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Reassessing Possible Naturalized Ideology Regarding Science, Education, and Religion

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Abstract

This manuscript asks questions about what may be the naturalized, or taken for granted, ideologies in science education regarding religion. There have been times in history when religion has taken a dogmatic role in limiting the practices of science (e.g., the Roman Catholic Church and Galileo). This manuscript reflects on the dogmatic rule of religion and argues that now science may be in danger of imposing dogmatic ideals through reaching beyond the capacities of an empirical way of knowing. A Science, Technology, and Society (STS) approach to science teaching is considered as a possible mechanism for honoring both science and religion as valid yet different ways of knowing and better addressing students' integration of science learned in school into their everyday lives.

> Absence of evidence is not evidence of absence. (Roy, 2006)

> Behe's conclusion is that since complex biochemical systems in advanced organisms could not have evolved through strict Darwinian evolution, the only possible explanation is that the system was designed and put into place deliberately. (Card, 2006, ¶ 10)

These two quotes, in differing ways, get at relevant imperatives that I believe should be considered in science education. In his address, Rustum Roy (2006), Evan Pugh Professor of the Solid State, Professor of Geochemistry, and Professor of Science, Technology, and Society at The Pennsylvania State University, discussed the "change in guard" that he believes has taken place since the days of the Roman Catholic Church in the time of Galileo. In this earlier period, the Roman Catholic Church belief system, or worldview, represented what could be described as the dogma of the time, "a definite authoritative tenet" (Merriam-Webster Online dictionary). The change in guard that Roy argues has taken place, which may be accurate, is the new rule of Science. Roy posited that science has taken the role of the dogmatic authority of today.

Feyerabend (1975) illuminated dangers associated with an unchecked dogmatic rule of science in his writings pertaining to the potential dangers of an objective search for truth that disconnects the humanity from science and in his critique of rigid methodologies portrayed as the norms of scientific investigations. Feyerabend (1978) also argued that science should be separated from the

state, just as religion has been in many states, so that a free society can be established that gives equal rights to all traditions, thereby giving them equal access to the power of the state. As a science educator with some 9 years of science and post-secondary education training, the resonance through which Roy's argument caught my attention led me to believe that there may be some credibility to his claims, or at the least cause for consideration. I feel that science educators are in danger of implicitly teaching society that absence of evidence is evidence of absence, through counting only those things that can be understood through science to be the only things worthy of being considered a purer grade of knowledge. This idea is manifested in the translated writings of Auguste Comte, in which he counts scientific knowledge as the only authentic knowledge, and the influence that the positivistic philosophy he helped articulate has had in science, and continues to have to some extent (Martineau, 2003).

In the second quote introducing this opinion piece, I see an unjustified argument that represents the danger some fear may be assumed if Science pulls back from anything but a dogmatic rule. Through the argument/logic put forth in this quote, if evidence for evolution is found as problematic, the only possible explanation is a deliberate placement. There have been times in our human history that we have recognized or experienced a paradigmatic shift in understanding or thinking (Kuhn, 1962). One such shift referred to earlier was from the geocentric view of our universe to the heliocentric view. Through changing our lens, mankind was offered a different perspective that consequently offered new vantages for observation. Let us consider that there may be other paradigmatic shifts on the horizon. If this is the case, the logic that problems with the theory of evolution leads to proof of a deliberate placement seems close-minded, or perhaps even bordering dogmatic.

