REACT Framework in Contextualizing Lesson in General Biology 2 in Fostering Scientific Creativity

Joshua Philip T. Pirante[a], Elisa N. Chua[b]

[a] joshuaphilip.pirante@deped.gov.ph [b]elisa.chua@lspu.edu.ph

[a]Laguna State Polytechnic University, San Pablo City Campus, San Pablo City, Laguna, Philippines
[b]Laguna State Polytechnic University, San Pablo City Campus, San Pablo City, Laguna, Philippines

Abstract

This study aimed to assess the relationship of integrating the REACT framework with the 7Es instructional model in contextualizing lessons in General Biology 2 to foster scientific creativity among Grade 11 STEM students. The REACT framework (Relating, Experiencing, Applying, Cooperating, and Transferring) was utilized to design and implement contextualized lessons focused on systematics based on evolutionary relationships, specifically covering taxonomy, binomial nomenclature, and cladistics. A descriptive-developmental research design was employed, involving 39 Grade 11 STEM students.

Pretest and posttest assessments, validated lesson exemplars, and structured questionnaires were used to gather data on students' learning profiles, thinking styles (convergent and divergent), exposure to REACT, and levels of scientific creativity. Results showed a significant improvement in students' scientific creativity after the implementation of the REACT-based lessons. However, no statistically significant relationship was found between the level of REACT exposure and post-performance in scientific creativity. Despite this, the study underscores the value of contextualized, student-centered instruction in enhancing higher order thinking skills. The findings contribute practical insights into instructional design and support curriculum enhancement aligned with the MATATAG framework and the Most Essential Learning Competencies (MELCs).

This research offers validated materials and strategies that can be replicated by teachers and further investigated by future researchers to optimize the teaching of Biology in senior high school. It emphasizes that scientific creativity is best cultivated through meaningful, real-world applications that actively engage learners in the scientific process.

Keywords: REACT framework; scientific creativity; contextualized lesson; relating; experiencing; applying; cooperating; transferring

1. INTRODUCTION

Scientific creativity is increasingly acknowledged as an essential component of successful scientific investigation and innovation. This creativity not only fuels individual scientific achievements, but it also encourages joint efforts to address difficult global concerns [1]. In the latest assessment from Program for International Assessment 2022 (PISA) [2], Singapore, Korea, Canada, Australia, New Zealand, Estonia, and Finland were the best-performing education systems in the first-ever creative thinking evaluation administered by the OECD's PISA evaluation. In the same study, the Philippines performance highlighted significant challenges in science education, with a substantial portion of students scoring below Level 2. This indicates that many Filipino students struggle with basic scientific concepts and the application of knowledge to real-world problems especially in the concept of creativity. The results underscore the urgent need for curriculum reforms and targeted interventions to enhance science literacy and creative skills.

To improve the quality of basic education by bringing it into line with international standards and preparing students for further study, the workforce, or entrepreneurship, the Philippines introduced the K–12 curriculum in 2013. Although the curriculum's goals were remarkable it has come under critique for having too much content in too many classes, especially the sciences. Due to the restricted amount of instructional time allotted to each topic because of this content-heavy structure, students find it challenging to completely understand and absorb basic scientific principles. The need to cover many lessons frequently results in superficial learning rather than deep comprehension and critical thinking.

According to reports, the volume of lessons has overwhelmed both teachers and students, compromising mastery of essential skills [3].

The poor performance of Filipino students in science, as seen by PISA findings, highlights the need for substantial educational reforms [4]. By addressing both curricular and extracurricular elements, stakeholders may work to improve science literacy specifically student learning and innovation skills and better prepare Filipino children for future global problems. Implementing tailored interventions based on identified variables in this study will be critical in improving educational results in science. Improving the education system is a shared goal among DepEd, stakeholders, and every Filipino, including support from the United Nations (UN). Through the active implementation of the DepEd enhanced curriculum and collaboration with partners, administrators and teachers maintain a conducive and supportive atmosphere for optimal student learning.

The complexity of domain-specific creativity, especially scientific creativity which involves specialized processes like inquiry, experimentation, and problem-solving within a scientific context are not well taken by international assessments like PISA, even though they offer a broad measure of creativity across disciplines. There is not enough empirical research in the Philippine context that look at how instructional frameworks, like the REACT framework, can affect students' development of scientific creativity, despite the acknowledged significance of encouraging scientific creativity in 21st-century learners. Among various frameworks supporting scientific creativity, the REACT framework offers a practical approach. REACT (Relating, Experiencing, Applying, Cooperating, and Transferring) encourages students to connect biological concepts to real-life situations, participate in hands-on activities, and apply their learning in collaborative and new contexts [5]. Studies have shown REACT’s effectiveness in deepening students' understanding of molecular genetics and other science concepts and its role in enhancing critical thinking, creativity, collaboration, and communication skills in introductory chemistry [6,7]

Implementing REACT alongside other instructional models, such as 5E and 7E, further supports creativity in STEM. REACT integrated into the 5E model improved science learning outcomes, outperforming a computer-assisted 5E approach [8]. Similarly, the 7E model’s positive effect on scientific inquiry and creativity in molecular biology, fostering inquiry-based learning [9,10]. However, effective REACT implementation requires teachers to address practical limitations and receive adequate training [11]. Research shows positive impacts of the REACT framework and the 5E and 7E models on STEM students' creativity [4, 5, 6]. While PISA measures broad creativity skills, such as problem-solving and innovation across subjects, scientific creativity specifically involves generating new concepts, methods, or products that advance scientific knowledge or solve technical issues. Yet, few studies have examined REACT’s integration within the 7E model in Biology education, highlighting the need to explore how this combination can enhance scientific creativity through contextualized, student-centered learning.

The purpose of this study is to assess the relationship of contextualized lesson using REACT framework to the Grade 11 STEM students’ scientific creativity, which is defined as having the ability to develop original concepts, designs, or procedures that are useful in the scientific community. The intent of this study is to ascertain how contextualized, student-centered frameworks such as the 7E Learning Cycle and REACT (Relating, Experiencing, Applying, Cooperating, and Transferring) might enhance scientific creativity in biology classes. These frameworks facilitate meaningful, inquiry-based learning experiences that are in line with the objectives of the recently implemented MATATAG curriculum, which places a strong emphasis on scientific literacy, creativity, and critical thinking.

1.1. Conceptual Framework

Table 1. show the term and definition of REACT framework which stands for Relating, Experiencing, Applying, Cooperating, and Transferring [5]. This framework is a guide for developing contextualized lesson exemplar in General biology 2 lesson for Science, Technology, Engineering and Mathematics (STEM) students.

