



(RESEARCH ARTICLE)



Perceptions of stem students on the theory of evolution

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Abstract

This study aimed to describe how the STEM students perceive the relationship between their beliefs about science and religion or Christian beliefs. The respondents of this study are the grade 12 students of Antipolo City Senior High School during the school year 2020-2021. A questionnaire was administered in two sections of grade 12 STEM students. The researcher also conducted interview from 15 selected STEM students. This qualitative method was used to examine the learning experiences and perceptions of students on the theory of evolution and creationism.

The findings of this study show that STEM students viewed science and religion as different ways of understanding the world. Teachers should make a clear distinction between the roles of science and religion; the two need not be in conflict. Teachers that develop a depth of knowledge beyond what is actually expected of students will be able to confidently adjust instruction in response to students' needs and inquiries.

Despite scientific evidence presented by scientists on the legitimacy of evolution, many people still adhere to their religious or Christian beliefs. The researcher recommends that each of us should have given much respect to people's different beliefs because of different cultures and traditions. The researcher also recommends that if someone feels that the theory of evolution contradicts his/her belief, he needs to be open-minded for an in-depth understanding and to weigh things right for the enlightenment of oneself. Science and religion may provide answers to our existence in different approaches but for the well-being of everyone."

Keywords: Perceptions; Theory; Evolution; Creationism

1. Introduction

One of the most interesting topics in teaching Biology is "evolution". Teaching and learning about evolution have immense practical value that extends beyond understanding our world. The religious or cultural objections to the teaching of evolution in high school biology classrooms can impact both students' willingness to explore a scientific understanding of evolutionary theory and teachers' willingness to provide sound instruction on the topic. Some believe that teaching the topic early will provide children with a greater awareness of the evolution of life on earth. The students will have encountered it in nature programs and have some awareness or questions about the diversity of life on Earth.

The study of evolution is an excellent way for students to learn about the process of scientific inquiry. Evolution offers countless and diverse examples of the ways scientists gather and analyze information, test competing hypotheses, and ultimately come to a consensus about explanations for natural phenomena. Science is essential for making informed decisions and has become increasingly important for innovation and competitiveness in the 21st century workplace. Removing evolution from the science classroom or allowing it to be compromised not only deprives students of a fundamental tenet of biology and medicine, but it will undermine their understanding of how scientific knowledge is

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amassed. [1]. Teaching about evolution has another important function. Some people see evolution as conflicting with widely held beliefs, the teaching of evolution offers educators a superb opportunity to illuminate the nature of science and to differentiate science from other forms of human endeavor and understanding.

The teaching of evolution at Senior High School is a much talked about topic amongst the teaching profession. Apart from the cultural and religious perspective of many families, it is a topic that is also appears at first simple but is actually quite complex and open to misinterpretation. [2], stressed that student's study evolution only when they reach High School or College. By this time prior instruction, media, church or home had already contributed to students' perceived conflict between religion and science regarding evolution. Improvements in understanding of evolution are observed when students practice with probabilistic reasoning [3]. However, student knowledge was significantly improved through a number of inquiry activities that strengthened their foundational understanding of evolution. [4]). Most studies of evolution suggest that appreciation of evolution as an explanation for life's diversity presents a number of conceptual challenges, despite the apparent simplicity of the theory [5].

Evolutionary theory is considered "the most powerful theory within the field of biology [6]. The theory of evolution seemed to go against religious teachings that God made the Earth and created all living things, as they knew them. Christians believed that God had created humans 'in his own image', that humans were superior to all other creatures and had a soul that is immortal. The theory of evolution challenged the idea that God is the designer of the universe and that the beauty, order and complexity of the universe is evidence of this (the design argument). The idea that living things adapt to their environment was opposed to their belief that God had created the perfect environment for them.

