about this intellectual freedom.

In that case, defenders of science and science education must move away from a narrow pragmatism. There are many disciplines within science that may appear of questionable immediate use, from astrophysics to paleontology. In this regard, they are in a situation similar to the arts and humanities. They are valuable primarily to constituencies that appreciate them on their own terms, due to the intellectual excitement that they generate and reproduce in new generations of students. Expertise, in such a context, can more easily be seen as something earned rather than derived from a privileged position within liberal institutions. But a business dominated culture that tends to conceive of art or philosophy as private indulgences will very likely put evolutionary biology or general relativity in the same position.

And in the end, all sciences have some practical significance, perhaps because they *do* represent our best collective effort to figure out how nature works. Political rejection of the physics of global warming, even more than the constant religious opposition to evolution, illustrates that ideological opposition to scientific ideas invites dire consequences. But the same example also illustrates the difficulty in achieving a successful political argument for accepting scientific expertise. After all, it appears industrial civilization is committed to business as usual—the political obstacles to even inadequate changes in course have proven insurmountable. In such circumstances, when politics cannot even respond to probable catastrophe, it is hard to expect that the prospects for evolution education are very good.

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