Table 1. Definition of REACT Framework

REACT Framework	
Relating	motivate students to relate new knowledge to their existing experiences
Experience	engage in hands-on activities like science laboratory activities
Applying	encourage to apply concepts in practical scenarios during class activity
Cooperating	stimulate collaboration, sharing ideas and open communication with the classmate
Transferring	encourage learners to learned skills from activities that can applied to different situations.

Figure 1 present the incorporation of REACT framework to the 7E's instructional model (Elicit, Engage, Explore, Explain, Elaborate, Evaluate and Extend). This incorporation will be the guide in creating a lesson exemplar for General Biology 2 topics including Basic Taxonomic Concepts and Principles, Description, Nomenclature, Identification, and Classification (STEM_BIO11/12IIIhj-14-16). Because the REACT framework itself is designed to make learning more meaningful and relevant by connecting academic concepts to real-world contexts.

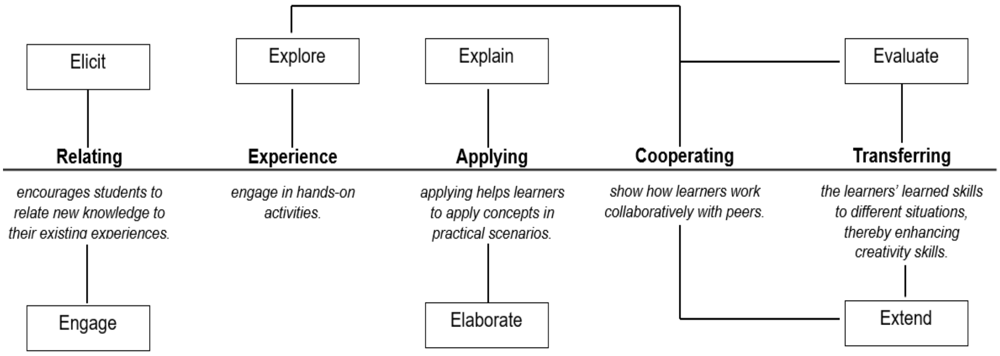

Figure 1. REACT Framework to 7es instructional method.

This study will employ the REACT framework in contextualized science activities for a General Biology 2 class as an integration for the existing 7Es instructional model. Shown in Figure 4 is the conceptual framework of this study serves as a structured foundation, outlining the relationship between the key variables/concepts and guiding the direction of the research.

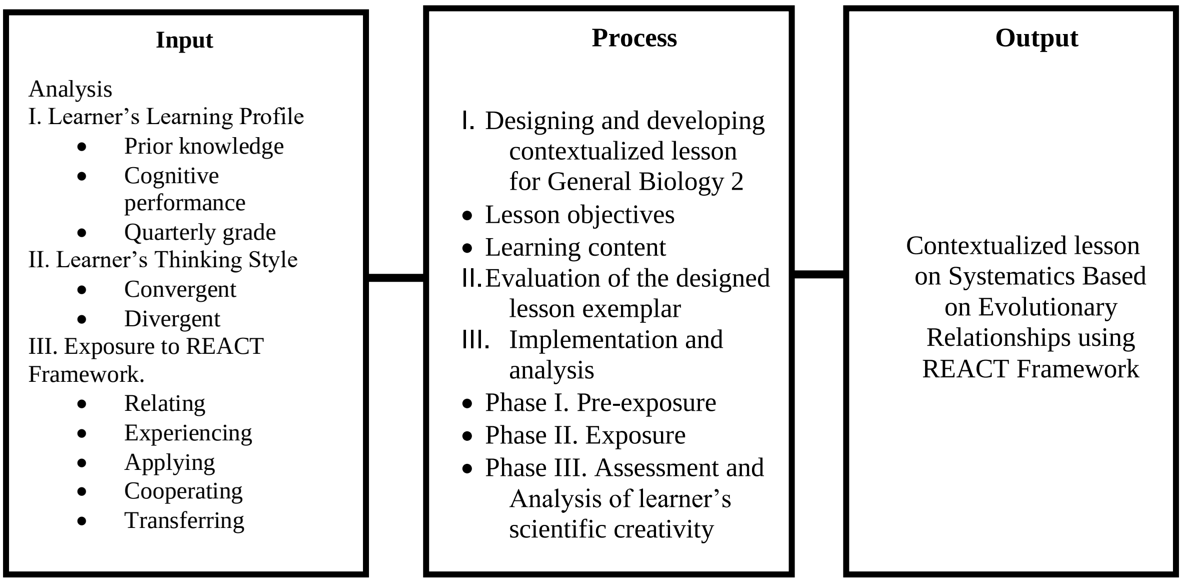

Figure 2. Research paradigm.

Anchored in constructivist and experiential learning theory this framework illustrates how REACT framework with integration of 7Es instructional model potentially impacts students' scientific creativity emphasizing the pathways through which these interactions occur.

This framework utilized the input-process-output-model. Input contains learners' learning profile including the prior knowledge that is consider as foundation in constructivist learning where students build on what they already know to connect new ideas. The cognitive performance identifies learners' ability to analyze problem and evaluate data as part of scientific thinking. While the quarterly grade reflects the academic performance of Grade 11 STEM learners together with the learners thinking style (convergent and divergent) that have been chosen and performed by learners and the attributes of REACT framework. Divergent thinking predicts creativity in those high in convergent thinking, and only when convergent thinking capacity reaches a certain level, divergent thinking can play a role in scientific creativity [12].

The REACT framework, which focuses on promoting divergent and convergent thinking and providing an open, inquiry-based learning environment, improves students' creative science thinking and inquiry performance [13]. Additionally, the utilization of components of REACT framework which stands for Relating, Experiencing, Applying, Cooperating, and Transferring [5]. These variables emerged as part of inputs because they reflect the necessary preconditions for enhancing scientific creativity in STEM students by understanding their learning profile, their preferred thinking styles and in what component they are exposed to REACT framework.

The process aligned to the implementation of REACT framework to assess the learner's performance that includes designing and developing of contextualized lesson, evaluation of the designed lesson exemplar and implementation and analysis of the contextualized lesson using REACT framework. Lastly, the output that contains the contextualized lesson exemplar for General Biology 2 lesson focusing on Systematics Based on Evolutionary Relationships using 7es instructional model with integration of REACT framework that will help to assess learners' scientific creativity.

2. METHODOLOGY

2.1. Research Design

The study employed a descriptive-developmental design of quantitative research [14]. This study assessed the Grade 11 Science, Technology, Engineering, and Mathematics (STEM) students' prior knowledge, cognitive performance and preferred learning thinking styles following the designing a contextualized lesson exemplar under General Biology 2 incorporating the REACT framework and 7Es instructional model.

