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Vanjoreeh A. Madale

vanjoreeh.madale@g.msuiit.edu.ph

Mindanao State University–Iligan Institute of Technology

Research Article

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Posted Date: August 14th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10223140/v1>

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Additional Declarations: No competing interests reported.

College Students' Experiences of Learning Evolution and Negotiating Science and Belief in a Culturally Diverse Philippine Context

Vanjoreeh A. Madale¹

¹Department of Science and Mathematics Education, College of Education, Mindanao State University–Iligan Institute of Technology, Iligan City, Philippines

vanjoreeh.madale@g.msuiit.edu.ph, <https://orcid.org/0009-0002-0229-755X>

Corresponding Author: Vanjoreeh A. Madale

Abstract

Evolution remains one of the most conceptually difficult and socially sensitive topics in biology education, particularly in culturally and religiously diverse contexts where scientific explanations may intersect with students' personal belief systems. This study explored college students' experiences in learning evolution within a culturally diverse Philippine context, particularly in Mindanao. Anchored in Conceptual Change Theory and informed by Cognitive Dissonance Theory, the study employed a qualitative descriptive design involving twenty-seven Bachelor of Secondary Education major in Biology students from a state university in Mindanao. Data were collected through an open-ended questionnaire and analyzed using thematic analysis. The findings revealed that students viewed evolution as both intellectually meaningful and academically challenging due to abstract scientific concepts and misconceptions related to evolutionary processes. Several participants experienced tensions between scientific explanations and personal or religious beliefs, particularly regarding human origins and creation. However, many students attempted to negotiate or reconcile science and belief by distinguishing scientific understanding from matters of faith and remaining open to evidence-based reasoning. The findings also highlighted the importance of classroom discussions, evidence-based activities, collaborative learning, and culturally respectful teaching approaches in supporting students' understanding of evolution. The study contributes to higher education science teaching by emphasizing the value of culturally responsive and inclusive instructional practices that promote scientific literacy, critical thinking, respectful dialogue, and meaningful engagement with evolution education in culturally diverse learning environments.

Keywords: evolution education, science and belief, qualitative descriptive research, culturally responsive teaching, higher education science learning

1. Introduction

Evolution is widely recognized as the central organizing principle of modern biology because it explains the diversity of life, adaptation, inheritance, and the interconnectedness of living systems across time (Barnes & Brownell, 2016; Hokayem & BouJaoude, 2008). Through the study of evolution, learners develop understanding of key biological concepts such as natural selection, genetic variation, speciation, and common ancestry (Araújo, 2020; Baytelman et al., 2023). As a foundational component of biology education, evolution also contributes to scientific literacy by helping students understand how scientific knowledge is generated and supported through empirical evidence (Borgerding et al., 2016). Despite its importance, evolution remains one of the most conceptually difficult and socially sensitive topics in science education (Archila et al., 2023; Barnes & Brownell, 2016).

Students often experience difficulties in understanding evolution because it involves abstract and long-term biological processes that are not directly observable (Baytelman et al., 2023). Misconceptions commonly arise regarding natural selection, adaptation, randomness, human evolution, and the origin of species (Araújo, 2020; Archila et al., 2023; Quelo et al., 2017). Many learners interpret evolution as a purposeful or linear process, which may hinder meaningful scientific understanding (Araújo, 2020; Quelo et al., 2017). Beyond conceptual difficulties, learning evolution becomes more complex when scientific explanations intersect with students' cultural backgrounds, religious beliefs, and personal worldviews (Aini et al., 2024; Hokayem & BouJaoude, 2008). Some students perceive evolution as conflicting with religious teachings regarding human origins and creation, leading to uncertainty, discomfort, or resistance (Bramscheiber, 2013; Clores & Limjap, 2006; Sinatra et al., 2008).

Research has shown that students' understanding and acceptance of evolution are shaped by multiple factors, including prior knowledge, religious commitment, cultural identity, classroom climate, and instructional approaches (Aini et al., 2024; Borgerding et al., 2016; Hokayem & BouJaoude, 2008). Importantly, students may understand evolutionary concepts scientifically while personally struggling to accept them because of perceived conflicts with belief systems (Clores & Limjap, 2006; Hokayem & BouJaoude, 2008). Consequently, evolution learning involves not only cognitive processes but also emotional, cultural, and identity-related dimensions (Frejd, 2019; Sinatra et al., 2008). Previous studies have emphasized the need for instructional approaches that are both scientifically rigorous and culturally responsive in order to support meaningful engagement with evolution education (Aini et al., 2024; Hizon & Leon, 2025).

These issues are particularly relevant in the Philippine context, where religion and cultural traditions strongly influence perspectives toward science and education (Albuero, 2024; Clores & Limjap, 2006). In Mindanao, a region characterized by cultural, ethnic, and religious diversity, students may encounter varying perspectives regarding evolution shaped by community beliefs, traditions, and prior experiences (Francisco et al., 2021; Ruales et al., 2020). Learning evolution in this context therefore becomes a multidimensional educational experience influenced by scientific, cultural, and personal meaning systems (Clores & Limjap, 2006; Picardal, 2019). Understanding how students navigate these influences is important for improving evolution instruction within culturally diverse higher education settings.

Although previous studies have explored misconceptions, acceptance of evolution, and instructional effectiveness, fewer studies have examined how Filipino college students personally describe and negotiate their experiences in learning evolution within culturally and religiously diverse contexts (Clores & Limjap, 2006; Hokayem & BouJaoude, 2008). Limited research has specifically explored how students negotiate tensions between scientific explanations and personal beliefs while engaging with evolution education in Philippine higher education classrooms (Clores & Limjap, 2006; Picardal, 2019). This gap highlights the need to examine students' perspectives, reflections, and meaning-making processes regarding evolution learning.

