Exploring the Relationship between Science, Religion & Attitudes toward Evolution Education

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ABSTRACT

While some have argued that abandoning religious belief is the only way to help religious individuals accept evolution, we strongly contend that highlighting faith-evolution compatibility is much more effective. This article describes a professional development event for science teachers and religious educators highlighting ways to teach human evolution using a science inquiry approach coupled with methods for helping students reconcile science and religion. Since many science teachers in our population face a highly religious student body, are religious themselves, and have religious education integrated into the school system, we asked them to invite the religious educators (i.e., seminary teachers) at their schools to join them at the event. In addition, a group of religious educator faculty members from the local university joined the event. We collected data both before and after intervention. Results showed that the event strengthened understanding of the intersection between evolution and religion for this particular faith group, decreased feelings of conflict in participants themselves, and increased their confidence and comfort level in offering reconciliation to students and designing lesson plans that include human examples of evolution. Differential impacts on each group of participants are discussed in terms of what we can apply to efforts like this going forward.

Key Words: evolution education; reconciliation; ReCCEE; professional development workshop.

Introduction

High school teacher beliefs affect how many students are taught evolution in their biology classrooms. According to the National Survey of High School Biology Teachers, which surveyed 926 public high school biology instructors across the nation, 13% of the teachers actively advocate creationism or intelligent design in their classroom for at least one hour of class time. Meanwhile, 28% of teachers advocate for evolutionary biology in their classroom, and the remaining 60% of teachers neither advocate for creationism nor evolutionary biology (Berkman & Plutzer, 2011). Research also shows that teachers who view evolution positively are more likely to cover standards- and nonstandards-based evolutionary topics compared to colleagues who do not view evolution positively (Borgerding, 2012).

Recent research has been conducted to draw conclusions about why so many teachers are not teaching evolution in their classrooms. Confidence may be a significant factor. The Report of the 2018 NSSME+ found that only 63% of high school biology / life science teachers considered themselves very well prepared to teach evolution (Banilower et al., 2018). These teachers listed evolution as the topic they had the least confidence to teach compared to all other topics listed. Along with confidence, many teachers do not teach evolution because it is not in their curriculum or they want to avoid conflict (Hermann et al., 2020). With that said, some teachers may perceive potential conflict among parents or students but in reality may never encounter such problems, depending on the community in which they live (Hermann, 2013). These barriers impede evolution education in high school biology classrooms.

Focusing on the nature of science (NOS) is a commonly used and proven approach to gaining acceptance when teaching evolution. Studies with high school biology teachers reveal significant relationships between an understanding of NOS and the acceptance of evolutionary theory (Akyol et al., 2010; Rutledge & Warden, 2000). Especially for religious individuals, an understanding of the differences between the purposes of science and religion can have a large impact (Cavallo & McCall, 2008; Cofré et al., 2017; Dunk et al., 2017). Understanding NOS is an excellent way to reduce feelings of tension between religion and science, and we believe it is an excellent starting point for teaching evolution.

One common approach to teaching evolution, however, assumes that students do not accept evolution because of a deficit in knowledge on the subject. This approach focuses on teaching the facts of evolution, assuming a correlation between knowledge and acceptance. Studies on the efficacy of teaching the facts as a means of increasing acceptance of evolutionary theory, in the absence of additional strategies, have yielded varying results. A series of more recent studies have suggested a well-supported, positive relationship between knowledge of evolution and its acceptance (Dunk et al., 2017; Glaze et al., 2014; Rissler et al., 2014; Weisberg et al., 2018). However, a portion of the literature has found no correlation (e.g., Bishop & Anderson, 1990;
Brem et al., 2003; Chinsamy & Plăgăniy, 2008; Mead et al., 2017; Nehm & Schonfeld, 2007; Smatresk et al., 2003). Taken to an extreme, this approach may assume those who do not accept evolution are of lower intelligence or reasoning ability (e.g., Honey, 2015; Lawson & Wiser, 1990). In this extreme approach, unproven claims and inflammatory statements imply that a rejection of evolution is the result of lower cognitive aptitude and unintelligence. Unsurprisingly, we have found this mindset to be polarizing and unhelpful in changing attitudes toward acceptance of evolution.