The purpose of this study is to explore the impact of integrating the REACT framework into General Biology 2 lessons through 7E's instructional model for Grade 11 STEM students. By contextualizing biological concepts through the REACT framework, the study sought to demonstrate how a shift from traditional, teacher-centered approaches to a more student-centered, interactive method can enhance both the learning experience and the development of essential skills such as scientific creativity.

2.2. Respondents of the Study

The researcher focused on Grade 11 STEM students consisting of 15 male and 24 female students, totaling of thirty-nine (39) participants from Don Manuel Rivera Memorial Integrated National High School located in Barangay Bulilan Sur, Pila, Laguna. The whole class participated in implementation of the REACT framework using contextualized lesson in General Biology 2 class during the third quarter of the second semester, school year 2024-2025. Each participant asked to complete a pretest, posttest, and survey questionnaires.

This study utilized total population to align the sample more precisely to the research's goals and objectives, therefore enhancing the study's quality and reliability of the data and findings (Campbell et al., 2020).

2.3. Data Gathering Procedures

This study started in quarter 3 (2nd semester) in the month of January-March of the school year 2024-2025. The researcher prepared a formal request letter to seek approval for the study from the Senior

High School Principal and the Public-School Division Superintendent of Laguna. Parental consent forms distributed to the parents or guardians during the parent orientation of the participating students, along with a waiver ensuring the safety and protection of the learners.

The researcher adapted and validated survey questionnaires, and test questions for pretest and posttest. Likewise, validators rated the instrument including the lesson exemplar using a provided evaluation sheet and rubrics. To ensure the validity of the test items, researcher conducted a pilot-testing from thirty (30) Grade 11 STEM students from one public school. After the validation and pilot testing, the researchers employed a validated learning activities from the validated lesson exemplar to ascertain the students' performance which consist of thirty-nine (39) Grade 11 STEM students from Don Manuel Rivera Memorial Integrated National High School.

For the implementation of the designed lesson exemplar, the researcher maintained strict anonymity throughout the study and used the data solely to analyze the REACT framework and its implications for Grade 11 STEM students' scientific creativity. The processing of the personal information and their legal entities based in the R.A 10173 – Data Privacy Act of 2012 and learners are safeguarded and monitored in following the Child Protection Policy. All data stored in paper or online disposed properly according to ethics of research.

Additionally, the researcher performed this research study through this process: in the *Development phase*, the researcher created a full-blown contextualized lesson exemplar and worksheet for General Biology 2 about Basic Taxonomic Concepts and Principles, Description, Nomenclature, Identification, and Classification (STEM_BIO11/12IIIhj-14-16). The lesson exemplar was evaluated by Master Teacher and Head Teacher using an adopted rubric. In the second phase which is the *Implementation phase* involves pre-exposure, exposure, and analysis phase. After the implementation phase, the researcher immediately conducted an *Analysis phase*, where the output and performance of the learners assessed and check if the learning objectives was met at the end of the session.

2.4. Research Instruments

The learners involved in this study are Grade 11 STEM students enrolled in General Biology 2. These students are characterized by their interest in science, technology, engineering, and mathematics (STEM), and they typically demonstrate analytical thinking and curiosity about natural phenomena. Their exposure to foundational biology concepts equips them to engage with advanced topics such as taxonomic principles, nomenclature, and classification. The researcher adapted forty-eight (48) items validated survey questionnaires and 20 test-items for pretest and posttest. The set of questions undergone a validation and modification by eight (8) science and one (1) language teachers to ensure its validity. The responses of the validators used to reorganize, add, and delete questions after the validation of survey and test questionnaires.

2.5. Statistical Treatment of Data

For the data analysis, the researcher with the guidance of the assigned research statisticians and CTE-GSAR Research and Statistics Center (GRACE) analyzed, computed, and interpreted the data using statistical methods such as frequency, percentage, mean, standard deviation, paired t-tests, and Product Moment Correlation Coefficient analysis. Pretest and posttest results compared to determine the effectiveness of the REACT framework in improving cognitive performance and fostering scientific creativity. Survey responses provided insights into the students' experiences and perceptions of the contextualized lesson exemplar.

3. RESULTS AND DISCUSSIONS

Understanding students' prior knowledge is crucial for effective teaching in biology, especially under the topic of taxonomy and phylogeny. Prior knowledge and cognitive performance shapes how students grasp new concepts, influences their academic achievement, and helps science teachers design better learning experiences through lesson planning. This research identifies first the profile of the students through their prior knowledge, cognitive performance, quarterly grade, and their thinking style.

Table 2. Profile of the Students in Terms of Prior Knowledge

Score	f	%	Verbal Interpretation
3	27	69.23	High
2	10	25.64	Moderate
1	2	5.13	Low
Total	**39**	**100.00**	

Presented in table 2 is the profile of the students in terms of prior knowledge, where twenty-seven (27) Grade 11 STEM students who answered “Yes” to all three questions demonstrated high prior knowledge in science subject before they attend General Biology 2 class, suggesting they entered the General Biology 2 class with a foundational understanding from their previous lessons in Grade 8 taught in Quarter 4. This indicates that a significant majority had already encountered comprehensive lessons on DNA-based classification, taxonomic distinctions, and species diversity with an emphasis on cladistics.

Likewise, based on the result only 25.64% had moderate prior knowledge. These Grade 11 STEM students responded “Yes” to one or two of the survey questions. This suggests partial familiarity with the topics. For instance, a student may have learned about species diversity but not about the molecular basis of classification such as DNA sequences or cladistics. Their understanding might be limited or fragmented, indicating the need for reinforcement in certain areas before tackling higher-order biological classification concepts. Moreover, only two or 5.13% from Grade 11 STEM students in this group responded “No” to all three questions. This implies minimal or no prior exposure to the key concepts of basic taxonomy and classification. These students may require remedial instruction to build the prerequisite knowledge necessary for meaningful engagement with the topics in General Biology 2.

The data reveals that while a majority of the Grade 11 STEM students possess high prior knowledge in foundational classification and diversity concepts, a noteworthy portion still falls under the moderate and low categories. The students who possess moderate to low prior knowledge considered the situation of the implementation of the spiral progression in science curriculum. Students from Grade 7 to 10 level taught lesson from life science, physics, chemistry, and earth science. The integration across science topics wants students to have a deeper understanding of the lesson. However, there are students who are not able to understand the concept from their previous science lesson.

In developing a lesson exemplar, the researcher took into consideration the level of the students in terms of their prior knowledge. This highlights the importance of differentiated instruction and diagnostic assessment to address learning gaps early in the lesson. Instructional strategies such as concept mapping and visual organizers which is part of activities included in lesson exemplar was used to help bridge the knowledge gaps for those in the moderate and low groups from Grade 11 STEM students.