Lederman, Abd-El-Khalick, Bell, and Schwartz (2002) offer this explanation of a theory: "Theories serve to explain large sets of seemingly unrelated observations in more than one field of investigation" (p. 500). They go on to explain that theories "are well-established, highly substantiated, internally consistent systems of explanations" (p. 500). However, they also go on to discuss the tentative nature of science, whereby "scientific knowledge, although reliable and durable, is never absolute or certain" (p. 502). If scientists find a theory that is problematic, then the options for dealing with the problem are modification of the theory to deal with anomalies or dismissal of the theory. I believe we can find examples in mankind's history where this has happened (e.g., the recognition of plate tectonics as the geological explanation for large-scale physical changes of the earth, or the shift from a behaviorist emphasis to a cognitive one in psychological studies). Theories, because of their very essence as human explanations, can be changed. The National Research Council (1996) discussed this tentativeness and how it should be understood:

> Because all scientific ideas depend on experimental and observational confirmation, all scientific knowledge is, in principle, subject to change as new evidence becomes available. The core ideas of science such as the conservation of energy or the laws of motion have been subjected to a wide variety of confirmations and are therefore unlikely to change in the areas in which they have been tested. In areas where data or understanding are incomplete, such as the details of human evolution or questions surrounding global warming, new data may well lead to changes in current ideas or resolve current conflicts. In situations where information is still fragmentary, it is normal for scientific ideas to be incomplete, but this is also where the opportunity for making advances may be greatest. (p. 201)

So, while I as a science educator want to be sure that neither a dogma of science nor a dogma of church exists, I find myself wondering what might be done on this front.

Interdisciplinary Considerations

As an educator, I have developed a philosophy that has me believing that teaching interdisciplinary programs, like the cross-curricular science and reading program shared by Creech and Hale (2006) or the cross-curricular programs involving math, science, and social studies shared by Yager and Lutz (1995), leads learners toward a more meaningful understanding. This approach does not leave to chance the construction of the pieces of the school curriculum into a meaningful final educational product, as it allows students to work at these constructions in the presence of a facilitator and peers. Likewise, a Science, Technology, and Society (STS) approach to teaching, "the teaching and learning of science in the context of human experience" (National Science Teachers Association, 1990-1991, pp. 47-48), might reach farther in allowing learners to construct the pieces of life's curriculum, one part only of which is learned in school.

As I consider these ideas that make up the fabric of my educational philosophy, I have recognized a contradiction in my thought or understanding or education. At some point in developing my philosophy, I have accepted the idea that science and religion cannot be discussed in the same context. It is unclear if I justified it as the separation of church and state, or as what has been described by Fairclough (1995) as the naturalization or opacity of an established ideology. One can find staunch opposition to anything seeking to merge education and religion in the following position, which may justify me attributing my current understanding to separation of church and state:

> Professor of political science Marjorie George argues that the U.S. Constitution and the Supreme Court have created a solid wall between the educational system and religion. Despite the efforts of creationists to find ways around or through that wall, she holds, religion "can play no role in the classroom." (Easton, 2005, p. 40)

Whether or not this thought is held by all, it seems reflection on established ideologies can be helpful in guarding against the emergence of dogma and helping students to attain a more cohesive understanding.

Whatever the case, I have always held as part of my philosophy that science cannot be in an interdisciplinary context with anything associated with religion. In my own life, the very absence of consideration for how science and religion interact, or the confusion of how this may be possible, has long left me concerned. This is the thought I am now beginning to reexamine, in a practice of reflection. This brings me to the following new questions:

1. Can science and religion be taught in an interdisciplinary way?
2. Should science and religion be taught this way?

Then, if the answers are *yes*,

3. In what respect should science and religion be taught in an interdisciplinary manner?
4. What benefits might emerge from such an unorthodox suggestion?

To be clear here, I am not entertaining the thought of teaching religion and science in an interdisciplinary manner in our schools, at least not in the way that would have students accepting and practicing one religion. What I am entertaining is the thought of employing STS instruction without the exclusion of religion. From within a culture consisting of many religions, I am considering the implementation of STS instruction whereby science as a way knowing is

considered alongside religion as a way of knowing, in whatever context or community the students find themselves. If science literacy is contingent in part on students understanding that science is a way of knowing, I cannot think of a more meaningful way of gaining deeper understanding about knowing in science than contrasting it with another way of knowing. This would allow learners to recognize the similarities and difference between the two and better distinguish between them. It would also help students better understand the causes of tensions arising among debaters, all of which lie well within the boundaries of STS instruction.

