

Patterns for managing potential conflict between religion and evolution among Muslim undergraduate biology students

Introduction

Evolution is a foundational component of biology (AAAS, 2011), yet it is controversial in the public and among biology students (Sbeglia & Nehm, 2018, 2019). Perceived conflict between religion and evolution is the most predictive factor for whether a student will reject evolution (Barnes et al., 2021), and perceived conflict between religion and evolution also varies depending on religious affiliation. A nationwide study conducted by Barnes et al. (2021) indicated that Muslim and non-Catholic Christian biology students had the lowest acceptance of evolution compared to Jewish, Hindu, and Buddhist students. To understand the low acceptance rates of evolution among biology students, an abundance of research has been conducted on undergraduate biology Christian student populations in the United States (Bradshaw et al., 2018; Martin, 2010) but very few research studies have explored Muslim student perceptions in the United States beyond their levels of evolution acceptance. In addition, most of the discussion on student views of evolution and religion are from a Christian narrative of creationism (Scott, 2005; Yasri & Mancy, 2016) even though Islamic belief systems also have potential conflicts with evolution. Thus, research exploring Muslim students' attitudes toward evolution still needs more attention. In this study, we specifically explored Muslim students' perceptions of conflict or compatibility between evolution and their religion.

Although research has shown Muslim individuals can experience a conflict with evolution, very few studies have explored Muslim student perceptions in the United States. Many Egyptian Muslim students have misconceptions about evolution and the nature of science that leads to evolution rejection (BouJaoude et al., 2011) and Canadian, Pakistani, and Indonesian high school Muslim science teachers often do not accept human evolution (Asgar et al., 2013; Rachmatullah et al., 2021). Some Indonesian undergraduate Muslim students see conflict between religion and evolution, but some students believe the two were independent realms of knowledge (Aini et al., 2020). However, we do not know if these results extend to Muslim students in the United States who likely have a unique religious culture. This research examined how undergraduate biology Muslim students in the United States manage potential conflict between evolution and their religion. Our research questions were:

1. What groupings of undergraduate Muslim students are identified based on their perceived conflict between their religion and evolution, acceptance of evolution, and understanding of evolution?
2. How do Muslim students manage the potential conflict between their religion and evolution?

Methods

From fall 2018 to spring 2021, we collected data from undergraduate students enrolled in introductory biology courses across 14 states in the United States. 11,995 students participated in the survey. 270 students who identified as Muslim and consented to complete all survey questions were selected for this research. 61% of the students identified as female; 60% enrolled in a biology major and 40% were non-biology major; 64% of Asian, 13% of White, 9% of Multiracial, and 15% PEER¹. Before the instruction, students filled out previously published surveys measuring their

¹ PEERS students included: American Indian, Native American, or Alaskan Native, Black or African American, Hispanic or Latinx, and Native Hawaiian or Other Pacific Islander.

evolution acceptance (*I-SEA*, Nadelson & Southerland, 2012), evolution understanding (*EALS*, Hawley et al., 2010), perceived conflict between their religion and evolution (Barnes et al., 2020), and religiosity (Cohen et al., 2008). Further, students chose 1 out of 9 options that presented their perception between evolution and religion, and then 180 students completed an open-ended question for why they chose their specific answers (Table 1).