Anchored in Conceptual Change Theory and informed by Cognitive Dissonance Theory, this study recognizes that learning evolution may involve conceptual reconstruction, negotiation of conflicting perspectives, and efforts to reconcile scientific understanding with personal belief systems (Clement & Rea-Ramirez, 1997; Czinczel et al., 2025; Rea-Ramirez et al., 2023). Using a qualitative descriptive approach, the study explores how college students in a culturally diverse Philippine context understand evolution, experience science-belief tensions, negotiate these tensions, and describe the instructional experiences that influence their learning (Bramschreiber, 2013; Hokayem & BouJaoude, 2008; Picardal, 2019).

1.2 Purpose of the Study

The purpose of this study was to explore college students' experiences in learning evolution within a culturally diverse Philippine context, particularly in Mindanao. Specifically, the study sought to examine how students understand and interpret evolution as a scientific concept, how they experience and negotiate possible tensions between scientific explanations and personal belief systems, and what classroom experiences influence their understanding of evolutionary concepts. Through the analysis of students' narratives and reflections, the study aimed to provide deeper insights into the cognitive, emotional, cultural, and social dimensions of evolution learning in higher education.

Furthermore, the study intended to contribute to the improvement of evolution instruction by identifying teaching practices and learning experiences that support meaningful, inclusive, and culturally responsive science education. By understanding how students navigate the relationship between science and belief, the findings may help science educators develop instructional approaches that promote critical thinking, scientific literacy, respectful classroom dialogue, and evidence-based understanding while remaining sensitive to learners' diverse cultural and religious backgrounds.

1.3 Research Questions

This study aims to explore college students' experiences and perspectives in learning evolution within a socio-cultural context. Specifically, it seeks to answer the following questions:

1. How do college students describe their experiences in learning evolution?
2. How do students understand and interpret evolution as a scientific concept?
3. What tensions do students encounter between scientific explanations and personal beliefs?
4. How do students negotiate these tensions?
5. What instructional experiences influence students' understanding of evolution?

2. Literature

2.1 Evolution Education in Biology

Evolution is considered one of the foundational concepts in biology because it explains the diversity, adaptation, and relatedness of living organisms . It provides a scientific framework for understanding biological change across generations, including processes such as mutation, natural selection, genetic drift, gene flow, and speciation . In biology education, evolution serves as an integrating concept that connects genetics, ecology, taxonomy, paleontology, molecular biology, and biodiversity . Because of this, students' understanding of evolution is essential for developing scientific literacy and evidence-based reasoning .

In higher education, evolution is especially important for students enrolled in biology, science education, and related fields because it strengthens their understanding of life processes and prepares them to explain biological phenomena using scientific evidence . However, despite its central role, evolution remains one of the most difficult topics for students to understand and accept . Many students enter biology classrooms with prior ideas about life, origins, adaptation, and human existence that may not align with scientific explanations . These prior ideas, often rooted in personal, cultural, or religious worldviews, may significantly influence how they interpret evolutionary concepts and how they respond to instruction .

2.2 Students' Difficulties and Misconceptions in Learning Evolution

Students commonly encounter conceptual difficulties when learning evolution because the topic involves abstract, complex, and long-term biological processes . Evolutionary change occurs across generations and often involves mechanisms that are not directly observable in everyday experience . As a result, learners may struggle to understand how small genetic variations can accumulate over time and lead to population-level changes .

Common misconceptions include the belief that individuals evolve during their lifetime, that evolution always leads to progress or improvement, that organisms change because they “need” to adapt, or that natural selection is a purposeful process . Some students also misunderstand the phrase “survival of the fittest,” interpreting it as physical strength rather than reproductive success and adaptation to environmental conditions . These misconceptions may prevent students from developing a scientifically accurate understanding of evolution .

Human evolution is often one of the most sensitive and challenging areas for learners . Students may accept microevolution or adaptation among animals and plants but become hesitant when the discussion involves human origins or common ancestry . This suggests that difficulty in learning evolution is not only cognitive but also emotional, cultural, and personal .

2.3 Understanding and Acceptance of Evolution

In evolution education, understanding and acceptance are related but distinct constructs . A student may understand evolutionary concepts scientifically but may not personally accept evolution because of religious, cultural, or personal beliefs . Similarly, a student may express acceptance of evolution without fully understanding the mechanisms—such as natural selection or genetic drift—that explain evolutionary change . This distinction is critical because teaching evolution should not only focus on the memorization of concepts but also on helping students engage meaningfully with scientific evidence and epistemological reasoning .

Students' acceptance of evolution is influenced by a complex interplay of factors, including prior knowledge, exposure to scientific explanations, trust in science, religious background, family beliefs, teacher approach, and the overall classroom environment . When students perceive evolutionary theory as a direct attack on their core worldviews, they may become defensive or experience significant cognitive dissonance . However, research indicates that when

evolution is taught as a scientific explanation supported by empirical evidence rather than as a challenge to personal faith—particularly through the use of conflict-reducing practices—students are more likely to become open to learning the topic . Cultural competence and responsive instructional strategies are recommended in evolution education to help bridge the gap between scientific instruction and students’ diverse religious or cultural backgrounds, fostering a more inclusive and effective learning experience .

2.4 Science, Religion, and Belief Systems

The relationship between science and religion is an important concern in evolution education, as learners often bring prior worldviews that shape their scientific understanding . For some students, evolution may appear to conflict with religious teachings about creation, human origins, or the purpose of life . This perceived conflict may create emotional discomfort, confusion, or hesitation during the learning process, often described as cognitive dissonance . Students may feel that accepting evolution means rejecting their faith, family values, or cultural identity, leading to a sense of internal tension .

However, not all students view science and religion as incompatible . Some learners negotiate the relationship between evolution and belief by treating science and religion as different ways of understanding the world, a process often described as reconciliation . In this view, science may be seen as explaining natural processes through empirical evidence, while religion may be viewed as addressing meaning, morality, and spiritual belief . This distinction can help students engage with evolution without feeling that their personal beliefs are being dismissed . Instructional approaches that clarify the nature of science and the limits of scientific explanation—often referred to as conflict-reducing practices—may reduce perceived conflict and support more respectful classroom dialogue .