STS instruction has these core components:

- Science, technology, and social studies are taught in a socially relevant context.
- Students experience active citizenship by actively exploring issues, processing information, forming opinions, and making personal judgments on real-world events.
- Lessons encourage awareness and acceptance of differing viewpoints.
- Students use problem solving to make personal commitments and take responsible social action. (Alaska Department of Education & Early Development, n.d., section 5)

"STS is active learning on relevant topics that, in addition to the acquisition of information and skills, results in commitment, action and acceptance on the part of the student" (Alaska Department of Education & Early Development, n.d., section 5). In additional to contrasting ways of knowing through discussion of science and religion, STS instruction also offers students space, as well as a medium, for exploring the interaction of the two.

An example of how this may play out in the school science curriculum could be in the study of world populations, or the issue of population control. When a student of mine chose to research assertions made about population controls, he found that one of the reasons offered for population control was that it retains economic prosperity and a high standard of living. This reason went against this student's beliefs, as he stated: "I consider population control policies to be morally wrong and want to know the extent of their effectiveness." While this student did not specifically state that this belief was a religious one, it should be noted that I teach in a state where the vast majority of citizens are practicing members of The Church of Jesus Christ of Latter-Day Saints, known also as the Mormons, and consideration of population control in this context can be informative. Teachings from this religion pertaining to population control can be seen in Conference Reports or other influential Mormon resources. The following are three excerpts documenting teaching on this subject at various times:

> Children are a heritage from the Lord, and those who refuse the responsibility of bringing them into the world and caring for them are usually prompted by selfish motives, and the result is that they suffer the penalty of selfishness throughout eternity. There is no excuse for members of our Church adopting the custom of the world. . . We have been better taught than they. (Smith, 1917, p. 72)

"When the husband and wife are healthy and free from inherited weaknesses and disease that might be transplanted with injury to their offspring, the use of contraceptives is to be condemned" (McKay, 1943, p. 30). "The first commandment that God gave to Adam and Eve pertained to their potential for parenthood as husband and wife. We declare that God's commandment for His children to multiply and replenish the earth remains in force" (Hinckley, 1995).

Another member of this class was an Evangelical Christian. These discussions prompted this member to explore and share his own religions beliefs about population control.

"We cannot train people in single disciplines and expect them to deal with the multifaceted nature of their work. Including interdisciplinary instruction will help students better integrate 'school learning' into their lives" (Alaska Department of Education & Early Development, n.d., section 5). As the first student mentioned above moved forward with his study on whether the population control policies suggested by Brown, Gardner, and Halweil (1999) have been effective, he devised a study that collected empirical data to inform conclusions that he would make at the end of his study. Discussions at the end of the project pertaining to the moral reasons related to population control, as well as the teachings of the various religions, were then also grounded in empirical data supported by the study. Here is the point that comes from this example. We as science educators in the classroom can choose to examine the influences that are at play when students in the classroom are learning and/or making decisions, or we can allow them to go unacknowledged, but either way they still exist. I believe that these discussions at the conclusion of the project, allowing for grappling between the answer to questions about population control based on religious teachings and scientific evidence, can be every bit as important as the process of completing the scientific investigation that precedes them. This process allows the students to work at integrating school learning into their lives.

This consideration seems even more valid in the context of the interdisciplinary rationale fueling a further belief in STS instruction. If students experience "the teaching and learning of science in the context of human experience" (National Science Teachers Association, 1990-1991, pp. 47-48), this human experience by its very nature includes religion. Likewise, this approach does not leave to chance the construction of the pieces of the school curriculum into a meaningful final educational product. It allows the students to work at these constructions in the presence of a facilitator, a family, and/or peers and reach farther in allowing learners to construct the pieces of life's curriculum.