Instruction 1: Please indicate which the following statements most closely represents your personal view, based on your personal opinion	
<i>The description presented to students</i>	<i>Interpretation</i>
All forms of life were first brought into being in their present form by God 6000–10,000 years ago at the same time.	Young Earth creationism
All forms of life were first brought into being in their present form by God at different times over billions of years.	Old Earth creationism
Some forms of life evolved from earlier forms, but God created groups of organisms such as reptiles, birds, mammals, and humans separate from one another, and organisms that currently exist have evolved slowly from those first creations.	Creationism with some evolution
Almost all forms of life evolved from earlier forms, but humans were created by God in their present form separate from the rest of life.	Humans-only creationism
All forms of life evolved from earlier forms, but God intervenes from time to time to shape or override evolution.	Interventionist evolution
All forms of life evolved from earlier forms, but God set up evolution from the start in a perfect way so that it would fulfill God’s purpose, and no subsequent intervention was necessary.	Theistic evolution
All forms of life evolved from earlier forms, but life and evolution were first set in motion by God without a specific purpose or plan.	Deistic evolution
All forms of life evolved from earlier forms, but it is uncertain whether God was involved in evolution.	Agnostic evolution
All forms of life evolved from earlier forms, but no God has ever played any role in evolution.	Atheistic evolution
Instruction 2: Please explain why you gave the answer you did in a short paragraph	

Table 1. Students' perception of evolution and special creation options (Barnes et al., 2020)

We converted Likert-scale measures to continuous measures using a Rasch model (Boone, 2016). We used k-means cluster analysis to understand patterns based on students’ acceptance of evolution, perceived conflict between their religion and evolution, and evolution understanding. As part of the analysis, we utilized the *NbClust* package on R software to determine the number of clusters that best explained our data based on 30 indices (Charrad et al., 2014). Then we ran an analysis of variance (ANOVA) to see the mean differences among groups.

Furthermore, students’ open-ended responses were coded deductively using a previously constructed framework to examine the relationship between evolution and religion. First, we categorized students’ responses to accepting evolution and religion as *compatibility* or *incompatibility* (Coding #1, Cohen’s kappa = 0.73). We then used a previously constructed framework to deductively categorize students’ views on the relationship between science and religion (Yasri et al., 2013), replacing ‘*science*’ with a more specific context of ‘*evolution*’ (Coding #2, Cohen’s kappa = 0.66). Inductive coding was then used to determine any themes not captured by the primary and deductive framework (Coding #3, Cohen’s kappa = 0.80).

Findings

The analyses determined that three clusters of students best described the data. These clusters were determined based on similar patterns observed between students. Figure 1 presents the group characteristics based on evolution acceptance, perceived conflict between evolution

and religion, and evolution understanding, Table 2 presents group characteristics based on students' open-ended explanations to explain their views on the relationship between evolution.

Figure 1. The distribution and average of scores of undergraduate Muslim Biology students on 9 variables. A statistically significant mean difference between clusters for all variables was demonstrated by one-way ANOVA.