In the most recent survey, 65% of adults say that humans and other living things have evolved, while 31% say humans and other living things have existed in their present form since the beginning of time. Roughly half of those who say that humans have evolved over time believe that evolution has occurred from natural processes, such as natural selection (35% of all adults), while a somewhat smaller share (24% of all adults) believe a supreme being guided the evolution of humans and other living things. Another 5% of all adults are unsure how evolution occurred. [7].

To teach evolution successfully, teachers need to be prepared with a conceptual understanding of the topic and with effective curricular strategies. Teachers that develop a depth of knowledge beyond what is actually expected of students will be able to confidently adjust instruction in response to students' needs and inquiries. This is particularly true in the teaching of evolution, where students' questions can be numerous and challenging.

Public schools must maintain a neutral stance toward religion, and this clearly should not be a hostile stance toward children who approach learning about evolution from the perspective of the faith they are being taught at home.

Research Questions

This study aims to describe how stem students perceive the theory of evolution in this modern time. The respondents of the study are the sixty students who took Biology at Antipolo City Senior High School.

Specifically, it aims to answer the following questions:

- How do the students perceive on the relationship between their beliefs about science and religion or Christian beliefs?

2. Material and methods

The respondents of this study are the 60 Grade 12 STEM students of Antipolo City Senior High School during the school year 2020-2021. The researcher will use questionnaires and interviews during the conduct of the study. The instrument used in gathering data is the survey questionnaires to be filled out by the respondents. The Likert scale will be utilized to analyze and interpret the data. The interpreted Mean for Strongly Agree corresponds to highly acceptable and Agree to Acceptable as the level of acceptance.

3. Results and discussion

Below are the gathered data during the conduct of survey questionnaire.

Table 1 Students' Perceptions on the Theory of Evolution

Item	\bar{x}	Interpretation of \bar{x}	Level of Acceptance
1	4.3	Strongly Agree	Highly Acceptable
2	4.25	Strongly Agree	Highly Acceptable
3	2.65	Neutral	Neutral
4	4.52	Strongly Agree	Highly Acceptable
5	4.02	Agree	Acceptable
6	3.07	Neutral	Neutral
7	2.84	Neutral	Neutral
8	4.05	Agree	Acceptable
9	4.0	Agree	Acceptable
10	3.81	Agree	Acceptable
11	2.37	Disagree	Unacceptable
12	3.87	Agree	Acceptable
13	4.0	Agree	Acceptable
14	4.13	Agree	Acceptable
15	3.81	Agree	Acceptable
	G \bar{x} = 3.71	Agree	Acceptable

Table 1 shows that items 1, 2, and 4 were rated as Strongly Agree which corresponds to highly acceptable as the level of acceptance. This indicates that the majority of the students strongly agreed that evolution is a scientifically valid theory. Organisms existing today are the result of evolutionary processes that have occurred over millions of years. Modern humans are the product of evolutionary processes which have occurred over millions of years. However, items 3, 6, and 7 are interpreted as Neutral. The students fairly believed that the theory of evolution is based on speculation and not valid scientific observation and testing. Also, the theory of evolution is capable of being scientifically tested. The theory of evolution cannot be correct since it disagrees with the Biblical account of creation. Items 5, 8, 9, 10, 12, 13, 14, and 15 were interpreted as Agree corresponds to Acceptable. This shows that most scientists accept evolutionary theory to be a scientific valid theory. The theory of evolution brings meaning to the diverse characteristics and behaviors observed in living things. Evolutionary theory generates testable predictions with respect to the characteristics of life. Current evolutionary theory is the result of sound scientific research and methodology. Also, evolutionary theory is supported by factual, historical, and laboratory data. On the other hand, item number 11 interpreted as Disagree corresponds to Unacceptable. This shows that evolution is not a scientifically valid theory. In this category, very few students found the theory of evolution lack of evidence. In the study of [8] mentioned that one student attacked the validity of the evidence. For this student, valid evidence is "something that is very certain" such as "the earth is round, the earth is oval, things that are scientific, very scientific things". Majority of students expressed the idea that evolution is considered a theory because it lacks "hard facts". In the article of [9] emphasized that the student who had the strong scientific orientation gained the most in conceptual understanding of evolution.