Table 3. Profile of the Students in Terms of Cognitive Performance

Score	f	%	Verbal Interpretation
4-5	8	20.52	High
2-3	23	58.98	Moderate
0-1	8	20.50	Low
Total	**39**	**100.00**	

Table 3 showed that 20.52% of Grade 11 STEM students demonstrated high cognitive proficiency. It indicates that 8 students consistently answered 4 to 5 items correctly. These students can recall key concepts of phylogeny with ease, establish meaningful connections between prior knowledge and new biology content. They can also define biology terminologies accurately during discussions and assessments, solve biology problems independently, and explain biological phenomena effectively in real-life or situational contexts. This student reflects learners with strong analytical and critical thinking skills who can process and apply scientific information confidently.

Additionally, twenty-three (23) Grade 11 STEM students (58.98%) were in the moderate proficient range. These students may partially recall concepts or need prompts during discussions, can sometimes connect ideas, but may struggle with unfamiliar contexts. Some are inconsistent in defining terms or solving problems independently, and often require support to explain scientific concepts in application-based scenarios. This indicates that while a foundational understanding exists, these students need reinforcement, practice, and scaffolding to build deeper cognitive skills in biology.

Another eight (8) students (20.50%) exhibited low cognitive performance, answering 0 to 1 item correctly. These students experienced to struggle to remember basic biology content, even if previously taught. They encountered to find it difficult to integrate new information with what they already know. And often rely on peers or teachers to define concepts or solve biology problems. Lastly, those students are unable to explain biological ideas clearly in a contextual setting. This group may benefit from remediation sessions, targeted interventions, and active engagement strategies to strengthen their cognitive engagement in biology.

It can conclude that the cognitive performance shows a broad range, with a notable number of students needing support to reach proficiency levels specifically for General Biology 2 classes under systematics based on evolutionary relationships. In comparison from data in Table 2, two (2) Grade 11 students agreed that they belong to low proficient however, in Table 3, there are eight (8) students categorized as low proficient in their cognitive performance. Educational strategies such as the use of formative assessments, peer-assisted learning, and concept-based teaching approaches are recommended to elevate students from moderate to high performance levels and support those in the lower bracket. This showed as a basis to develop a lesson exemplar that can be used to enhance students learning and improve scientific creativity using contextualized lesson for General Biology 2.

Table 4. Profile of the Students in Terms of Quarterly Grade

Grade	f	%	Verbal Interpretation
90 to 100	13	33.33	Outstanding
85 to 89	11	28.21	Very Satisfactory
80 to 84	13	33.33	Satisfactory
75 to 79	2	5.13	Fairly Satisfactory
Below 75	0	0.00	Did Not Meet Expectation
Total	**39**	**100.00**	

Table 4 presents the profile of Grade 11 STEM students in terms of their quarterly grades in General Biology 2, based on the grading scale and descriptors outlined in the DepEd Order no.8 s2015. 13 out of 39 Grade 11 STEM students obtained grades within the range of 90 to 100, falling under the "Outstanding" category. This indicates a high level of academic performance, where students demonstrated excellent mastery of biology competencies, the ability to explain scientific concepts with clarity, and consistent achievement in both formative and summative assessments. Another 11 students, achieved grades from 85 to 89, classified as "Very Satisfactory." These students exhibited strong understanding and application of content but may occasionally need minimal support in dealing with complex tasks.

An additional 13 students received grades between 80 and 84, which falls under the "Satisfactory" level. These learners met the essential learning competencies but may require further support to enhance their analytical and critical thinking skills. Only 2 students scored between 75 and 79, belonging them in the "Fairly Satisfactory" category. While they have passed the General Biology 2, their performance suggests minimal mastery, and they need remediation or targeted academic intervention. Notably, none of the students scored below 75, indicating that all learners met at least the minimum expectations set by the curriculum.

Overall, the data reflects a positive academic profile for the class, with a majority achieving grades categorized as either outstanding or very satisfactory. This suggests that most students possess a solid grasp of biological concepts and can demonstrate learning outcomes at higher levels. However, there remains a portion of the STEM class who are either performing at a basic level or are at risk of underperformance. These Grade 11 students would benefit from differentiated instruction and additional reinforcement to support their academic growth. The results also echo the trends seen in Table 4, where most students were identified as having moderate cognitive performance, further emphasizing the importance of strengthening cognitive skills such as comprehension, application, and scientific reasoning to raise overall academic achievement.

Table 5. Learner's Thinking Style in Terms of Convergent

Indicators	Mean	SD	Verbal Interpretation
1. I prefer following structured steps to solve biological problems.	3.51	0.51	Highly Preferred
2. I take care over how I interpret data and avoid jumping to conclusions in biology related problem.	3.28	0.46	Preferred
3. I tend to be attracted to techniques such as flow charts, contingency plans etc. during science activities.	3.26	0.64	Preferred
4. I enjoy tasks that require finding the single best solution to a biology-related question.	3.21	0.57	Preferred
5. I believe that rational, logical thinking should be applied in biology activities	3.46	0.60	Preferred
Over-all	**3.34**	**0.57**	**Preferred**

Legend: 3.50 – 4.00 Highly Preferred, 2.50 – 3.49 Preferred, 1.50 – 2.49 Not Preferred, 1.00 – 1.49 Strongly Not Preferred

Table 5 with an overall mean of 3.34 indicates that Grade 11 STEM students value evidence-based reasoning and more comfortable following step-by-step procedures using flowcharts or solving problems with a single correct answer in General Biology 2. This suggests that science teachers should ensure that lessons should include well-structured activities like laboratory protocols and data analysis situations.

Indicator 1 described with the highest mean score of 3.51. This suggests that Grade 11 STEM students strongly value systematic problem-solving methods, consistent with the nature of scientific inquiry, where logical sequences and experimental protocols in Biology are fundamental. Their preference for structured steps reflects the cognitive demands of STEM education, where learners must follow defined procedures to arrive at accurate conclusions. This also indicates their readiness to engage in activities like experimental design, flowchart creation, and scientific problem-solving, all of which align with the "Apply" elements of the REACT framework. In contrast, the lowest-rated indicator is scored a mean of 3.21 and was interpreted as Preferred. While still positively viewed, the lower rating implies a slightly lesser inclination toward tasks that emphasize only one correct answer. This suggests that Grade 11 STEM students may be more engaged when given open-ended or exploratory science activities, even within a convergent thinking style.

This comparison highlights an important nuance: while Grade 11 STEM learners value structure and logic, they also appreciate the flexibility to interpret and analyze data, as seen in indicator 2 with a mean of 3.28. This suggests a blended cognitive approach, where learners want to be guided by structure but not confined to rigid, one-answer paradigms. As such, science activities like guided inquiry laboratory, case-based problem solving, and scaffolded research projects are ideal, as they strike a balance between structure and cognitive autonomy, the components of the REACT (Relate, Experience, Apply, Cooperate, Transfer) framework.