Students may also respond to science-belief tensions in different ways, ranging from full acceptance to total rejection . Some may reject evolution entirely, while others may accept selected aspects of evolution, such as microevolution or adaptation, while remaining skeptical of macroevolution or human origins . Some may compartmentalize scientific and religious explanations into separate mental domains, while others attempt to reconcile them into a unified worldview . These varied responses show that learning evolution is a complex process of negotiation and meaning-making, influenced by social, cultural, and personal factors rather than simply a matter of receiving biological information .

2.5 Cultural Context and Evolution Learning

Culture plays an important role in shaping how students interpret scientific knowledge . Learners do not enter classrooms as neutral recipients of information; they bring with them values, beliefs, traditions, language, family expectations, and community influences . These cultural resources shape how students respond to scientific concepts, particularly those that relate to human life, origins, identity, and belief .

In culturally diverse classrooms, students may differ in how they interpret evolution depending on their religious affiliation, ethnic background, prior schooling, and family environment . Some may feel comfortable discussing evolution openly, while others may remain silent due to fear of judgment or conflict . This highlights the importance of classroom environments that allow respectful discussion and encourage students to ask questions without feeling that their beliefs are being attacked .

Culturally responsive teaching emphasizes the use of students’ experiences, backgrounds, and perspectives as meaningful resources for learning . In the context of evolution education, culturally responsive instruction does not mean weakening scientific content . Rather, it means teaching evolution accurately while recognizing that students may process the topic through cultural and personal lenses . Culturally responsive teaching uses learners’ experiences and perspectives to make academic learning more meaningful .

2.6 Evolution Education in the Philippine Context

The Philippine context provides a meaningful setting for examining students’ experiences in learning evolution because the country is culturally diverse and strongly influenced by religious traditions . In many Filipino communities, religious beliefs, family teachings, and cultural values play a significant role in shaping how students

understand life, creation, and human existence . These influences may affect how students interpret scientific explanations of evolution, as learners often filter scientific concepts through their existing worldviews .

Mindanao is particularly important in this discussion because it is characterized by cultural, ethnic, and religious diversity, often represented by the "tri-people"—the Moro, Lumad, and Christian settlers . Students in Mindanao may come from different religious communities and cultural backgrounds, which may influence their perspectives toward evolution . Some may approach the topic with curiosity and openness, while others may experience uncertainty, resistance, or tension when scientific theories appear to contradict traditional or religious teachings . Because of this diversity, studying students' experiences in Mindanao can provide valuable insights into how evolution is learned in multicultural and religiously diverse Philippine classrooms .

Although evolution is included in biology and science education curricula, the way students experience the topic may vary depending on teacher approach, instructional materials, classroom discussion, and the sensitivity of the learning environment . Factors such as a teacher's own acceptance of evolution and their ability to navigate sensitive discussions significantly impact student engagement . A culturally diverse Philippine classroom therefore requires teaching approaches that are scientifically accurate, respectful, and responsive to students' backgrounds to foster an environment where learners can explore scientific evidence without feeling their personal identities are being dismissed .

2.7 Instructional Approaches in Teaching Evolution

Effective evolution instruction requires more than presenting definitions and theories . Students need opportunities to examine evidence, ask questions, analyze examples, and connect concepts across biological systems . Evidence-based teaching strategies such as inquiry-based learning, active learning, and structured discussions can help students understand evolutionary mechanisms more deeply .

Classroom discussion is also important because it allows students to express questions, clarify misconceptions, and reflect on how they understand evolution . However, discussions must be handled carefully, especially when students connect the topic to religious or cultural beliefs . Teachers need to create a respectful learning environment where scientific explanations are clearly presented while students' personal identities are not ridiculed or dismissed .

A culturally sensitive approach may include explaining the nature of science, distinguishing scientific questions from religious or philosophical questions, and emphasizing that learning evolution in a biology course means understanding scientific explanations and evidence . Some teaching resources recommend helping students distinguish between science and religion as different ways of knowing, which may reduce perceived conflict in the classroom . Such practices foster a more inclusive and respectful environment where learners can explore scientific evidence while feeling their diverse backgrounds are acknowledged .

2.8 Border Crossing and Cultural Negotiation in Science Learning

Science learning can also be viewed as a form of border crossing, where students move between different worlds: the world of school science, the world of family and community beliefs, and the world of personal identity . When these worlds are compatible, learning may feel smooth and meaningful; however, when school science appears to conflict with students' cultural or religious worlds, learning may become difficult .

In evolution education, border crossing occurs when students attempt to understand scientific explanations while remaining connected to their personal beliefs . While some students successfully move between these perspectives through reconciliation or compartmentalization, others may experience significant internal conflict or resistance . Teachers can support this border crossing by acknowledging students' diverse backgrounds, clarifying that the goals of science instruction are centered on understanding rather than belief, and creating classroom spaces where respectful dialogue is possible .

This perspective is relevant to the present study because it recognizes that students' experiences in learning evolution are shaped by movement between scientific, cultural, and personal meaning systems . By viewing learning through

this lens, we can better understand how Filipino college students negotiate the intersection of academic content and their existing worldviews.

2.9 Qualitative Descriptive Research in Science Education

A qualitative descriptive approach is appropriate for studies that aim to present clear and detailed descriptions of participants' experiences, perspectives, and responses . Unlike phenomenology, which seeks to understand the essence of lived experience, qualitative description aims to provide a comprehensive summary of participants' accounts in everyday terms . Sandelowski described qualitative descriptive studies as useful when researchers want direct descriptions of events or experiences, particularly when firsthand knowledge of a phenomenon is required .

In the present study, qualitative description is suitable because the goal is to describe how college students experience learning evolution, how they understand science-belief tensions, and what classroom experiences influence their learning . Since the data are gathered through open-ended written responses, the approach allows the researcher to remain close to participants' actual words and meanings while identifying common patterns across responses . This methodological choice is consistent with research in evolution education that seeks to document the diversity of student perceptions and the specific nature of their conceptual difficulties .