In table 2, item 16 interpreted as Disagree corresponds to unacceptable. In this item students disagreed that Biblical creationist believe that the story told in Genesis of God's six-day creations of all things is literally correct. However, items 17, 18, 19, 20 rated as Agree corresponds to acceptable as the level of acceptance. In these items students agreed that Creationism or intelligent design is the belief that life and the universe were created by a supernatural being. Also, creationism teaches that life on Earth is the result of God's creative actions and not the result of blind scientific processes. It is largely based on religious belief that different religious and cultures have different creation theories. [10] Indicates that Science and Religion is a rare, team-taught course which has become part of the regular curriculum of the university, the regular teaching assignments of both professors, and several required curricula. As the article of

[11] stressed that students were less likely to accept evolution if they had been taught both evolution and creationism or just creationism than those who had been taught only evolution or neither evolution nor creationism in high school.

Table 2 Students' Perceptions on Creationism

Item	\bar{x}	Interpretation of \bar{x}	Level of Acceptance
16	2.27	Disagree	Unacceptable
17	3.92	Agree	Acceptable
18	3.84	Agree	Acceptable
19	3.4	Agree	Acceptable
20	4.06	Agree	Acceptable
	G \bar{x} = 3.50	Agree	Acceptable

Below are the data gathered during interviews from 15 STEM students of Antipolo City Senior High School?

According to Gerardo, Evolution helps living organisms in their daily existence by solving the biological problems that affect them. He also stressed that as an individual, evolution helped him understand the concept of how things existed on earth and to explain the changes that we have been experiencing from now to then. In the current situation, evolution also helps us face and fight the virus that is spreading worldwide, which is the covid-19. He said that the way how the Covid-19 evolved is also similar to human evolution therefore scientists used its concept to create a vaccine to fight the virus. He also mentioned that the natural selection work by the beneficial genetic mutations for an individual's survival are passed down through the generations. Because of that, a new generation of organisms is born that is similar to survive and reproduce. It is also a process where the population of living organism changes because of their surroundings.

Gerardo also mentioned that Evolution used scientific explanations and theories to prove the discoveries and answer the questions that have been pounding on us since then while Creation evidence used beliefs to explain how things occurred in this world. However, believing in evolution doesn't mean there is no god. Both of them need further explanations and have always been a question to many.

For Julianne, Darwin's theory of evolution is considered by many as a scientific fact because it explains how organisms and species came about and how they evolved to what we know in today's society. She thinks that the theory of evolution is proven by what we call genetic mutations, natural selection, and the inheritance of the genes from one generation to another which tell how species/ organisms evolve. In her opinion, evolution is a theory that talks about the progress and development of organisms, and it does not necessarily negate the idea that there is a higher being (God). She also said that evolution affects her daily life in a good way. Evolution is what happens when we try to change and adapt to our situation and this it helps us be part of the society, environment, and everyone as a whole.

From Daniela's point of view, the fossil record does not tell us the evolution of organisms but it can also show us backstory or significant history in our world that needs to be discovered and recognized. It shows us how different organisms changed over time and how they are related to each other. Even though fossil records can't tell us everything happened in the past because of the gaps, it still reveals to us the way of living of our ancestors and relevant events from the past. She also added that maybe we can't visibly see the effects of evolution in our daily life but in some fields of study, the concept of evolution is applied to solve various biological problems. The constant evolution of antibiotic resistance in bacteria is one of the most pressing evolutionary challenges that humans face today.

Daniela also stressed that the relationship between beliefs about science and religion is relevant for her in having a general point of view about certain things in life especially when it comes to Creation and Evolution since there are things that science can explain but religion can't and there are phenomena that religion can prove but science cannot, therefore, the relationship between science and religion beliefs is both fundamental in the development of thinking of a person. As a STEM student, it is hard for her to not notice the actual evidence that proves the evolution of a species but as a Roman Catholic, she can't also discard the fact that her life centered on faith in God. She actually believes that God created life and structured the world.