Given these findings, the development of a REACT framework-based lesson exemplar should integrate structured steps (*as seen in Convergent indicator 1*) during the "Experience" phase, ensuring that learners clearly understand the scientific process. However, during the "Relate" and "Transfer" phases, learners should be encouraged to evaluate multiple data interpretations and reflect on real-life applications. For instance, a lesson on basic taxonomy can begin with a flowchart of the Linnaean system of taxonomy (structured), followed by an observing local species, identifying its characteristics and end with students designing an infographic or presentation about evolutionary relationships.

In conclusion, the data supports the notion that STEM students prefer convergent thinking strategies that are organized, logical, and evidence-based, yet they also benefit from tasks that foster engagement and meaningful application. Teachers can use this insight to design REACT-aligned lesson exemplars that maintain a balance of rigor and relevance. By doing so, instruction becomes both cognitively aligned with student preferences and pedagogically sound, fostering deeper learning and scientific literacy among STEM learners.

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Table 6. Learner's Thinking Style in Terms of Divergent

Indicators	Mean	SD	Verbal Interpretation
1. I like to think of creative ways to explain biology concepts to others.	3.15	0.67	Preferred
2. I actively seek out new experiences during biology activities.	3.33	0.53	Preferred
3. I enjoy group discussions where everyone can share different perspectives on a biology topic.	3.49	0.60	Preferred
4. I enjoy creating models or drawings to represent complex biological processes.	3.38	0.88	Preferred
5. I prefer open-ended activities in biology, like designing experiments or projects.	3.72	0.51	Highly Preferred
Over-all	**3.42**	**0.67**	**Preferred**

Legend: 3.50 – 4.00 Highly Preferred, 2.50 – 3.49 Preferred, 1.50 – 2.49 Not Preferred, 1.00 – 1.49 Strongly Not Preferred

Based on the results presented in Table 6, the Grade 11 STEM students exhibited a strong inclination toward divergent thinking, with an overall mean of 3.42 interpreted as "Preferred". It includes exploring creative, open-ended activities and student-centered learning environment, such as designing projects or experiments. Students benefit from the activities that show their innovation and creativity. While students preferred divergent thinking, a balance approach with convergent strategies can help to ensure mastery of lesson while fostering scientific creativity.

Among the five indicators measured, the highest-rated item was indicator 5 with a mean score of 3.72, classified as "Highly Preferred." This suggests that students find motivation and engagement in tasks that allow creative freedom, exploration, and the application of their own ideas which is hallmarks of divergent thinking. The preference for open-ended tasks likely stems from the inherent curiosity and investigative mindset nurtured in the Grade 11 STEM strand, where solving complex, real-world problems is a core focus. In contrast, the lowest-rated indicator was indicator 1 which received a mean score of 3.15, still within the "Preferred" range but relatively lower than the rest. This could be attributed to students' varying confidence levels in expressing abstract or technical biological concepts creatively, especially in peer-to-peer settings. While students may be eager to explore and create, explaining their thoughts in novel ways may not be as intuitive or may require more support and structured practice. This gap highlights an area where instructional scaffolding may be necessary to foster communication skills along with scientific creative thinking.

The comparison between the highest and lowest indicators reveals that while Grade 11 STEM students are highly engaged in hands-on, exploratory, and design-based science activities, they may need further encouragement in the reflective and expressive aspects of learning. Activities that promote design thinking, such as student-led investigations, project-based learning, and real-life simulations, align well with their preference for open-ended tasks. However, integrating reflective discussions, peer-teaching strategies, or online simulation may help improve their ability to creatively articulate biological ideas.

These insights strongly support the integration of the REACT Framework (Relating, Experiencing, Applying, Cooperating, and Transferring) into the development of lesson exemplars. For example, designing a lesson on environmental biotechnology could start with a local issue (Relating), move into lab simulations or community observations (Experiencing), involve designing a simple biotechnological solution (Applying), include peer feedback and group refinement (Cooperating), and conclude with a reflection or communication task where students present their ideas to a wider audience (Transferring). In this way, lessons become multi-dimensional and cater to a broader range of divergent thinking traits.

In conclusion, the findings indicate that Grade 11 STEM students benefit most from science instruction that empowers them to explore and innovate. Developing lesson exemplars grounded in the REACT framework will allow teachers to cater to students' strong preference for open-ended, meaningful activities, while gradually building their competence and confidence in creatively communicating science. This dual focus not only nurtures scientific creativity but also prepares learners to solve complex biological problems in both academic and real-world contexts.

Table 7. Exposure to REACT in Terms of Relating

Indicators	Mean	SD	Verbal Interpretation
1. I can connect biology concepts to real-life situations.	3.44	0.50	Exposed
2. I can relate prior knowledge to new concepts during biology class.	3.21	0.47	Exposed
3. I can make connections between different processes to generate ideas.	3.13	0.34	Exposed
4. I can use analogies or comparisons to explain biology concepts.	3.08	0.27	Exposed
5. I can identify patterns or relationships in science systems.	3.23	0.43	Exposed
Over-all	**3.22**	**0.42**	**Exposed**

Legend: 3.50 – 4.00 Highly Exposed, 2.50 – 3.49 Exposed, 1.50 – 2.49 Slightly Exposed, 1.00 – 1.49 Not Exposed

Based on the results shown in Table 7, learners demonstrated an overall exposure level of 3.22, interpreted as "Exposed", to the “Relating” component of the REACT framework. This suggest that students can relate biology concepts in real life situations. Exposure to analogies, comparisons of species help students think metamorphically and infer relationships which are foundations to scientific creativity. While STEM student exposed to this component, teachers may integrate activities into project-based or inquiry-based science activities.

Among the five indicators, the highest mean (3.44) was recorded near to the threshold for “Highly Exposed.” This suggests that Grade 11 STEM students find value in seeing the relevance of biology lessons in their daily lives, and they can contextualize concepts such as taxonomy and evolutionary relationships within real-world scenarios. For instance, when identifying unique characteristics of a taxon of native species like Philippine Eagle (*Pithecophaga jefferyi*), and Philippine Tamaraw (*Bubalus mindorensis*) students could relate to the important of this species important in the Philippines.

On the other hand, the indicator 4 with the lowest mean of 3.08 was still classified as “Exposed,” the relatively lower rating implies that learners may struggle with abstracting biological concepts and transforming them into relatable metaphors or analogies. Some of the students experience challenging moment in sharing unique species in their local community and discuss its characteristics. Moreover, some of the students allotted more time in preparing observable differences of local species that highlights the physical characteristics, habitats, and behaviors of a species. This is particularly relevant when teaching complex lessons in Biology such as cladistics or species diversity, where understanding branching evolutionary relationships requires a conceptual leap. The challenge may arise from limited opportunities or guided instruction in translating scientific ideas into familiar terms, such as comparing a cladogram to a family tree.

