

## **Ambivalence in the teaching of publicly controversial issues in science.**

### **Context**

In the biological sciences, evolution is a scientific theory that explains the emergence of new varieties of living things and their genetic change throughout history; it is not a *theory of origins* about how life began. Evolution is not only science, it is a robust and highly successful line of research and a powerful explanatory model (Freeman & Herron, 2004; Futuyma, 2005; Lenski & Travisano, 1994; Miller, 1999, 2004). Evolution has been subjected to advanced empirical analysis for over a century, and has been (and continues to be) consistently confirmed by evidence from a wide range of disciplines (Avisé & Wollenberg, 1997; Coyne, 2009; Dawkins, 2009; Edwards & Cavalli-Sforza, 1963; Futuyma, 2005; Lenski & Travisano, 1994; Miller, 1999, 2004; Nei & Kumar, 2000; Rice, 2007; Wiley & Lieberman, 2011). Similarly, there is substantial scientific agreement about the occurrence, and processes of the more modern theories of climate change. Yet due to the inherent complexity of the topic and the social controversies that have arisen around it, confusion and doubt often persist (Pappas, 2012). The social controversy over climate change is in part due to climate change denial (Hulme, 2009). In order to defend and support the teaching of climate change, it is important to understand—and be able to rebut—spurious arguments about climate science, and to understand why educators in particular oppose such well-established science.

Apple (2008) explored the evolution versus creationism debate in U.S. education, examining its political context and discussing the destructive nature of its continuance. He discussed the growing right-wing movement—*authoritarian populism*—arguing that its popularity may have been due to millions of people feeling “economically and culturally threatened” (p. 329), and warning of a “very real breakdown in public understanding and in the ways in which claims to knowledge are debated” (p. 334). A similar case has been made with regard to the causation of anxiety by climate change science, “global warming is anxiety-provoking. Being able to bear anxiety is a vital part of being able to face reality, as we know that when anxiety becomes too much to bear, our thinking can become irrational” (Weintrobe, 2013, p. 33). Long (2011) argued that evolution educators such as Dawkins (2006, 2009), have not sufficiently considered the level of *existential anxiety* imposed on some creationist students when asked to accept evolutionary science. Throughout the prior experience of many students, is the belief in creationism and the relative stability of the worlds’ climate as a normative aspect of their culture. The two frequently go hand-in-hand (Branch, 2013). A students’ learning, their internal self-analysis of the curriculum of their lives is necessarily steeped in the dominant culture of a given community (Pinar, 2012). It would therefore be impossible to entirely divorce a student’s prior worldview, from any imposed theories of science.

High levels of ambivalence exist to teaching both evolution and climate change science (Berkman & Plutzer, 2011; Davis & Kenyon, 1993; Donnelly & Boone, 2007; Long, 2011; Moore, 2000, 2004; Scott & Branch, 2006). This has resulted in costly legal arguments that have raged for more than fifty years (*Epperson v. Arkansas*, 1968; *Edwards v. Aguillard*, 1987; *Freiler v. Tangipahoa*, 2000; *Kitzmiller v. Dover*, 2005; *LeVake v. Independent School District (ISD)*, 2002; *McLean v. Arkansas*, 1982; *Peloza v. Capistrano*, 1994; *Seagraves v. California*, 1981; *Selman v. Cobb County*, 2005; *Webster v. New Lenox*, 1990) and multiple Academic Freedom Bills, designed to allow for the teaching of climate change denial and creationist doctrine, are monitored by the National Center for Science Education (NCSE), and have been seen in Alabama, Florida, Iowa, Kentucky, Louisiana, Maryland, Michigan, Missouri, New Mexico, New Mexico, Oklahoma, South Carolina, South Carolina, Tennessee, and Texas (NCSE, 2012). Despite the practical concerns of such topics, limited research has been conducted on the associated nature of creationism and climate change controversy in U.S. education.

## **Purpose**

The overarching purpose of this study is to examine why, given the weight of scientific evidence, government policy and legal precedent, such ambivalence is still so widespread throughout those concerned with education policy and curriculum. Specifically, this study has three aims (a) to examine how ambivalence to teaching established science such as climate change and evolution, might be used as part of a political agenda—Apple’s (2008) *authoritarian populism*, (b) to analyse the extent to which classroom teaching practice is affected by teachers’ personal views on creationism and climate change, and (c) to contribute a theoretical understanding to the nature of teaching politically controversial topics in U.S. science classes.

The following research questions will be guiding this study:

- (1) Can a political agenda be ascribed to partisan support for the teaching of climate change denial and creationist doctrine?
- (2) How do science educators interpret current U.S. legislation with regard to teaching publicly controversial issues in science?
- (3) How are student opinions on publicly controversial issues in science, affected by their experienced curriculum?