While methods of research and subsequent opinions differ, it is reasonable to assume that one’s level of knowledge plays some role in evolution acceptance. However, the relationship between knowledge and evolution appears to be influenced by a number of external factors aside from understanding. These factors include religious beliefs and backgrounds (Dagher & BouJaoude, 1997; Deniz et al., 2008; Miller, 2006) as well as views about the nature of religion and pressure from parents (Winslow et al., 2011). In fact, with Judeo-Christian religions, several studies agree that those who hold a literal interpretation of the Bible are more likely to reject evolution (Baker, 2013; Berkman & Plutzer, 2010; Hill, 2014). For many religious people, learning the facts about evolution will not be enough for them to accept. Many may still see the theory of evolution as threatening to their religion. Additional interventions are often necessary for these students. We acknowledge, however, that not all religious faiths find conflict with evolution, and thus, religious beliefs likely play no role in the acceptance of evolution.

Religious Cultural Competence in Evolution Education (ReCCEE) appears to be a useful framework to overcome existing potential religious barriers to learning evolution (Barnes & Brownell, 2017). Data suggests that students facing an instructor with a negative disposition toward their religious beliefs have adverse experiences when learning evolution (Barnes et al., 2017). The practices of ReCCEE are aimed at helping educators “reduce students’ perceived conflict between evolution and religion, increase students’ acceptance of evolution, and help create more inclusive undergraduate biology classrooms” (Barnes & Brownell, 2017, p. 1). These strategies include acknowledging the potential conflict, exploring diverse views on evolution and religion, teaching about the nature of science and the nature of religion, outlining diverse viewpoints about the ways in which science and religion coexist, introducing role models who accept evolution and maintain faith, and discussing potential compatibility. These practices are shown to be effective at bridging the gap between evolution education and orthodox religious belief in even just six minutes of instruction (e.g., Truong et al., 2018).

While considerable efforts have been made to help students and faculty accept evolution for themselves, there have been far fewer strides toward equipping teachers with the necessary knowledge and tools to effectively teach evolution, especially to their religious students whose religious beliefs may present conflict (e.g., many Judeo-Christian traditions). The primary vehicle for change in this area has been top-down administrative changes. Judicial courts have repeatedly supported the teaching of evolution over intelligent design (e.g., Edwards v. Aguillard, 1987; Kitzmiller v. Dover Area School District, 2005; Pelova v. Capistrano Unified School District, 1992), and state standards typically require evolution education (Lerner, 2000). However, while judicial and political support for evolution education is essential, it is far from sufficient for engaging religious teachers and students. Wording of state standards can be filled with ambiguity, making it easy for teachers to provide curricular explanations or cast doubt on the scientific consensus regarding evolution (Lerner, 2000). Additionally, even when quality state standards are implemented effectively, such as those suggested in “A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas,” students can only be required to know, understand, and apply evolutionary concepts. Long (2012) found in his interviews of religious students that they were able to separate the facts of evolution from their religious beliefs and perform well on exams without believing the information.

There have been other interventions in the past attempting to reconcile students’ religious beliefs with evolution (e.g., Lindsey et al., 2019). Pobiner and others (2018) used human evolution examples to help aid high school biology students in evolution understanding and acceptance. In addition, strategies were implemented to help create an environment that was sensitive to various religious and cultural beliefs. Results from this research show that using human examples as well as teaching evolution in a culturally and religiously sensitive environment helped students to gain both evolution understanding and acceptance.