Freddie believes that Evolution over the years is already well known to be true and accepted although not completely proven. Nonetheless, we should not abhor the fact that evidence of evolution exists. He pointed out that in natural selection, various creatures undergo a process in which they change and grow to adapt to the change of environment. This natural selection is one of the different mechanisms of evolution namely, migration, mutation, and genetic drift. Organisms evolve in evolution's processes that happen in different mechanisms like migration, mutation, and genetic drift. Organisms evolve by having changes in their genetic trait or type.

Freddie also emphasized that Evolution affects him in a way that he was able to adapt and grow to be fit in the fast-paced changes of every day and to survive. For him, every day, evolution keeps him adaptive, for example, as he faces the challenge of new normal.

Nicole believes the theory is lack of evidence and prove to their stand and the history recorded that Darwin create fake evidence that proves the link between human and monkey but in the end, the experiment conducted was a fraud because the jaw bone that came from the Apes, not in the skull of the dead human. She said that "we are not evolving from monkeys because if we are the descendants of the Apes why do we look different to each other? Someone looks like a horse, looks like a pig, someone looks like a fish, etc. It means that we are different from one another. As the Bible says in Genesis 3:20, we all came from one woman because God stated that Eve was the mother of all living. The Bible says from Genesis 1:1-26 to Genesis 2:1-7 God created.

Akisa believed that humans did not evolve from monkeys. Monkeys and humans, on the other hand, have a common ancestor from which they both emerged some 25 million years ago. The fossil record and DNA analysis both support this evolutionary relationship. She also said that the cumulative changes in a population or species over time are referred to as evolution, while "survival of the fittest" relates to natural selection, which is a mechanism that promotes evolutionary development. She also added that the fossil record certainly has gaps, mostly because the conditions required to create fossils have been rare ever since life began on Earth.

For Abbygale Evolution is a mere theory and it cannot prove that all things are scientifically inclined. She emphasized that "The Bible says the word 'Breath of Life'. I am convinced that there is God because of his works just try to look in yourself and everything around you". The Bible says from Genesis 1:1-26 to Genesis 2:1-7 God created everything. He created the Solar system, Stars, Fish, Animals, Trees, and Man. For Abbygale, creationism, and evolution affect the faith and scientific thinking of a person.

Arnie believes that Darwin's theory of evolution shows a similar variation of different species that precedes in time. Most likely, these species went through an evolution where they evolved into a better organism to survive their current nature. For her, evolution can either affect us in a good or bad way. Certain things tend to evolve to make our lives easier such as gadgets getting an improved version and having more features.

Princess mentioned that creationism and evolution affect the faith and scientific thinking of a person. Some might get confused about the things that do not correspond to their beliefs while some might get more aware of the truth. "I see the relationship between beliefs in science and religion equally. Many things can indeed be proven by science yet there are still some that remain a mystery and can only be understood through faith". Princess added.

For Rieka, the bible contradicts the idea of evolution. It states that the earth as well as every living thing was created by God. He thinks the fossil record gives us a glimpse of how organisms look like in the previous eras. By studying these, scientists have been able to tell the story of our planet's history. For him, some things are viewed differently depending on the point of view of people. Some people believe in their faith about everything while some pursue the truth using science. He sees both beliefs about science and religion equally because some things are written in the bible as well as happenings in the universe that science cannot explain.

Leslie stressed that humans are not descended from monkeys or any other primate living today. "For me, evolution doesn't prove that there is no God. Evolution refers to change in characteristics of an organism generation after generation." Juan Carlos added. He also emphasized that the bible says that for 6 days, God created the world with his hands, and for the 7th day, he rested.

For Michael, individual organisms don't evolve. These individuals generally survive and produce more offspring, thus passing their advantageous traits on to the next generation. Over time, the population changes. Scientists categorize fossils to determine when the organisms lived relative to each other. The resulting fossil record tells the story of the past and shows the evolution of forms over millions of years. He also stressed that evolution affects us in daily life like today when pandemic continues in evolving its more dangerous for us to go outside.