## **Method**

This Ph.D. dissertation will feature three phases (1) the search, identification, and mapping of policy and curriculum documents that relate directly to the teaching of climate change denial and creationism in U.S. science classes, (2) issue survey questionnaires to educators and student, directly addressing research questions (2) and (3), and (3) purposive and convenient sampling will be used to select student and teacher participants for semi-structured interviews. Thereby achieving variation in the data collected (Creswell, 2002). Triangulating document analysis (e.g., proposed statute changes, court records, and technical argument), with survey and questionnaire data will help ensure “a confluence of evidence that breeds credibility” (Eisner, 1991, p. 110).

## **Implications**

It is important for the science of climate change to be taught, both in formal and informal educational environments, in order for future citizens to be able to make scientifically informed decisions about the consequences of climate change. But educators face challenges in helping their students attain *climate literacy*. Of equal importance, evolutionary science encompasses some of the fundamental principles of modern biology (Coyne, 2009; Dawkins, 1996; Futuyma, 2005), and has been termed the “unifying theory of the biological sciences” (Futuyma, 2005, p. 14). As such, I would contend that the importance of the accurate teaching of both areas in a modern science curriculum cannot be overstated. Furthermore, I believe that to deliberately misinform a generation in the name of education, for the sake of a political or cultural agenda, is as fundamental a betrayal of the trust of that generation as can be achieved, and should never go unchallenged. Whatever the theory, whatever the academic discipline or *conversational domain* (Pinar, 2008) may be, if the theory fails at the hurdles of academic rigor or honesty, then it has no business in a classroom.

## **Background Experience**

My doctoral work will be supervised by Dr. Anne-Marie Hill, who has extensive expertise in curriculum, particularly in science, technology and mathematics, and Dr. Azza Sharkawy whose expertise includes the biological sciences curricula. I am well-positioned to conduct this research due to my undergraduate degree in zoology; specializing in behavioural ecology, my degree necessitated considerable reading in evolutionary biology and environmental science. I have lived, worked and studied in Canada since 2009 and have an exemplary career history as both a science educator and technology consultant. At the commencement of my award tenure I will be commencing Ph.D. level classes and refining my program of study under the guidance of my supervisory committee.

### Bibliography and Citations

- Apple, M. (2008). Evolution versus creationism in education. *Educational Policy*, 22(2), 327–335. doi: 10.1177/0895904807312466
- Avise, J., & Wollenberg, K. (1997). Phylogenetics and the origin of species. *Proceedings of the National Academy of Sciences of the United States of America*, 94(15), 7748–7755. Retrieved from <http://www.pnas.org/cgi/content/full/94/15/7748>
- Berkman, B. & Plutzer, E. (2011). Defeating creationism in the courtroom, but not in the classroom. *Science*, 331(6016), 404–405. doi: 10.1126/science.1198902. Supporting online material retrieved from <http://www.sciencemag.org/content/suppl/2011/01/24/331.6016.404.DC1/Berkman.SOM.pdf>
- Branch, G. (2013). Defending science education: Climate as a second front for biologists. *BioScience*, 63(9), 717–718. Doi: 10.1525/bio.2013.63.9.5
- Coyne, J. (2009). *Why evolution is true*. Oxford, UK: Oxford University Press.
- Cresswell, J. (2002). *Educational research: Planning, conducting and evaluating quantitative and qualitative research*. Upper Saddle River, NJ: Merrill Prentice Hall.
- Davis, P., & Kenyon, D. (1993). *Of pandas and people: The central question of biological origins*. (2nd ed.). Richardson, Texas: Foundation for Thought and Ethics (FTE).
- Dawkins, R. (1996). *Climbing mount improbable*. London, England: Penguin Books.
- Dawkins, R. (2006). *The god delusion*. Boston, MA: Houghton Mifflin.
- Dawkins, R. (2009). *The greatest show on earth: The evidence for evolution*. New York, NY: Free Press, Simon & Schuster Inc.
- Donnelly, L. & Boone, W. (2007). Biology teachers' attitudes toward and use of Indiana's evolution standards. *Journal of Research in Science Teaching*, 44(2), 236–257. doi: 10.1002/tea.20150
- Edwards, A., & Cavalli-Sforza, L. (1963). The reconstruction of evolution. *Annals of Human Genetics*, 27, 105–106
- Edwards v. Aguillard, 482 U.S. 578 (1987). Retrieved from [http://www.law.cornell.edu/supct/html/historics/USSC\\_CR\\_0482\\_0578\\_ZS.html](http://www.law.cornell.edu/supct/html/historics/USSC_CR_0482_0578_ZS.html).
- Eisner, E. W. (1991). *The enlightened eye: Qualitative inquiry and the enhancement of educational practice*. Toronto, Canada: Collier Macmillan.
- Epperson v. Arkansas, 393 U.S. 97, 37 U.S. Law Week 4017, 89 S. Ct. 266, 21 L. Ed 228 (1968). Retrieved from <http://www.law.cornell.edu/supremecourt/text/393/97>.
- Freeman, S. & Herron, J. (2004). *Evolutionary analysis* (3rd. ed.). Upper Saddle River, NJ: Pearson/Prentice Hall.
- Freiler v. Tangipahoa Parish Board of Education, 530 U.S. (2000).
- Futuyma, D. (2005). *Evolution*. Sunderland, MA: Sinauer Associates Inc.
- Hulme, M. (2009). *Why we disagree about climate change: Understanding controversy, inaction and opportunity*. New York, NY: Cambridge University Press.