Based on our literature review, we know that many students (and teachers) see a conflict between certain religious beliefs (especially Judeo-Christian beliefs) and science, and specifically evolution. It has also been shown that simply giving them more knowledge about evolution does not resolve the conflict. Currently, tools to help high school teachers approach religious students in faith-friendly ways, and even to navigate their own religious beliefs, are scarce. We propose that it is crucial that we facilitate communication between both those who teach biology and those who advise in religion in order to provide tools for reconciling evolution amongst religious audiences. In this study, we tested the effectiveness of a professional development workshop that brought together science in-service teachers and high school religious educators of a specific Christian denomination under the tutelage of a famous evolutionary anthropologist to learn about evolution and to help construct approaches to support students in resolving the conflict.

Methods

Ethics Statement

All data for this study was collected anonymously with no identifying information collected. It was also not analyzed until it had become archival data. The Institutional Review Board determined that review was not necessary (IRB2020-410).

Participants

To determine the effectiveness of our intervention on both science and religious instructors, we recruited 76 participants. Science instructors consisted of 43 secondary education in-service teachers from local junior highs and high schools in Utah County. The workshop was advertised through the local Science Teachers Association (USTA) listserve as a professional development opportunity. Secondary ed participants received 4.0 relicensure and a $100 stipend in exchange for their participation. An additional 6 participants were pre-service secondary education biology teachers currently attending the hosting university. Of those participating, 12 junior high and 22 high school teachers completed both surveys (N_{Secondary biology teachers} = 34).

Religious instructors included 27 participants associated with religious education, specific to the predominant religion of the area, that of the Church of Jesus Christ of Latter-day Saints (CJCLDS). Participants were recruited by email and word of mouth. These participants were also offered a $100 stipend for their participation.
Three participants were current curriculum writers of the Seminary and Institute program of the CJCLDS. Eleven were current CJCLDS seminary instructors who teach daily seminary classes, during a “release time,” to CJCLDS youth attending the junior highs and high schools in the same districts as our science teacher participants. Thirteen participants were faculty who teach religious education, church history, and ancient scripture at the hosting university and who are of the CJCLDS affiliation. Of those participating, 9 seminary instructors, 3 curriculum writers, and 11 university faculty members completed both surveys; however, the 3 curriculum writers were excluded from analysis because maintaining anonymity was difficult with their small numbers (N

| Participants | Seminary Teachers | Religious Faculty |
|--------------|------------------|------------------|
| 3            | 9                | 11               |

**Evolution & the Church of Jesus Christ of Latter-day Saints**

The major focus of the workshop was reconciliation between evolution and the prominent religion in the area, the CJCLDS. The CJCLDS has a decidedly neutral stance on the theory of evolution, stating recently, “The Church has no official position on the theory of evolution…. Nothing has been revealed concerning evolution” (“What does the church believe,” 2016, p. 41). However, the CJCLDS has had a somewhat controversial past of disagreement about evolution among prominent leadership in the church (see Evenson and Jeffery 2005 for a review) that has led many members to hold on to a false belief that the CJCLDS is decidedly against evolutionary theory. The official doctrine of the CJCLDS affirms a creation and that “God directed the creation of Adam and Eve and placed their spirits in their bodies” (“What does the church believe,” 2016, p. 41).

**Intervention**

The purpose of the workshop was to help both science and religious educators be aware of the perceived conflict in their students and find ways to help students reconcile their religious faith with learning evolution. In addition, we aimed to teach principles of human evolution, eliminate misconceptions, and increase acceptance of evolution by the participants. The workshop had two parts: “Using a Reconciliation Approach” and “Human Evolution with Dr. John Hawks,” a visiting guest speaker and codiscoverer of Homo naledi (e.g., Berger et al., 2015).