Christine said that "Biblically, humans exist through the creation of God while Darwin's theory of evolution states that humans were initially apes. Evolution helps us gain advantageous traits that enable us to adapt to our environment. She also added that Evolution is the reason why we can walk, crave, think, eat, and even dream! The things we can do and what our body can do are because it is the result of our evolution.

Juan Carlos pointed out that the Theory of Evolution is proven by the remains we found across the planet. Patterns of Homologous and Analogous fossils found in different parts of the world show how organisms evolved through time. He also stressed "Survival of the fittest" is the mindset of Darwin's Evolutionary Theory. Organisms that are fit to survive in a certain environment will proliferate and make more generations of the organism. This is the most accepted postulate of evolution by the way. He also added that "According to Evolutionary Theory, apes and monkeys share about 98-99% same genetic materials. Thus, it is more likely that we came from monkeys rather than any other animals.

James Bryan believes that we are evidence of Evolution. We evolved from humanoid creatures, which came from great apes. Many animals show evolutionary patterns such as the same structures and DNA. Moreover, fossils show that animals are linked with each other. He also added that Creation tells that God created all organisms, land, water, and we humans on Earth. Science tells us that we evolved from other organisms and that is a result of what we called "evolution". Though the two may seem to contradict, future experiments will show they are connected.

[12] Assert that Evolution is an important and sometimes controversial component of high school Biology. In this study, a mixed methods were used to explore students' evolution acceptance and views of evolution teaching and learning. Students explained their acceptance and rejection of evolution in terms of evidence and conflicts with religion and authority. Students largely supported the teaching of evolution and offered several reasons for its inclusion in high school biology. To understand evolution requires consideration of concepts and principles at different levels of organization (micro, meso, macro), and this has been shown to be very difficult for students [13]. However, Smith has urged instructors to discuss with students how the nature of science implies that evolution and religion do not have to be in conflict [14]. However [15] emphasized that a student not explicitly challenging an instructor's instruction may be a poor indicator for student acceptance of evolution, given that studies indicate that some students find science, technology, engineering, and mathematics (STEM) instructors intimidating and unapproachable.

[16] Suggests that future research seek to compare individuals of various educational levels and backgrounds with a deeper look into their nature of science views, theological views, and understanding and acceptance of biological evolution. As the article of [17] emphasized students' understanding of evolution as the extent to which a student has an accurate conception of the tenets and processes of evolutionary theory. While they acknowledge that student understanding of evolution is important. In areas of the country where the vast majority of residents believe in God and the literal truth of the Bible, students may enter college less prepared and more skeptical of science because of disclaimers or poor science standards that limit the quality and quantity of science education in high school [18].

[19], stressed that teaching bounded nature of science in relation to religion can help students be more open to subjects that generally conflict with religious ideas. They argue that engaging students' religious beliefs might be the most important factor to consider when teaching scientific subjects that relate to human origins. [20] Stressed that the biggest point of controversy between science and religion is what should be taught in schools. Science is based upon evidence and knowledge of the natural world. All hypotheses in science must be falsifiable. Religion, or faith, deals with the supernatural world and is a feeling that cannot be falsified. Therefore, religion and science should not be pitted against each other as they are in completely different fields. To reduce student resistance to learning evolution, researchers have proposed that we need to diminish the perceived conflict between religion and evolution in biology classes. [21] Mentioned that teachers who hold views that are both creationist and evolutionist should find teaching the subject of evolution less problematic than teachers who hold fundamentalist creationist views. [22] Suggest that if we want our students to understand and accept evolution, a more realistic picture of the nature and process of science is essential.