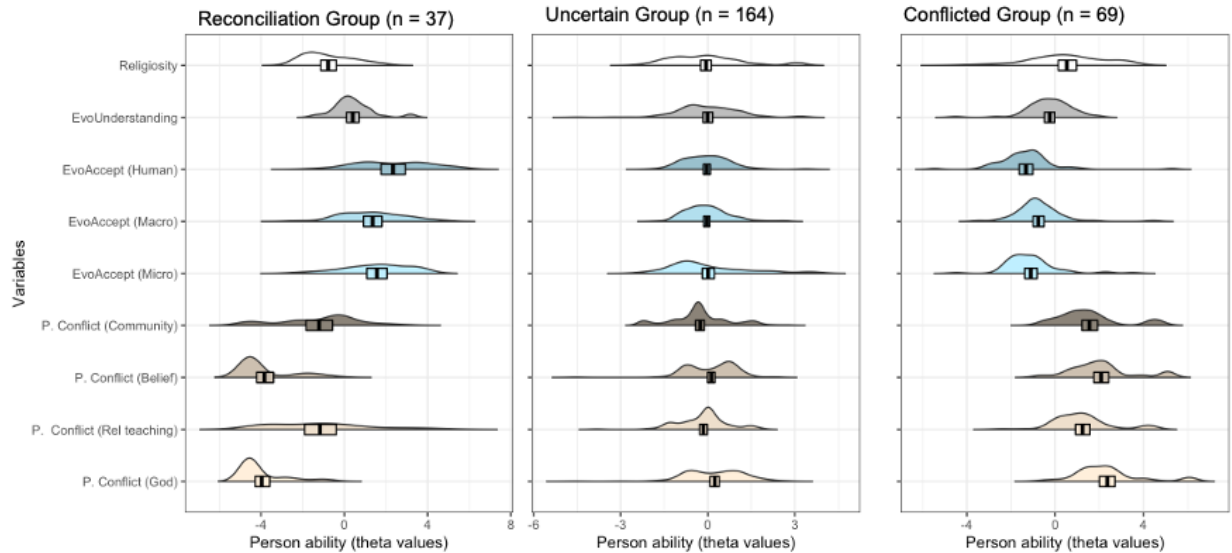


Table 2. Distribution of qualitative coding results of students' explanation of their view on the relationship between religion and evolution. Columns represent the different clusters of students found in the cluster analysis and rows represent qualitative codes. Students' responses were split into views that represented incompatibility or compatibility between accepting evolution and religion (*) and then coded based on a prior published framework of views on the relationship between evolution and religion (*italic*). Finally, we determined whether responses that were initially categorized as compatibility had any incompatibility components and whether responses that were initially categorized as incompatibility had any compatibility components (#).

Code	Total (n=180)	Number of students		
		Reconciliation (n = 19)	Uncertain (n=118)	Conflict (n=43)
Incompatible*	101	6	59	36
<i>Religion trumps Science</i>	39	0	21	18
<i>Science trumps Religion</i>	5	3	2	0
<i>Compartment</i>	6	1	3	2
Compatibility#	27	2	19	6
Compatible*	77	12	59	6
<i>Contrast</i>	6	1	5	0
<i>Different Methods</i>	2	1	1	0
<i>Different Questions</i>	3	2	0	1
<i>Consonance</i>	26	2	23	1
<i>Dialogue</i>	15	3	11	1
<i>Mutual Support</i>	4	1	3	0
<i>Science Supports Religion</i>	2	0	2	0
Conflict#	9	0	8	1

Cluster 1. Reconciliation between evolution and religious belief group

This cluster consisted of 14% of Muslim students (n = 37/270) who had a higher average of evolution acceptance, lower perceived conflict between their religious beliefs and evolution, and

evolution understanding. 35% of these students were Agnostic about a God/god(s) involvement in evolution (*Agnostic Evolution* perception (n = 13/37)) and 25% of these students thought that God purposefully created evolution as a means of creating humans (*Theistic Evolution* perception (n = 9/37)).

The majority of students in this group, 63% (n=12/19), perceived evolution and religion as *Compatible*. Three students' responses were categorized as showing a *Dialogue* relationship between religion and evolution. Dialogue refers to students' explanation that evolution is God's plan and there is indirect interaction between evolution and religion. They also tend to mention that scientists and science today explain how life evolves and it is from God's will. For example, Student #4 chose *Theistic Evolution* and their response was coded as *Dialogue*: "I feel like evolution has a point and the traits that we possess come from those organisms that came before. But I feel like when scripture says that 'God created man and woman', it never explicitly states how. I think God plays a role in establishing our being and provides us opportunities to grow, learn, and elevate ourselves; but it is up to us and our environment if we choose or need to evolve"

From the 37 students in the reconciliation group, 19 explained their view on evolution and religion in short paragraphs. Interestingly, 31% (n=6/19) of students in this groups saw *Incompatibility* between accepting evolution and religion, by thinking that *Science Trumps Religion*. These students' perceived that accepting evolution appears to conflict with religion and that only science provides a true answer. For example, student #97 who did not believe that a God/god(s) was involved in evolution (*Atheistic Evolution*) wrote, "I picked what I did because I am a very science and evidence-based person and in my opinion there is more evidence that points towards a natural evolution than god having a part in it". However, even in the reconciliation group, there were students who did not fully accept evolution, but did show compatibility in their written responses . For example, student #127 chose *Creationism with some Evolution* as their view: "I believe in God and that creationism and evolution can coexist".