Thematic analysis is also appropriate because it provides a flexible method for identifying and organizing recurring patterns in qualitative data . Braun and Clarke described thematic analysis as an accessible and theoretically flexible approach for analyzing qualitative data to understand shared or common meanings across a dataset . Through thematic analysis, students' responses can be coded, categorized, and developed into themes—such as those related to evidence, certainty, and belief systems—that represent their shared and varied experiences in learning evolution .

2.10 Theoretical Framework

This study was anchored in Conceptual Change Theory, which explains how learners reconstruct their understanding when confronted with new scientific ideas that challenge their existing beliefs and prior knowledge . In evolution education, students often enter the classroom with various misconceptions regarding natural selection, adaptation, human evolution, and the origin of species . Conceptual Change Theory suggests that meaningful learning occurs when learners critically examine these prior conceptions and replace them with scientifically accurate explanations supported by evidence . In the context of this study, the theory helps explain how students interpret and understand evolutionary concepts through classroom instruction, scientific discussions, and evidence-based learning experiences . Since evolution involves abstract concepts and may contradict previously held beliefs, students may either accept, reinterpret, resist, or negotiate scientific explanations depending on how they process new information .

The study was also informed by Cognitive Dissonance Theory, which explains the psychological discomfort experienced when individuals encounter ideas that conflict with their beliefs, values, or worldview . In learning evolution, students may experience tension when scientific explanations about human origins and biological change appear inconsistent with their cultural or religious beliefs . This dissonance may lead to confusion, hesitation, selective acceptance, or efforts to reconcile science and faith . Some students may separate scientific understanding from personal belief—a process sometimes termed compartmentalization—while others may reinterpret their perspectives to reduce internal conflict . Together, Conceptual Change Theory and Cognitive Dissonance Theory provide a comprehensive framework for understanding the cognitive, emotional, and socio-cultural experiences of students learning evolution in a culturally diverse Philippine context . These theories support the study's focus on how students negotiate scientific understanding and personal belief systems while engaging with evolution education .

3. Method

3.1 Research Design

This study employed a Qualitative Descriptive Design to explore college students' experiences in learning evolution within a culturally diverse Philippine context. Qualitative descriptive research is appropriate for studies that aim to provide comprehensive and straightforward descriptions of participants' experiences, perspectives, and responses in their natural setting. Unlike phenomenological or grounded theory approaches that focus on uncovering the essence

of experience or generating theory, qualitative descriptive research emphasizes presenting participants' accounts in a clear and practical manner closely grounded in their actual responses.

The study focused on understanding how students interpret evolution as a scientific concept, how they negotiate possible tensions between scientific explanations and personal beliefs, and what learning experiences influence their understanding of evolution. Since the study aimed to obtain detailed descriptions of students' perspectives and experiences rather than develop abstract theoretical interpretations, the qualitative descriptive approach was considered most appropriate.

3.2 Research Setting

The study was conducted at a state university in Mindanao, Philippines, where evolution is included as part of the biology and science education curriculum. The university serves students from diverse cultural, religious, linguistic, and socio-economic backgrounds, making it an appropriate setting for examining students' experiences in learning evolution within a multicultural educational environment.

Mindanao is known for its cultural and religious diversity, with communities shaped by different traditions, beliefs, and worldviews. Such diversity provides a meaningful context for exploring how socio-cultural factors influence students' understanding and interpretation of scientific concepts, particularly evolution. The setting allowed the researcher to gather varied perspectives regarding the relationship between science, culture, and belief systems in higher education science learning.

3.4 Research Participants

The participants of the study consisted of twenty-seven (27) Bachelor of Secondary Education (BSED) major in Biology students enrolled in a biology or science education course where evolution was discussed as part of the curriculum during the semester of data collection. The participants were selected because they had direct experience learning evolution in a formal higher education setting and were capable of providing meaningful reflections and descriptions related to the objectives of the study. A purposive sampling technique was employed to identify students who could provide relevant insights regarding their experiences, understanding, and perspectives toward evolution learning within a culturally diverse context.

The inclusion criteria for participant selection were as follows: (1) currently enrolled in a biology or science education course covering evolution; (2) at least 18 years old; (3) willing to participate voluntarily in the study; and (4) able to provide written responses regarding their experiences and perspectives in learning evolution. The participants represented a culturally diverse group of college students from different backgrounds and belief systems, making them appropriate for examining the interaction between scientific understanding and personal perspectives in evolution education. Table 1 presents the demographic profile of the participants in terms of age, sex, prior exposure to evolution, current views toward evolution, and level of comfort in discussing evolution in class.

Table 1. Demographic Profile of the Participants

Variable	Category	Frequency (f)	Percentage (%)
Age	20 years old	7	25.93
	21 years old	14	51.85
	22 years old	5	18.52
	23 years old	1	3.7
Sex	Male	10	37.04
	Female	17	62.96

Program/Course	BSED Biology	27	100
Previously Studied Evolution Before This Course	Yes	18	66.67
	No	9	33.33
Current View Toward Evolution	Accept	22	81.48
	Unsure	1	3.7
	Do not accept	1	3.7
	Prefer not to say	2	7.41
	Accept/Unsure	1	3.7
Comfort Discussing Evolution in Class	Very comfortable	17	62.96
	Comfortable	7	25.93
	Neutral	2	7.41
	Very comfortable/Comfortable	1	3.7

3.5 Sampling Technique

The study utilized purposive sampling, a non-probability sampling technique commonly used in qualitative research to identify participants who possess specific experiences or knowledge relevant to the phenomenon under investigation. Purposive sampling enabled the researcher to intentionally select students who had direct exposure to evolution instruction and who could provide meaningful responses regarding their learning experiences.

This sampling approach was appropriate because the study focused specifically on students who had experienced learning evolution within a higher education context. The researcher selected participants based on their ability to contribute rich and relevant information concerning their understanding of evolution, perceived challenges, science-belief tensions, and classroom experiences.