Based on the data gathered during an interview with 15 students, different perceptions of students have been considered. Creationism vs evolution impacts a person's views in the world by contradicting views. When a person believes in creationism, he/she is more likely to rely on what the bible says and just go with the flow of changes. A person who believes in evolution is more likely to do researches that may contribute to the world. The relationship between beliefs about science and religion can be sometimes confusing but we can always recall the difference between the two and their utmost similarities, long ago, it is only the beliefs about religion that are present but it was questioned due to the existence of evolution and different science theories created by scientists. Evolution might seem to contradict God's words but it is not. The time of God is different from ours. This is true according to the Theory of Relativity by great Albert Einstein. Thus, he tells that in 7 days, the whole planet is born, while in our point of view, that is a product

of 4-5 Billion Years. Understanding how species survived, evolved, or became extinct as a result of the changing Earth can provide clues for how life will continue to evolve.

In natural selection, we can associate the phrase "survival of the fittest" where only those who are capable of adapting and growing are fit to be alive in this planet, in natural selection, organisms undergo changes to maintain homeostasis and adapt in the environment. In origin of variation, there are three main sources of variation which includes mutation, recombination, and immigration of genes. We are told that Charles Darwin's theory of evolution is a scientific fact because many other theories evolved from his theory and supported his claims about evolution. Survival of the fittest is the mindset of Darwin's Evolutionary Theory. He said that organism that are fit to survive in a certain environment will proliferate and make more generations of organisms. This is the most accepted postulate of evolution. Humans are not related to monkeys or any other living primate. Chimpanzees and humans share a common ape ancestor. It lived between the ages of 8 and 6 million years ago. However, humans and chimps evolved in different ways from the same ancestor.

Creationism believe that humanity was created by God. Religion assumes that humans have access to a deeper level of knowledge that neither observation nor reason can provide. While observation and reasoning from observation are the foundations of science. Faith in God says that God made all the things present in our planet as well as the way our life prospers. On the other hand, science tells a different point of view of how things started and how organisms are formed.

The idea of creation vs evolution is always debatable nowadays, especially that every human and field of study beliefs in different concepts in life. Bible gives the story of Creation in which it states that God created heavens and the earth, the sun, moon, stars, and all of the earth creatures in six days, and on the very last days he created Adam, a human being. Concerning that Creationists think that creatures are fixed and each organism on earth is the same one that God created. In contrast to that, evolution is a natural process and phenomenon in which the characteristics of a species change over time as the generations passed by.

Acceptance of the evidence for evolution can be compatible with religious faith. Today, many religious denominations accept that biological evolution has produced the diversity of living things over billions of years of Earth's history. Science and religious beliefs need not be in contradiction. If they are properly understood, they cannot be in contradiction because science and religion concern different matters. The scope of science is the world of nature: the reality that is observed, directly or indirectly, by our senses.

4. Conclusion

Science and religion should be viewed as different ways of understanding the world. Heaven and earth with everything in them were created by God according to the bible. Christians strongly believe that God is the owner of the universe and everything that is in it. According to the evolution theory, all living organisms descended from a common ancestor. Charles Darwin (the person who developed the theory), human beings developed from a common species of an animal known as ape.

The findings of this study show that STEM students perceive science and religion viewed as different ways of understanding the world. Teaching evolution should not make students with religious beliefs feel that their beliefs are wrong. Teachers should make a clear distinction between the roles of science and religion; the two need not be in conflict.

Teachers that develop a depth of knowledge beyond what is actually expected of students will be able to confidently adjust instruction in response to students' needs and inquiries. This is particularly true in the teaching of evolution, where students' questions can be numerous and challenging. Understand and be respectful of where the students are coming from.

Despite scientific evidence presented by scientists on the legitimacy of evolution, many people still adhere to their religious or Christian beliefs. The researcher recommends that each of us should have given much respect to people's different beliefs because of different cultures and traditions. The researcher also recommends that if someone feels that the theory of evolution contradicts his/her belief, he needs to be open-minded for an in-depth understanding and to weigh things right for the enlightenment of oneself. Science and religion may provide answers to our existence in different approaches but for the well-being of everyone."

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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