Cluster 2. Uncertain Group

This was the largest cluster and consisted of 60% of students (n = 164/270) who had an average evolution acceptance, average perceived conflict between their religious beliefs and evolution, and average evolution understanding. 25% of these students subscribed to *Creationism with some Evolution* (n = 41/164) and 21% of these students had a *Theistic Evolution* perception (n = 34/164).

In this group, 118 students explained their view on the relationship between evolution and religion. Half of them (n=59/118) saw *Incompatibility* between accepting evolution and religion with 18% (n = 21/118) showing the *Religion Trumps Science* relationship. These students perceived that aspects of evolution appear to conflict with religion, and when there are different answers to the same questions, they think only religion provides a true answer. For example, student #103 who had a *Young Earth Creation* perception responded: "I believe God gave life to all living and non living things. Since I grew up in a religious household that was the perspective I was taught, and makes the most sense to me." However, even though students in this group primarily indicated incompatibility in their view, 32% (n=19/59) of responses indicated they also saw compatibility between evolution and religion. For example, student #220 who had *Creationism with some Evolution* perception responded: "The reason I gave this answer is because it is a scientific fact that evolution is real. This however does not have to go against the creation of God. Evolution is something God has brought to mankind in order to help humanity and nature survive this long."

The other half of these students (n=59/118) perceived evolution and religion as *compatible*, with 19% (23/118) coded as *Consonance*, meaning that they perceived that combining evolution and religion as two sets of knowledge are necessary to provide complete explanations. Following that, 9% (n = 11/118) had a *Dialogue* explanation explained in the previous section. In addition, 13% (n=8/59) of responses that were coded as a compatibility conception also showed conceptions of conflict. For example, student #257 who had *Interventionist Evolution* view wrote: “All animals evolved from each other. However, I believe God intervened to create mammals (humans) that are so smart, that they can even be judged for their actions on the day of judgment. This is also mainly because humans have a missing link from other mammals in evolution”

Cluster 3. Conflicted Group

This cluster consisted of 26% of Muslim students (n = 69/270) who had a lower than average evolution acceptance, higher perceived conflict between their religious beliefs and evolution, and lower evolution understanding. The most frequent views within this cluster was 29% *Old Earth Creation* (29%, n = 27/69) and *Creationism with some Evolution* view (20%, n = 14/69). From the 69 students, 43 of them explained their views. 79% of their responses (n=36/46) were primarily coded as perceiving incompatibility between religion and evolution, and 42% (n = 18/33) of these responses were coded as *Religion Trumps Science* views. There were very few compatibility responses within this cluster; only 13% of responses (n=6/46) coded as compatible, where they saw compatibility between accepting evolution and religion.

General Discussion and Implications

Although students were affiliated with the same religious belief, this research indicated that undergraduate Muslim students have a dynamic and complicated ways of managing potential conflict between evolution and religion. From the cluster analysis, we found only 13% of them showed a reconciliation pattern before learning about evolution in the introductory biology course. The qualitative results indicated that undergraduate Muslim students hold diverse evolution viewpoints ranging from young-earth creationism to atheistic evolution and have diverse views on whether evolution and religion can be compatible. For example, through the written response 50% of students in the uncertain group held incompatible conceptions between accepting evolution and religion, but 32% of those responses actually indicated some compatibility between the two. This is important for understanding the growing population of Muslim biology students in the United States and how to teach evolution in a way that is inclusive of their religious background and minimize potential conflict.

For teaching practices to minimize the potential conflict, instructors could use Religious Cultural Competence in Evolution Education (ReCCEE; (Barnes & Brownell, 2017)) but research has not yet explored how to implement this instruction among Muslim students. ReCCEE is an instructional framework that encourages instructors to highlight potential compatibility between religion and evolution, for instance, showing Muslim role models during the instruction. These results indicate that more research is needed to understand how to implement culturally competent evolution instruction for Muslim students.

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