The contrast between the highest and lowest indicators highlights a key instructional insight: while STEM students are comfortable applying biological ideas to concrete real-life examples, they may not yet possess the cognitive scaffolding to creatively restructure information through analogies. This affects their ability to explain and internalize more abstract concepts, which are crucial when discussing differences between local species or classification criteria among taxa. This gap suggests a need for enhanced learning strategies in Biology that embed analogy-based exercises and comparison activities to improve student conceptualization.

Considering this, a lesson exemplar guided by the REACT framework for the learning competencies STEM_BIO11/12IIIhj-15 and STEM_BIO11/12IIIhj-16 should include opportunities to relate taxa classification and cladistics to locally familiar organisms and environmental settings (Relating). Lessons should begin with real-world applications, such as identifying distinct traits among local species in the Philippines, and progress toward abstract comparisons using analogies (e.g., linking cladograms to family histories). Integrating lectures, diagram-building, and analogy-generation exercises will help students move from basic recognition to deeper conceptual understanding and retention. Such structured REACT-based exemplars will empower science teachers to nurture more meaningful and sustained learning.

Table 8. Exposure to REACT in Terms of Experiencing

Indicators	Mean	SD	Verbal Interpretation
1. I can do hands-on activities in Biology.	3.62	0.54	Highly Exposed
2. I can do experimentation in General Biology 2 that enhances my problem-solving skills.	3.67	0.48	Highly Exposed
3. I can explore new ideas in Biology because of practical experiences in the lab.	3.74	0.44	Highly Exposed
4. I can use models or diagrams to visualize and generate solutions.	3.38	0.49	Exposed
5. I can observe Biology phenomena in experiments that inspire innovative thinking.	3.21	0.41	Exposed
Over-all	**3.52**	**0.51**	**Highly Exposed**

Legend: 3.50 – 4.00 Highly Exposed, 2.50 – 3.49 Exposed, 1.50 – 2.49 Slightly Exposed, 1.00 – 1.49 Not Exposed

Based on the findings presented in Table 8, learners demonstrated an overall exposure level of 3.52, interpreted as "Highly Exposed", to the experiencing" component of the REACT framework. The results from the table imply that Grade 11 STEM students who are highly exposed to this component have enhanced their problem-solving skills through hands-on activities and have explored new ideas in Biology. This suggest that instructional strategies employed promote problem solving, innovation and exploration of biological concepts through hands-on experiences.

Moreover, the highest indicator is statement number 3 with a mean score of 3.74, which is verbally interpreted as “Highly Exposed.” This suggests that learners are highly exposed when given opportunities for discovery and exploration through practical activities. Students experienced to create a phylogenetic tree using a provided data of DNA sequences of several species using a website. Exposure to hands-on activities appears to stimulate curiosity and deeper understanding, particularly when students are allowed to form hypotheses, conduct observations, and analyze results independently. In the context of learning about distinctive characteristics of taxa and cladistics, practical exposure such as observing physical traits and create a cladogram, enriches their conceptual knowledge and appreciation for biological diversity.

In contrast, the lowest-rated indicator was indicator which received a mean of 3.21, verbally interpreted as “Exposed.” While still positive, this score implies that although students are exposed to hands-on activities, these do not consistently promote higher order thinking or innovation. This discrepancy may stem from the structure of the laboratory exercises, which might be too guided or confirmatory in nature rather than inquiry based. This is critical in teaching evolutionary relationships, where encouraging students to formulate their own questions and derive evidence-based conclusions could enhance their analytical and evaluative thinking.

This disparity between the highest and lowest indicators underscores a need to shift laboratory experiences from traditional procedural tasks to experiential learning that nurtures innovation. Students already express enjoyment in discovering new concepts through laboratory activities, but their ability to connect those experiences to creative problem-solving or design thinking is not maximized. For example, after studying species diversity, learners might be asked to create their own cladogram based on observable characteristics and hypothesize evolutionary links using simulated or real data. This allows them to apply new ideas in meaningful and personally relevant ways.

Student reflections and classroom performance reveal that learners excel when given autonomy in the lab, such as designing their own procedures, comparing traits among organisms, or applying genetic data to infer evolutionary pathways. However, limitations in time, resources, and rigid protocols often constrain these opportunities. Teachers should aim to incorporate guided-inquiry or open-inquiry strategies that promote student-led investigations in line with the REACT framework’s “Experiencing” principle. This supports creativity, decision-making, and ownership of learning.

To address this, lesson exemplars aligned with the REACT framework should focus on maximizing experiential learning. For instance, in teaching cladistics, the lesson could involve online simulations or interactive science activities where students classify unknown species using observable traits and molecular evidence, encouraging exploration, modeling, and synthesis of data. Teachers may incorporate collaborative lab stations where learners rotate through evolutionary evidence types (morphological, molecular, fossil records) and formulate their own evolutionary trees. Such lesson exemplars not only reinforce scientific content but also cultivate critical thinking, a deeper understanding of biological systems, and a mindset of innovation among STEM learners.

In this research, the use of hands-on activities in General Biology 2 lessons are widely recognized as strategy for enhancing scientific creativity and related skills. Exposing Grade 11 STEM students in active, experiential learning—such as laboratory experiments, modeling or creating a poster, and open-ended tasks can significantly boost creative thinking, scientific attitudes, and interest in systematics based on evolutionary relationships specifically for taxonomy and phylogeny under General Biology 2.

Table 9. Exposure to REACT in Terms of Applying

Indicators	Mean	SD	Verbal Interpretation
1. I can apply theories in creative ways to solve new problems.	3.08	0.27	Exposed
2. I can develop innovative solutions to challenges by applying classroom knowledge.	3.23	0.43	Exposed
3. I can creatively apply concepts to real-world environmental issues.	3.41	0.50	Exposed
4. I can use concepts in projects to generate creative outcomes.	3.21	0.41	Exposed
5. I can incorporate creativity in writing reports or presentations related to topics.	3.21	0.47	Exposed
Over-all	**3.23**	**0.43**	**Exposed**

Legend: 3.50 – 4.00 Highly Exposed, 2.50 – 3.49 Exposed, 1.50 – 2.49 Slightly Exposed, 1.00 – 1.49 Not Exposed

The results presented in Table 9, exposure to REACT in terms of Applying, revealed meaningful insights with an overall mean of 3.23 into how STEM students engaged with the REACT framework during lessons that focused on identifying the unique characteristics of taxa and exploring species diversity and cladistics. This suggest that the students exposed to relating can apply theories in solving problems, develop innovative solutions to challenges by applying lessons learned and creatively apply concepts from the lesson to the real-world environmental issues as performed by the students during the implementation of this study.