3.6 Research Instrument

Data were collected using a researcher-developed open-ended questionnaire administered through Google Forms. The instrument was designed to gather qualitative descriptions of students' experiences, perceptions, and reflections regarding evolution learning. It consisted of three parts: (1) a participant profile sheet that gathered demographic information such as age, sex, program or course, previous exposure to evolution, current views toward evolution, and level of comfort in discussing evolution; (2) open-ended questions exploring students' experiences, understanding of evolution, misconceptions and challenges encountered, perceived tensions between scientific explanations and personal beliefs, negotiation of science and belief, and instructional experiences that influenced learning; and (3) a reflective narrative prompt encouraging participants to describe how their understanding of evolution changed throughout the course. The open-ended format allowed participants to freely express their perspectives and experiences, while the use of Google Forms ensured accessibility, convenience, and efficient organization of qualitative data.

To establish content validity, the instrument was subjected to expert validation by specialists in science education and qualitative research. The validators reviewed the instrument for clarity, relevance, coherence, and alignment with the objectives of the study. Suggestions and recommendations were incorporated to improve comprehensibility, reduce ambiguity, and ensure that the questions effectively captured students' experiences and perspectives regarding evolution learning.

3.7 Data Collection Procedure

Prior to data collection, permission to conduct the study was secured from the appropriate institutional authorities. Ethical considerations were strictly observed throughout the research process.

The researcher coordinated with instructors and distributed the Google Forms link to eligible participants through official communication channels and class group platforms. Before accessing the questionnaire, participants were presented with an informed consent form explaining the purpose of the study, the voluntary nature of participation, confidentiality measures, and the intended use of the data.

Participants were informed that they could withdraw from the study at any time without penalty. Only participants who voluntarily agreed to the informed consent were allowed to proceed with the questionnaire.

Participants were given sufficient time to complete the online form. Responses were automatically recorded and securely stored in password-protected digital files accessible only to the researcher. The researcher regularly monitored submissions to ensure completeness and organization of the collected data.

3.8 Data Analysis

The qualitative data gathered from the open-ended responses and reflective narratives were analyzed using thematic analysis following the six-phase framework of Braun and Clarke. The researcher repeatedly reviewed the responses to become familiar with the data and identify initial ideas and patterns. Significant statements and responses related to students' experiences, beliefs, challenges, emotions, and instructional experiences were coded and grouped into categories to develop broader themes. The themes were then reviewed, refined, defined, and interpreted to ensure coherence and accurate representation of the data. Findings were presented through narrative descriptions supported by relevant participant excerpts. Thematic analysis enabled the researcher to identify recurring patterns related to students' understanding of evolution, tensions between science and belief, negotiation strategies, emotional responses, and instructional experiences influencing learning.

3.9 Trustworthiness of the Study

To ensure the rigor and trustworthiness of the study, the researcher employed strategies based on the criteria of credibility, dependability, confirmability, and transferability. Credibility was established through expert validation of the research instrument, careful review of participants' responses, and repeated examination of the data to ensure accurate representation of participants' perspectives and experiences. Dependability was maintained by documenting the research procedures, data collection process, coding procedures, and thematic analysis steps to create an audit trail that enhanced the consistency and transparency of the study. Confirmability was ensured by grounding interpretations and conclusions on participants' actual written responses rather than researcher assumptions or personal biases, while reflexivity was practiced throughout the analysis process. Transferability was supported by providing detailed descriptions of the research setting, participants, procedures, and context to allow readers to determine the applicability of the findings to similar educational settings.

3.10 Ethical Considerations

The study adhered to ethical standards in conducting research involving human participants. Participation in the study was entirely voluntary, and participants were informed of their rights as research participants. Confidentiality and anonymity were maintained by excluding identifying information from the data and using participant codes or pseudonyms during data analysis and presentation of findings. All collected data were securely stored and used solely for academic and research purposes. The researcher also ensured sensitivity and respect when dealing with participants' personal beliefs, opinions, and perspectives regarding evolution and science learning. Participants were informed that there were no right or wrong answers and that their responses would not affect their academic standing. Furthermore, the study emphasized respect for cultural and religious diversity by presenting evolution as a scientific topic for academic understanding rather than as a challenge to participants' personal beliefs. This approach helped create a safe and respectful environment for participants to express their thoughts and experiences honestly.

4. Results

Theme 1: Evolution as an Interesting Yet Challenging Scientific Concept

The findings revealed that most participants described learning evolution as both intellectually stimulating and academically challenging. Students expressed that the course expanded their understanding of biology and helped them appreciate the scientific explanations behind the diversity of life. Many participants described evolution as an important scientific framework that connected various biological concepts such as adaptation, genetics, inheritance, and natural selection.

Several students emphasized that learning evolution allowed them to understand how organisms change over time and how species adapt to environmental conditions. Participants also reported that the discussions, evidence, and examples presented during class deepened their appreciation of science and encouraged them to think critically.

One participant shared:

“Learning evolution in this course has provided me new knowledge in addition to what I have learned previously. It helped me understand how and why organisms evolve and adapt.” (P1)

Another participant explained:

“Learning evolution in this course was both interesting and challenging for me. At first, I thought it would be difficult to understand because it involved many scientific terms and theories. But as the lessons continued, I became more curious and started appreciating how evolution explains the diversity of life.” (P3)

Students generally understood evolution as a scientific process explaining biological change over time through mechanisms such as natural selection, adaptation, mutation, and inheritance. Many participants associated evolution with evidence from fossils, genetics, and comparative anatomy.

One participant stated:

“I understand evolution as a scientific concept that explains how living organisms change over time through processes such as natural selection, adaptation, mutation, and inheritance.” (P3)

Another participant described evolution as:

“A dynamic process, a tapestry woven from mutation, selection, drift, and migration.” (P5)

Despite these positive perspectives, students also identified several concepts that were difficult to understand. The most commonly reported challenges involved genetic drift, molecular evolution, cladistics, geological timescales, and the gradual process of speciation. Participants explained that these concepts were difficult because evolution occurs over millions of years and involves abstract scientific mechanisms that are not directly observable.

One participant shared:

“The most difficult concept for me was understanding how small genetic changes over a long period of time can eventually create entirely new species.” (P1)

Another participant explained:

“Genetic drift and molecular evolution were more difficult because they involve randomness.” (P5)

Although students encountered conceptual difficulties, the findings suggest that most participants remained interested and motivated to learn evolution because of its relevance to understanding life and biological diversity.