- Kitzmiller v. Dover Area School District, No. 04cv2688, 2005 U.S. Dist. (M.D. Pa. 2005). Retrieved from <http://www.pamd.uscourts.gov/opinions/jones/04v2688d.pdf>.
- Lenski, R. & Travisano, M. (1994). Dynamics of adaptation and diversification: a 10,000-generation experiment with bacterial populations. *Proceedings of the National Academy of Sciences*, 91(15), 6808–6814.
- LeVake, R. v. Independent School District #656, 625 N.W.2d 502 (MN Ct. of Appeal 2000), cert. denied, 534 U.S. 1081 (2002). Retrieved from <http://caselaw.findlaw.com/mn-court-of-appeals/1085860.html>
- Long, D. (2011). Evolution and religion in American education: An ethnography. In K. Tobin & C. Milne (Eds.), *Cultural Studies of Science Education: Vol. 4*. Dordrecht: Springer.
- McLean v. Arkansas Board of Education, 529 F. Supp. 1255, 50 U.S. Law Week 2412 (1982). Retrieved from [http://www.leagle.com/xmlResult.aspx?xmlDoc=19821784529FSupp1255\\_11613.xml&docbase=CSLWAR1-1950-1985](http://www.leagle.com/xmlResult.aspx?xmlDoc=19821784529FSupp1255_11613.xml&docbase=CSLWAR1-1950-1985).
- Miller, K. (1999). *Finding Darwin's God: A scientist's search for common ground between God and evolution*. New York, NY: Cliff Street Books.
- Moore, R. (2000). The revival of creationism in the United States. *Journal of Biological Education*, 35(1), 17–21. doi: 10.1080/00219266.2000.9655730
- Moore, R. (2004). How well do biology teachers understand the legal issues associated with the teaching of evolution? *Bioscience*, 54, 860–865. doi: 10.1641/0006-3568(2004)054[0860:HWDBTU]2.0.CO;2
- National Center for Science Education (NCSE). (2012). *Academic Freedom Legislation: "Academic Freedom" Bills by State & Year*. Retrieved from <http://ncse.com/creationism/general/academic-freedom-bills-by-state-year>
- Nei, M., & Kumar, S. (2000) *Molecular evolution and phylogenetics*. New York, NY: Oxford University Press.
- Pappas, S. (2012, February 17). Classrooms Become Next Battleground for Climate Change Skeptics. Retrieved from: <http://www.livescience.com/18531-classroom-battleground-climate-change.html>.
- Peloza v. Capistrano Unified School District, 37 F.3d 517 (9th Cir. 1994).
- Pinar, W. (2008). The Analytic Movement: Anti-Intellectualism and Complicated Conversation. In *What is Curriculum Theory?* (p. 194). New York: Taylor & Francis e-Library, 2008.
- Pinar, W. (2012). *What is curriculum theory?* (2<sup>nd</sup> ed.). New York, NY: Routledge.
- Rice, S. (2007). *Encyclopedia of evolution*. New York, NY: Facts on File/Infobase.
- Scott, E. & Branch, G. (Eds.), (2006). *Not in our classrooms: Why intelligent design is wrong for our schools*. Boston, MA: Beacon Press.
- Seagraves v. California Department of Education, Dkt. No. 278978 (Sup. Ct. Cal. 1981).
- Selman v. Cobb County School District. 390 F. Supp.2d 1286 (N. D. Ga. 2005).
- Webster v. New Lennox School District #122, 917 F.2d 1003 (7th Cir. 1990).

Weintrobe, S. (2013). The difficult problem of anxiety in thinking about climate change. In *Engaging with Climate Change: Psychoanalytic and Interdisciplinary Perspectives* (S. Weintrobe, Ed.). New York, NY: Routledge.

Wiley, E., & Lieberman, B. (2011). *Phylogenetics—theory and practice*. Hoboken, NJ: John Wiley & Sons, Inc.

**Research Contributions:**

**Godden, P.** (in press). *Creationism in the United States public school science classroom: From policy to practice*. Reports of the National Center for Science Education. Ref. No.: 221. Submitted: April 21 2013.