The highest indicator in terms of mean score was indicator 3 with a mean of 3.41, The high score for applying concepts to real-world environmental issues suggests that STEM students are better at contextualizing classroom knowledge when it directly relates to tangible, authentic problems. During the lesson on binomial nomenclature system where students analyze a case study of local species using morphological and genetic data, students were likely more engaged when tasked with evaluating evolutionary relationships using real-life environmental data or case studies of local species. This reflects the strength of the REACT framework in fostering relevance and transfer of knowledge to real-life contexts. Grade 11 STEM students may have found it more intuitive to link evolutionary traits and classifications to ecological scenarios, thus enhancing creative application.

In contrast, the lowest-rated indicator points (3.08) to a need for improved instructional strategies when encouraging students to use theories in solving Biology problems. Applying theories creatively involves higher order thinking skills that may require more scaffolding, especially in abstract topics like evolutionary relationships. One example is the activity about analyzing local study entitled "Understory to canopy vertebrate fauna of a lowland evergreen forest in Mt. Makiling Forest Reserve, Philippines". While students may understand and replicate learned procedures (e.g., listing down species characteristics and habitat), they may struggle to extend this understanding into unfamiliar problems that require innovative thinking. This gap underlines a need for teachers to incorporate more open-ended inquiry tasks where students design their own classification systems or theorize evolutionary links using diverse evidence types such as molecular data or morphological traits.

The consistency in mean scores for the middle three indicators ranging from 3.21 to 3.23 suggests that STEM students are exposed to applying knowledge creatively in structured formats such as projects and reports. This consistency implies that while students are given opportunities to demonstrate creativity, these are likely scaffolded or guided rather than open-ended. In lessons dealing with taxonomic distinctions and species diversity, students may perform well when given templates or formats for reports and presentations but might not fully engage in deeper cognitive transfer unless

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explicitly prompted. This could reflect a gap between creative expression and true application of conceptual understanding.

Given these insights, lesson exemplar should integrate activities that allow students to solve real-world biodiversity challenges, such as designing conservation plans based on evolutionary lineage, while also pushing them to apply theoretical constructs in novel contexts, such as constructing hypothetical cladograms for unknown species. This dual approach ensures balanced cognitive engagement, fostering students' ability to think critically and creatively key competencies in STEM education. The lesson exemplar should include formative assessment strategies, real-life case studies, and project-based learning tasks to bridge the gap between the lowest and highest indicators, thereby enhancing the holistic implementation of the REACT framework.

Table 10. Exposure to REACT in Terms of Cooperating

Indicators	Mean	SD	Verbal Interpretation
1. I can collaborate with my classmates to inspire new ideas in activities.	3.56	0.50	Highly Exposed
2. I can work in group in science to build on others' ideas.	3.69	0.47	Highly Exposed
3. I can contribute to different solutions during group problem-solving in Biology.	3.36	0.54	Exposed
4. I can tackle Biology problems through brainstorming sessions with peers.	3.28	0.56	Exposed
5. I can support and encourage members to participate group discussions during Biology class.	3.41	0.59	Exposed
Over-all	**3.46**	**0.55**	**Exposed**

Legend: 3.50 – 4.00 Highly Exposed, 2.50 – 3.49 Exposed, 1.50 – 2.49 Slightly Exposed, 1.00 – 1.49 Not Exposed

The findings from Table 10, Exposure to REACT in terms of Cooperating, reveal insightful trends with an overall mean of 3.46. It suggests that Grade 11 STEM students tend to work together, contribute different thoughts, during brainstorming or activity discussions and address problems collaboratively during science activities. Moreover, the cooperative learning is integrated in the lesson and students participated in group discussions and activities like creating infographic and conducting a gallery walk about taxonomy and phylogeny. This component help improved student's engagement, scientific communication, and teamwork.

The highest-rated indicator was indicator 2 with a mean of 3.69. The high score for building on others' ideas during group work shows that Grade 11 STEM students have a collaboration during activities. In activities like gallery walk, students probably found it useful to pool their knowledge and build on shared understanding of biological concepts. Students may have benefited from peer explanations of how to interpret derived traits which aligns with the REACT framework's emphasis on collaboration and relevance. This shows that cooperative learning can be a key driver for conceptual clarity in complex biology topics.

In contrast, the lowest-rated indicator was indicator 4 scoring a mean of 3.28. The contrast between these two indicators points to nuances in collaborative engagement among Grade 11 STEM students. The lower mean score for brainstorming biology problems suggests that students may struggle during the ideation phase of group work. Brainstorming requires open-ended thinking and willingness to share ideas which can be tough in a high-status academic environment. In the context of lessons about species classification and cladistics, brainstorming might have been generating hypotheses about evolutionary relationships or creating classification schemes for unknown species. The lower score mean in Table 10 suggests that while Grade 11 STEM students can build on structured inputs, they may struggle with the unstructured, more creative aspects of collaboration.

A comparative analysis in Table 10 of the middle three indicators in contributing different solutions (3.36), supporting participation in group discussions (3.41), and tackling problems through brainstorming (3.28) shows that while Grade 11 STEM students are exposed to key cooperative behaviors, there is variability in how confidently they engage in lectures and activities. For example, contributing different solutions may be easier in tasks with defined outcomes (like filling out a cladogram), while encouraging students to participate may depend on classroom dynamics and teacher facilitation. These differences suggest that students benefit most when tasks are well-structured but still collaborative, and they may need additional scaffolding specially for science activities to fully embrace the exploratory and supportive aspects of cooperative learning.

Given these findings, the REACT lesson exemplar should include structured cooperative learning strategies to build students' confidence in collaborative creativity. For the taxonomic distinctions and cladistics lesson, teachers can use tiered group activities starting with small group analysis of species traits using clear data sets and moving to open ended brainstorming and cladogram creation with hypothetical species. Teachers should also use cooperative strategies like think-pair-share, group roles and utilization of collaborative digital platforms to encourage inclusive discussion and collective problem solving in science activities. By intentionally addressing both the strengths and gaps in student collaboration, the lesson exemplar in General Biology 2 can deepen STEM students' engagement with evolutionary biology and the broader REACT components.