Theme 2: Encountering Tensions Between Scientific Explanations and Personal Beliefs

The findings revealed that several participants experienced varying levels of tension when scientific explanations of evolution appeared to differ from their religious beliefs or prior understanding. While some students openly acknowledged experiencing internal conflict, others reported that they approached the topic with curiosity and openness despite recognizing differences between science and religion.

Many participants described evolution as a sensitive topic because discussions on human origins and common ancestry sometimes challenged beliefs learned from family, religion, or community teachings.

One participant stated:

“When the topic of evolution was first introduced, I felt nervous and unsure because I knew it could be a sensitive topic for some people.” (P3)

Another participant explained:

“Although some concepts differ from biblical beliefs, my faith remained unchanged.” (P4)

Some students reported moments of confusion and discomfort when scientific explanations contradicted their previous understanding of creation and human origins. Participants described struggling to reconcile certain scientific claims with religious teachings.

One participant shared:

“There were moments when I felt conflicted because some explanations in evolution seemed different from what I learned from religion.” (P9)

Another participant expressed:

“I questioned how scientific explanations and religious teachings could both exist at the same time.” (P14)

However, not all participants perceived evolution and religion as incompatible. Some students emphasized that learning evolution did not necessarily weaken their faith but instead encouraged them to think more deeply about the relationship between science and belief.

One participant stated:

“There might have been non-overlapping information with my religious belief, but it did not confuse me. Rather, it made me think that science and religion can coexist.” (P2)

The findings indicate that students responded differently to science-belief tensions depending on their personal experiences, religious perspectives, and openness toward scientific explanations.

Theme 3: Negotiating and Reconciling Science and Belief

The findings revealed that many participants attempted to negotiate or reconcile scientific understanding and personal beliefs while learning evolution. Students used different strategies to manage perceived tensions between science and religion.

Several participants explained that they learned to separate scientific explanations from matters of faith. They viewed evolution as a scientific explanation supported by evidence while maintaining their religious beliefs regarding spirituality and creation.

One participant explained:

“I was able to balance my scientific understanding and personal beliefs by recognizing that science explains natural processes while religion focuses on faith and purpose.” (P7)

Another participant stated:

“I learned to respect scientific evidence while also keeping my personal faith.” (P12)

Some students reported that they became more open-minded after learning evolution. Instead of rejecting scientific explanations, they attempted to understand evolution academically while reflecting on their personal beliefs.

One participant shared:

“My understanding broadened, but at the same time I also reflected more deeply on my beliefs.” (P2)

Another participant explained:

“Learning evolution taught me to become more open to different perspectives and to analyze information critically.” (P15)

A few participants acknowledged that they still experienced uncertainty regarding certain concepts but expressed willingness to continue learning and exploring scientific evidence.

One participant stated:

“There are still things I do not fully understand, but I became more willing to study and understand evolution rather than immediately rejecting it.” (P18)

These findings suggest that evolution learning involved a process of meaning-making in which students negotiated scientific understanding and personal beliefs through reflection, critical thinking, and openness to dialogue.

Theme 4: Instructional Experiences that Supported Evolution Learning

The findings revealed that classroom discussions, evidence-based activities, collaborative learning, and real-life examples significantly influenced students’ understanding of evolution. Participants emphasized that interactive and engaging instructional approaches helped them better understand complex evolutionary concepts.

Many students identified discussions and teacher explanations as important learning experiences because they allowed students to clarify misconceptions and ask questions freely.

One participant stated:

“The discussions really piqued my interest because they clarified the points behind evolution.” (P2)

Another participant explained:

“Open discussions helped me understand difficult concepts because we were allowed to share ideas and ask questions.” (P10)

Participants also emphasized the importance of evidence-based learning activities such as examining fossils, analyzing examples of adaptation, discussing genetic evidence, and using real-world applications.

One participant shared:

“Real-life examples and evidence-based activities made evolution easier to understand because I could connect concepts to actual organisms and environmental changes.” (P6)

Another participant explained:

“Group activities and discussions helped me understand different perspectives and made the lessons more meaningful.” (P13)

Students also appreciated teaching strategies that created a respectful classroom environment where differing beliefs and opinions could be discussed without judgment.

One participant stated:

“The teacher explained evolution scientifically while respecting our beliefs, which made learning more comfortable.” (P20)

These findings suggest that supportive classroom environments, open discussions, and evidence-based instructional strategies played a significant role in helping students understand and engage with evolution.

Theme 5: Transformation of Perspectives Toward Science and Evolution

The findings revealed that learning evolution influenced many participants' perspectives toward science, critical thinking, and evidence-based reasoning. Several students explained that the course encouraged them to become more analytical, open-minded, and reflective when evaluating scientific information.

Many participants reported that their understanding of evolution became broader and more evidence-based throughout the course. Students explained that they moved beyond surface-level understanding and began appreciating the complexity and scientific foundations of evolutionary theory.

One participant reflected:

"Throughout the course, my understanding of evolution became deeper and more scientific." (P4)

Another participant stated:

"I learned to evaluate ideas using evidence rather than relying only on assumptions." (P16)

Some participants also expressed greater confidence in discussing evolution and explaining scientific ideas to others.

One participant shared:

"I now feel more prepared to explain evolution to others using scientific evidence while still respecting different beliefs." (P22)

Another participant explained:

"Learning evolution influenced the way I think about science because it taught me to question, analyze, and seek evidence." (P11)

The findings indicate that learning evolution not only improved students' scientific understanding but also encouraged critical thinking, openness to evidence, and respectful engagement with diverse perspectives.