During Part 1, Using a Reconciliation Approach, participants were led in a discussion about the nature of science and the nature of religion. They discussed the US historical events that led to this perceived tension between evolution and faith. They also were presented with and encouraged to discuss the current research surrounding what we know about the influences of evolution acceptance. We outlined our approach after the ReCCEE guidelines (Barnes & Brownell, 2017; see Tolman et al., 2020, for a detailed description), with a particular focus on acknowledging potential conflict and discussing potential compatibility. The discussion was led by a university faculty member who specializes in the preparation of secondary education students, and is himself a secondary teacher, and several university faculty members who regularly teach undergraduate majors and nonmajors introductory biology and are also members of the CJCLDS. After the presentation, participants were encouraged to discuss with each other and to ask questions of facilitators about how to effectively implement an approach like this in both the science and religion classroom.

During Part 2, Human Evolution with Dr. John Hawks, Dr. Hawks led the group in an interactive activity utilizing skull casts of multiple hominin species. Participants were encouraged to measure features and predict relatedness, to predict what things you can deduce from skeletal remains, and to ask questions of Dr. Hawks. Dr. Hawks also led participants in a discussion about how we know what we know about hominid evolution and also what things we do not yet know. The remaining time was open for a question-and-answer session where several religiously oriented questions were brought up and discussed as a group.

** Measures**

Upon registering at the event, participants were given an anonymous pre-survey. The full survey can be found in the Supplemental Material with the online version of this article. The survey asked participants to indicate (1) the level of conflict they think that their students perceive between evolution and religion, (2) their own understanding of the CJCLDS stance on evolution, (3) their belief in the compatibility of evolution and their religious faith, (4) their acceptance of evolutionary theory including human evolution, (5) their confidence in helping students reconcile evolution with religious belief, and (6) their comfort and confidence in using human examples to teach evolution in an interactive way in their classrooms. Upon completion of the workshop, participants were asked to take a post-survey that asked the same questions but also for them to indicate if any change had taken place, and if so, to quantify that change (again, the full survey can be found in the Supplemental Material). Participants were asked to attach their pre-survey to their post-survey and to turn it into workshop facilitators to be entered into a drawing to win a Homo naledi skull replica. No identifying information was collected from participants, so they were free to be honest with their responses.

**Analysis**

For the purpose of analysis and to maintain anonymity of participants, all science instructors (junior high and high school) were combined to represent “science instructors.” “Religious instructors” were kept as two groups: seminary instructors and religion faculty from the university. Responses on each item between pre-surveys and post-surveys were compared using nonparametric methods: Wilcoxon signed-rank tests for pre-post comparisons, Mann-Whitney U tests for comparisons between two groups, and chi-square goodness-of-fit tests for comparison of proportions. Nonparametric methods were used due to the small sample size, the ordinal nature of our data, and violation of the assumption of normality. Statistical significance was set to 0.05.

**Results**

**Perceptions of Student Conflict**

Participants were asked to rate the amount of conflict they believe that their students feel between evolution and their religion. On a five-point Likert scale from no conflict at all (1) to extreme conflict that inhibits learning (5), a Kruskal-Wallis test showed that the differences between groups was significant, \( \chi^2(2) = 6.23, p = 0.04, \eta^2 = 0.04 \). Pairwise comparisons, correcting for alpha inflation, show that seminary instructors felt significantly more student conflict than secondary biology teachers \((p = 0.04)\). The difference was not significant between religious faculty and seminary teachers \((p = 0.20)\) or between biology teachers and religious faculty \((p = 1.0)\). Perceptions of conflict did not change in response to the workshop \((p = \text{NS})\).
Understanding of Church’s Stance

Participants were asked prior to and then following the workshop about their understanding of the position of the CJCLDS toward evolution (a position that is neutral). Prior to the workshop, both seminary and secondary biology teachers had a mixed understanding of the church’s position, whereas all religious faculty were aware of the church’s neutral position. After the workshop, secondary biology teachers made a significant shift toward a correct understanding—χ²(2) = 25.12, \( p < 0.001 \), \( \phi = 0.86 \), a large effect—although two secondary biology teachers were still unsure, or unconvinced, by the end of the workshop that the church’s position is neutral (see Figure 2). Seminary teachers all ended with a correct understanding of the neutral position; however, the shift did not reach significance (\( p = 0.10 \)).