William Vanderburg (2006), president-elect for IASTS and professor in the Department of Mechanical and Industrial Engineering at the University of Toronto, Canada argued the analogy that "if the only tool we have is a hammer, all problems look like nails," but in reality all problems are not nails and cannot be addressed with a hammer. He went on to ask: "Can we have a society based on a thinking that this is the answer to all questions?" Science is one way of knowing, a hammer if you will, but it is not the only way of knowing. Lederman et al. (2002) suggest "science is empirical" (p. 500). It is a hammer for approaching nails that have empirical possibilities, but the latter is not always the case. Empirical study may not lead us to justice or ethics, and in these realms a different way of knowing may be needed; perhaps a screwdriver, which may represent religion (Foltz & Foltz, 2006). Gould (1994) similarly concluded:

> The myth of a war between science and religion remains all too current and continues to impede a proper bonding and conciliation between these two utterly different and powerfully important institutions of human life. How can a war exist between two vital subjects with such different appropriate turfs--science as an enterprise dedicated to discovering and explaining the factual basis of the empirical world, and religion as an examination of ethics and values? (p. 18)

If our schools continue to leave out ways of knowing that are not science, are we truly serving to educate the student populace? Are we taking away from their arsenal one tool for approaching problems rather than adding to the toolbox?

I will end this opinion piece by requesting that these observations and possibilities be regarded as dialogue for the science education community. To grow as a community, I believe we must always be open to question the naturalized, or opaque, ideologies (Fairclough, 1995) in order to consider how well they sit with the shifting understandings and thoughts of educators, scientists, and each community's current research. I welcome thoughts and comments from other science educators on this issue, and offer one final assertion that identifies the need for the entertainment of questions such as the ones raised in this paper:

> There must be no barriers to freedom of inquiry. There is no place for dogma in science. The scientist is free, and must be free to ask any questions, to doubt any assertion, to seek for any evidence, to correct any errors. (J. Robert Oppenheimer)

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Critical Incident

An Invitation

Readers are invited to send, to the Editor at editor@ScienceEducationReview.com , a summary of a critical incident in which you have been involved. A critical incident is an event, or situation, that marks a significant turning point, or change, for a teacher. The majority of critical incidents are not dramatic or obvious, but are rendered critical through the analysis of the teacher (see Volume 3, p. 13 for further detail). You might describe the educational context and the incident (please use pseudonyms), analyse the incident (e.g., provide reasons to explain your observations), and reflect on the impact the incident made on your views about the learning and teaching process. Upon request, authors may remain anonymous.

We have undoubtedly all done things about which we were very pleased, and perhaps done other things about which we did not feel so pleased, and we all need to remain reflexive of our practice. While teachers will view an incident through the lenses of their own professional experiences, and may therefore explain it differently, this does not detract from the potential benefits to be gained from our willingness to share our experiences and thus better inform the practice of other teachers.

Alternative Conceptions

By: Sue Cavell, Techniquest, Cardiff, UK suec@techniquest.org

This incident had a major impact on my teaching, and aided in identifying my PhD research project. At the time, I was teaching Sound to Year 9 Science and demonstrating that, when an alarm clock is ringing in a bell jar and all the air is evacuated from the jar, one no longer hears the sound. Even though I had told the students that I was pumping the air out of the jar, one of them said "the clock has stopped ringing" and a couple of others agreed. I realised then that these students did not understand that the air was needed in order for the sound to be heard, despite previous demonstrations of how vibrations are transmitted and about the transmission of sound in different media. This incident led me to research on students' alternative conceptions of sound and hearing, and to design a curriculum unit that better developed their understanding of the role of air in the transmission of sound to the ear, a project that was part of the larger study Linking Cognitive Development and Curriculum Design.

Science Poetry

Reading and/or listening to poems that have been composed by other children their own age can inspire and reassure students as to their ability to understand and write poetry, and the science poems in this regular section of *SER* may be used for this purpose. Please find information about the *International Science Poetry Competition* at http://www.ScienceEducationReview.com/poetcomp.html .