5. Discussion

The findings of the study revealed that college students perceived evolution as both an intellectually meaningful and academically challenging scientific concept. Participants generally recognized evolution as an important framework for understanding biological diversity, adaptation, and change over time. Students associated evolution with scientific mechanisms such as natural selection, mutation, inheritance, and adaptation, indicating that many participants developed a foundational understanding of evolutionary principles. These findings support previous research emphasizing that evolution serves as a central organizing concept in biology and contributes significantly to students' scientific literacy and understanding of life sciences. The participants' descriptions also suggest that learning evolution encouraged curiosity and critical thinking, particularly when students were exposed to scientific evidence and classroom discussions that connected abstract concepts to real-world biological phenomena.

Despite these positive perspectives, students encountered conceptual difficulties related to abstract evolutionary processes, geological timescales, molecular evolution, and genetic drift. Participants explained that evolution was difficult to understand because many processes occur gradually over long periods and cannot be directly observed. These findings are consistent with previous studies showing that students commonly struggle with misconceptions and abstract reasoning in evolution education. Misunderstandings involving randomness, adaptation, and speciation continue to be persistent challenges among learners because students often rely on intuitive or simplified explanations of biological change. From the perspective of Conceptual Change Theory, these difficulties suggest that students entered the classroom with prior conceptions that required reconstruction through evidence-based learning experiences. The findings indicate that conceptual change in evolution learning requires more than memorization of scientific definitions; rather, students need opportunities to engage critically with evidence, question misconceptions, and connect scientific concepts to meaningful contexts.

The study further revealed that several participants experienced tensions between scientific explanations of evolution and their personal or religious beliefs . Some students described feelings of uncertainty, discomfort, or internal conflict when discussions about human origins and common ancestry appeared inconsistent with beliefs learned from religion, family, or community teachings . These findings align with literature suggesting that evolution education is not purely a cognitive process but also involves emotional, cultural, and identity-related dimensions . Students' reactions demonstrate how scientific learning may intersect with deeply held beliefs and personal worldviews, particularly in culturally and religiously diverse societies . In the Philippine context, where religious belief remains influential in shaping perspectives toward life and creation, such tensions are understandable and expected . The findings therefore highlight the importance of recognizing that students' responses to evolution are shaped not only by scientific understanding but also by socio-cultural experiences and belief systems .

The findings also support Cognitive Dissonance Theory, which explains that individuals experience psychological discomfort when confronted with ideas that conflict with their existing beliefs or values . Participants in the study demonstrated different responses to this tension . Some students questioned how science and religion could coexist, while others attempted to reinterpret or negotiate their understanding of both perspectives . These varied responses suggest that students do not respond uniformly to science-belief conflict; instead, they engage in personal processes of reflection, negotiation, and meaning-making while learning evolution . The findings indicate that cognitive dissonance in evolution education does not necessarily result in rejection of science . Rather, for many participants, the tension encouraged deeper reflection regarding the relationship between scientific explanations and personal beliefs .

Interestingly, many students attempted to reconcile scientific understanding and religious belief rather than completely rejecting either perspective . Several participants explained that they learned to distinguish science as an explanation of natural processes from religion as a source of spiritual meaning and faith . This suggests that students developed negotiation strategies that allowed them to engage academically with evolution while maintaining personal beliefs . Such findings support previous research emphasizing that students may compartmentalize science and religion or perceive them as addressing different dimensions of human understanding . Rather than viewing evolution and faith as mutually exclusive, some learners adopted more flexible perspectives that allowed coexistence between scientific evidence and personal spirituality . This process of negotiation reflects the complexity of evolution learning within culturally diverse educational settings .

The findings further revealed that classroom environment and instructional strategies played a significant role in supporting students' understanding of evolution . Participants emphasized that open discussions, collaborative learning, teacher explanations, and evidence-based activities helped them understand difficult concepts and feel more comfortable engaging with the topic . Discussions and opportunities to ask questions were especially important because they allowed students to clarify misconceptions and explore differing perspectives in a respectful environment . These findings support previous literature emphasizing the importance of inquiry-based and student-centered approaches in science education . Interactive learning experiences appear to help students connect scientific evidence with conceptual understanding more effectively than passive instruction alone .

Evidence-based instructional activities such as discussions of fossils, adaptation, genetics, and real-world biological examples also helped students appreciate the scientific foundations of evolution . Participants reported that these activities made abstract concepts more understandable and meaningful . This finding highlights the importance of contextualized and experiential learning in evolution education . When students encounter concrete evidence and practical applications, they become more capable of understanding evolutionary processes and evaluating scientific explanations critically . The use of collaborative learning and group discussions also promoted openness toward diverse perspectives and encouraged students to examine their own assumptions regarding evolution .

Another significant finding of the study was the importance of culturally respectful and inclusive teaching practices . Participants appreciated teachers who explained evolution scientifically while remaining respectful toward students' beliefs and perspectives . This suggests that culturally responsive teaching approaches can reduce classroom tension and encourage more meaningful engagement with controversial scientific topics . The findings support the view that science educators should create safe learning environments where students can express questions, uncertainties, and personal reflections without fear of ridicule or judgment . Respectful dialogue does not weaken scientific instruction;

rather, it allows students to engage more openly with scientific concepts while reflecting critically on their own perspectives .

The study also revealed that learning evolution contributed to broader intellectual and personal development among students . Many participants reported becoming more open-minded, analytical, and evidence-oriented after studying evolution . Students described learning to evaluate ideas critically, seek scientific evidence, and appreciate the complexity of biological systems . These findings suggest that evolution education contributes not only to conceptual understanding but also to the development of scientific habits of mind, including critical thinking, reflective reasoning, and openness to evidence . The participants' increased confidence in discussing evolution further indicates that supportive learning environments can empower students to engage constructively with scientific ideas even when those ideas involve sensitive or controversial topics .

Overall, the findings demonstrate that learning evolution within a culturally diverse Philippine context is a multidimensional experience shaped by cognitive, emotional, cultural, and instructional factors . Students' understanding of evolution was influenced not only by scientific content but also by prior beliefs, cultural identity, classroom climate, and opportunities for dialogue and reflection . The study highlights the importance of culturally responsive evolution education that balances scientific rigor with sensitivity toward learners' diverse backgrounds and perspectives . By recognizing the complex interaction between science and belief, educators can design instructional approaches that promote meaningful scientific understanding while fostering respectful and inclusive learning environments in higher education .