Belief in Compatibility

Participants were asked to rank their feelings of compatibility between religious belief and evolution on a five-point scale, from low compatibility (1) to high compatibility (5). Most participants felt a high level of compatibility prior to the workshop; however, a Kruskal-Wallis test shows differences in conflict between participants—χ²(2) = 6.29, \( p = 0.04 \), \( \eta^2 = 0.046 \)—with secondary biology teachers feeling the highest level of compatibility and religious faculty feeling the lowest level of compatibility (see Figure 3). No changes in perceived compatibility were seen after the workshop (\( p = \text{NS} \)).

Acceptance of Evolution

Participants were first asked about their acceptance of organismal evolution using this prompt: “Organisms existing today are the result of the evolutionary processes that have occurred over millions of years” (from Rutledge & Sadler, 2007), on a five-point Likert scale. A Kruskal-Wallis test revealed that acceptance differed across groups—χ²(2) = 6.83, \( p = 0.03 \), \( \eta^2 = 0.057 \)—with biology teachers having the highest acceptance (mean = 4.69) followed by religious faculty (mean = 4.27) and then seminary teachers (mean = 3.78). No individual pairwise comparisons were significant with a correction for alpha inflation. After the workshop, Wilcoxon signed-rank tests showed that biology teachers stayed at their same high acceptance (mean = 4.9, \( p = 0.22 \)), seminary teachers significantly increased in acceptance (mean = 4.8, \( z = 2.06 \), \( p = 0.04 \), \( r = 0.73 \), a large effect), while religion faculty experienced no significant changes (mean = 4.2, \( p = 0.74 \)).

Regarding human evolution, participants were given four options: a naturalistic viewpoint (humans evolved and God is not involved), a theistic viewpoint (humans evolved with God guiding the process), a special creation viewpoint (humans did not evolve), and no opinion. Seminary instructors had the highest proportion of special creationist ideas prior to the workshop, followed by religious faculty; no secondary biology teachers had this viewpoint (see Figure 4). By the end of the workshop, both seminary instructors and religious faculty had made shifts toward theistic evolution and away from special creationism, but the seminary teachers are the only ones that reached significance—χ²(2) = 6.3, \( p = 0.04 \), \( r = 0.89 \), a large effect.

Confidence in Helping Students Reconcile

Participants were asked to rate their confidence in helping students overcome the conflict between science and religion on a five-point
Likert scale with 1 being low confidence to 5 being high confidence. Seminary teachers showed lower confidence both prior to and after intervention (although overall distributions were not significantly different), but all groups experienced gains in confidence, although secondary biology teachers are the only ones that reached significance, likely due to their larger sample size ($z = 2.14$, $p = 0.03$, $r = 0.37$, a medium effect; see Figure 5).

**Discussion**

Our results add to the body of literature demonstrating the efficacy of a ReCCEE approach. Specifically, we helped educators recognize potential conflicts and to gain tools to emphasize potential compatibility for their students. Ample evidence has shown that this approach can shift attitudes about evolutionary theory over a period of time among students in classroom settings (Barnes & Brownell, 2017; Lindsay et al., 2019, Tolman et al., 2020), and we believe it is important that both religious and science educators embrace the ReCCEE framework and gain confidence in their ability to help their students reconcile their religious faith with evolution. Specifically, encouraging both religious and science educators to acknowledge potential conflict in students when they approach this subject and then to offer students potential compatibility, or at least the space to explore this compatibility, between their religious beliefs and the science of evolution can be incredibly impactful for religious students who may see conflict with this topic. In addition, by encouraging collaboration between those teaching evolution and those teaching religion, we believe we can lessen the perceived conflict that students might encounter by equipping both kinds of educators with tools to approach the conflict, thereby making it easier for students to embrace evolution without feeling their faith is being threatened.