5.1 Practical Implications

The findings of this study highlight the importance of implementing culturally responsive and evidence-based approaches in teaching evolution within higher education science classrooms. Since students may experience tensions between scientific explanations and personal belief systems, educators should create respectful and inclusive learning environments where learners can openly discuss questions, misconceptions, and differing perspectives without fear of judgment. The study further suggests that inquiry-based activities, collaborative discussions, real-life examples, and evidence-based instructional strategies help students better understand complex evolutionary concepts and develop critical thinking skills. Additionally, teachers should be equipped with both strong content knowledge and pedagogical strategies for addressing sensitive science-belief issues constructively and respectfully. By promoting supportive, scientifically rigorous, and culturally sensitive instruction, higher education institutions can strengthen students' scientific literacy, openness to evidence-based reasoning, and meaningful engagement with evolution education within culturally diverse contexts.

5.2 Theoretical implications

The findings of this study contribute to the existing literature on evolution education by supporting the relevance of Conceptual Change Theory and Cognitive Dissonance Theory in understanding how students learn evolution within culturally and religiously diverse contexts. The study demonstrated that students' understanding of evolution involves not only cognitive reconstruction of scientific concepts but also emotional, cultural, and belief-related negotiation processes. The findings suggest that conceptual change in evolution learning is influenced by prior beliefs, cultural identity, and classroom experiences, indicating that scientific understanding cannot be separated from learners' socio-cultural contexts. Furthermore, the study supports the idea that cognitive dissonance does not necessarily lead to rejection of scientific explanations; rather, students may engage in reflection, reconciliation, compartmentalization, or negotiation between science and belief. The findings also reinforce perspectives on border crossing and culturally responsive science education by showing that students move between scientific, cultural, and personal meaning systems while learning evolution. Overall, the study expands theoretical understanding of evolution learning by highlighting the multidimensional nature of students' experiences and the importance of integrating cognitive, emotional, and socio-cultural perspectives in science education research.

5.3 Limitations and Future Research

This study has several limitations that should be considered when interpreting the findings. First, the study was limited to twenty-seven (27) Bachelor of Secondary Education major in Biology students from a single state university in

Mindanao, which may limit the transferability of the findings to other educational contexts or student populations. Second, the study relied on written responses collected through Google Forms rather than face-to-face interviews or classroom observations, which may have limited the depth and richness of participants' explanations and emotional expressions. Third, the study focused primarily on students' self-reported experiences and perspectives, which may have been influenced by personal interpretation, social desirability, or willingness to disclose sensitive beliefs. Future research may involve larger and more diverse participant groups from different universities and cultural backgrounds to provide broader perspectives on evolution learning in the Philippines. Researchers may also employ in-depth interviews, focus group discussions, or mixed-methods approaches to obtain richer and more comprehensive data regarding students' negotiation of science and belief. Additionally, future studies may explore the perspectives of science teachers, investigate the effectiveness of culturally responsive evolution instruction, or examine how classroom practices influence students' acceptance and understanding of evolution over time.

6. Conclusion

This study explored college students' experiences in learning evolution within a culturally diverse Philippine context and revealed that evolution learning is a multidimensional process shaped by cognitive, emotional, cultural, and instructional factors. The findings showed that students generally recognized evolution as an important scientific concept but also experienced difficulties related to abstract evolutionary processes and misconceptions. Several participants encountered tensions between scientific explanations and personal or religious beliefs, particularly concerning human origins and creation. However, many students demonstrated efforts to negotiate or reconcile science and belief by distinguishing scientific understanding from matters of faith, remaining open to dialogue, and engaging critically with scientific evidence. The study further highlighted the important role of classroom discussions, evidence-based activities, collaborative learning, and respectful teaching approaches in supporting students' understanding and engagement with evolution.

The study contributes to evolution education and higher education teaching practice by emphasizing the importance of culturally responsive and inclusive instructional approaches in teaching sensitive scientific topics. The findings suggest that students learn evolution more meaningfully when educators create respectful learning environments that encourage inquiry, reflection, critical thinking, and open discussion while maintaining scientific rigor. Consistent with existing literature on conceptual change and science-belief negotiation, the study demonstrates that understanding evolution involves not only scientific cognition but also personal meaning-making shaped by students' cultural and belief systems. Overall, the study underscores the value of balancing evidence-based science instruction with sensitivity toward learners' diverse perspectives in order to promote scientific literacy, respectful dialogue, and meaningful learning experiences in culturally diverse higher education contexts.

Acknowledgements

The author sincerely thanks the Bachelor of Secondary Education major in Biology students who voluntarily participated in this study by generously sharing their experiences and reflections. The author also expresses appreciation to the experts who provided valuable comments during the validation of the research instrument, as well as to the administrators and faculty members of the participating institution for their support in facilitating the conduct of this research.

Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. To protect the privacy and confidentiality of the participants, the qualitative data are not publicly available.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Declarations

The author declares that there are no competing interests.

Ethical approval

In accordance with the institutional policies of the Research Integrity and Compliance Office (RICO), Mindanao State University–Iligan Institute of Technology (MSU-IIT), formal ethics committee review is required only for graduate research and other studies that fall within the scope of institutional ethics review. As this study was a minimal-risk educational research project involving voluntary adult college students, anonymous survey responses, no experimental intervention, and no collection of sensitive personal information, it was exempted from formal ethics committee review by the Research Integrity and Compliance Office (RICO), MSU-IIT, in accordance with the institution's research ethics policies. Accordingly, the requirement for formal ethical approval was waived.

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and the applicable institutional guidelines for research involving human participants. Written informed consent was obtained from all participants prior to data collection.

Consent to participate

Informed consent was obtained from all individual participants included in the study prior to their participation. Participants were informed of the purpose of the research, the voluntary nature of their participation, their right to withdraw at any time without penalty, and the measures taken to ensure confidentiality and anonymity.

Consent to publish

Not applicable. This manuscript does not contain any identifiable individual person's data in any form.

Clinical trial number: not applicable

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