The secondary teachers that attended the workshop reported that their confidence to help students reconcile evolution with religion and their confidence to teach evolution increased significantly, with medium to large effect. However, participants did not experience increases in their confidence to use interactive lesson plans; instead, they began the workshop with rather high confidence and remained high.
negative comments, and how to keep students engaged. Workshops such as ours can help teachers address these issues and also connect them with other teachers who are encountering the same issues.

It is also important to note that both seminary teachers and religious faculty were also more accepting of evolution following the workshop. Truong, Barnes, and Brownell (2018) demonstrated that a six-minute ReCCEE-based intervention was able to decrease the perceived conflict between evolution and religion in a population of undergraduate students. The shift toward greater acceptance seen in the seminary teachers and religious faculty in our sample supplies further evidence that ReCCEE-based approaches can effectively be applied outside of classrooms through short interventions. Based on the current study, we would recommend specifically that training include ways to acknowledge conflict and offer potential reconciliation. This is encouraging, as many Americans will not have the opportunity to learn about evolution in a classroom setting. We call on the biology education community to further develop applications of ReCCEE that can be taken to the public, as we believe this will be a valuable tool in combating science denialism.

These ReCCEE practices can take various forms. In the current study, we have emphasized a collaboration between science and religious educators of a particular Christian faith group (CJCLDS) to target two particular ReCCEE practices: acknowledging the existence of conflict and highlighting potential compatibility. In addition, part of Dr. Hawks’ discussion focused on the nature of science and what we know and don’t know about human evolution. In addition to these practices, education researchers can explore the potentials of the “Explore” ReCCEE practice, which is to encourage students to explore views on evolution and religion. Many important resources exist already to facilitate this exploration including the Clergy Letters Project (https://www.theclergyletterproject.org/), BioLogos (https://biologos.org/), the Smithsonian’s Human Origins Projects’ Broader Social Impacts Committee (https://humanorigins.si.edu/about/broader-social-impacts-committee), and Brigham Young University’s Reconciling Evolution website (https://biology.byu.edu/reconciling-evolution/), to name a few. Each of these resources offers potential tools that educators can use within their classrooms or in a public setting to allow exploration of potential compatibility. In addition, many of these resources offer potential role models of religious figures who have embraced science or scientist or acknowledge their religious beliefs, another ReCCEE practice.

An additional ReCCEE practice is to teach the nature of science, specifically its bounds and how it differs from seeking religious truth. We would encourage researchers to explore this idea further. Additionally, outlining a spectrum of viewpoints can be effective in helping students feel less restricted to an atheistic viewpoint of evolution. Several studies have shown this to be a promising approach (e.g., Barnes, Elser & Brownell, 2017; Wiles and Alters, 2011), but more research is certainly warranted.

○ Conclusion

Simply providing teachers with a set of state standards regarding evolution does not necessarily prepare them to teach evolution to their religious students. It is important to note that as of 2015, over 80% of Americans consider themselves to be religious in at least some way (Pew, 2015), so it is vital that teachers have tools to reach religious students. Pobiner and others’ (2018) work with the Teaching Evolution through Human Examples project is an excellent start, but resources to increase teacher confidence and effectiveness are still scarce, and involvement of religious clergy in the process is a novel idea. Our workshop not only led to increased acceptance of evolution for the individuals who participated but also impacted their perceived confidence as teachers. Members of all three groups—secondary biology teachers, seminary teachers, and religious faculty—reported feeling greater confidence in their ability to address student concerns regarding evolution. Faculty development programs specifically designed to help biology and religious instructors work together to address evolution may be a relatively simple and cost-effective way to provide teachers with the necessary tools and confidence to bridge the perceived gap between scientific and religious thought.

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