Table 11. Exposure to REACT in Terms of Transferring

Indicators	Mean	SD	Verbal Interpretation
1. I can transfer creative problem-solving techniques from Biology to other subjects.	3.26	0.44	Exposed
2. I can apply science knowledge creatively to address issues in everyday life.	3.41	0.50	Exposed
3. I can adapt Biology concepts learned in class to develop innovative ideas outside the classroom.	3.15	0.37	Exposed
4. I can transfer creative skills in Biology to extracurricular projects or activities.	3.33	0.53	Exposed
5. I can use creative thinking from Biology to solve non-academic problems.	3.33	0.48	Exposed
Over-all	**3.30**	**0.47**	**Exposed**

Legend: 3.50 – 4.00 Highly Exposed, 2.50 – 3.49 Exposed, 1.50 – 2.49 Slightly Exposed, 1.00 – 1.49 Not Exposed

The data presented in Table 11, Exposure to REACT in terms of Transferring, showed an overall mean of 3.30 that reflects how well Grade 11 STEM students in the General Biology 2 class were able to transfer their knowledge and generalize their information and draw connections across disciplines and contexts, resulting in long-term retention and adaptation. However, the data also reflects that exposure in terms of transferring is not yet enough to interpret as highly exposed. This suggests for the improvement in designing activities that will enhance students' way of transferring knowledge based on the lessons learned and activities experienced.

The highest-rated indicator was indicator 2 with a mean of 3.41. The results suggest that students are becoming more interested at seeing how biological concepts can apply to everyday situations. Students are asked to develop a poster depicting the diversity of their assigned kingdom out of recyclable and indigenous materials. Perhaps they have found it stimulating and useful to explore evolutionary relationships in real world case studies and develop an interest for applying their scientific knowledge outside the classroom.

In contrast, lowest-rated indicator with a mean of 3.15, reflects a void that students have in their capability to innovate with biological ideas in new or nontraditional settings. Within the context of the lesson, students are encouraged to design an outreach project for their community on the importance of taxonomy and biodiversity. Students would have identified the relevance of evolutionary ideas to real-world issues including disease spread, habitat destruction and species decline. While they might understand and explain the distinctions between taxa or the process of creating a cladogram, adapting this knowledge to develop new, innovative ideas (e.g., using classification principles in app design or environmental planning) proves to be more difficult. Though they might accept to comprehend how to explain different taxa or how to make a cladogram, the way in which they can bring these concepts together in novel ways (e.g., to use principals of classification in app design or environmental planning) becomes a challenge. This indicates that, whereas students are able to apply learned content to familiar situations, they need more structured experiences to develop their ability to engage in divergent thinking and creativity. It suggests a possible limitation of the "Transfer" component of REACT, at least in lessons that do not explicitly encourage students to move over the boundary between established academic knowledge and novel use of this knowledge.

Other indicators fall between these extremes, such as the ability to use biology knowledge to solve non-academic problems (3.33) or apply skills in extracurricular settings (3.33). These findings demonstrate a reasonable level of exposure and imply that students can use their understanding of biology in a creative way outside of the classroom. The comparatively consistent reading of "Exposed" across all indicators, however, emphasizes the necessity of a more deliberate and constant emphasis on transfer abilities in STEM education. It's possible that while existing lessons expose students to applications, they fail to advance sufficient levels in enabling them to come up with original ideas or use biological reasoning to solve challenging, heterogeneous problems.

These results highlight the necessity of a REACT framework lesson exemplar that specifically includes transfer opportunities. Tasks like real-world problem scenarios where students must apply classification systems to conservation efforts or estimate the influence of environmental changes on species diversity should be incorporated into lessons teaching taxonomic identification and cladistics. Additionally, students could be assigned assignments that apply the concepts of biological categorization to commonplace decision-making, including classifying digital data or comparing consumer goods according to attributes. Encouraging students to explain how biology influences decisions outside of the classroom promotes critical and creative thinking, two essential components of STEM education.

In order to optimize the REACT framework's efficacy, the lesson exemplar must support students' recognition, adaptation, and innovative application of biological information. Instructors should lead their students in observations and conversations about how understanding evolutionary linkages might affect practical thinking in fields like environmental management and medicine. The lesson can be created to bridge academic knowledge with life skills by directly addressing the data's indicated areas of strength and weakness. This will realize the revolutionary potential of the REACT framework in STEM education for the twenty-first century. It is highly effective in encouraging scientific creativity by connecting biology teachings to real-world scenarios using active, project-based, and technologically enhanced approaches. These methods not only help students think more creatively and solve problems, but they also make biology more interesting and applicable to their daily lives. Scientific creativity is greatly enhanced by contextualized lessons that promote information transfer and employ innovative, student-centered methodologies. Lastly, teachers are essential to the creation and execution of contextualized lessons, and their professional growth is critical to enhancing students' creativity and science process abilities.

Table 12. Students' Pre- and Post-Performance Levels in Scientific Creativity

Score	Post-Performance Level				
	f	**%**	**f**	**%**	**VI**
17-20	0	0.00	14	35.90	Very High
13-16	6	15.38	24	61.54	High
9-12	21	53.85	1	2.56	Moderate
5-8	12	30.77	0	0.00	Low Mastery
1-4	0	0.00	0	0.00	Very Low
Total	39	100.00	39	100.00	

Presented in Table 12 is the pretest and posttest results, the pretest reveals that prior to the application of the REACT framework, twenty-one STEM students (53.85%) were categorized as moderate in the level of scientific creativity in their previous lesson and only 15.38% got a high level of scientific creativity. These findings indicate that a substantial portion of the Grade 11 STEM class was performing below the desired academic standards. Based on the item analysis of students' pre-test scores, questions number 3, 9, 18 and 20 got the lowest score. Students unable to correctly answer the questions that was based on analyzing member of the group within lineage with shared derived characteristics, identifying kingdom based on its characteristics, type of cladistics in classifying an organisms and principle in examining cladogram that illustrates the evolutionary relationships of primate. The concentration of Grade 11 STEM students in the lower levels of scientific creativity suggests the need for innovative teaching strategies to bridge learning gaps and enhance understanding before intervention.

In contrast, the posttest results of Grade 11 STEM student's performance increases following the implementation of the REACT framework. A total of 35.90% of students categorized with very high level of scientific creativity in the two weeks implementation of the lesson. Most of the students are able to explain how the structural and developmental characteristics and relatedness of DNA sequences are used in classifying living things and identify the unique/ distinctive characteristics of a specific taxon relative to other taxa.

Furthermore, there are no Grade 11 STEM students categorized as low level of scientific creativity during and after the implementation of the REACT framework in General Biology 2 lesson. It was observable based on the implementation that before the use of REACT framework, most of the students does not have prior knowledge This upward shift across high levels of scientific creativity reflects the positive impact of the REACT approach in helping students better understand and apply concepts. The increase in higher-level scientific creativity indicates that the contextualized and experiential learning strategies embedded in the REACT framework successfully engaged Grade 11 STEM students and supported deeper learning in General Biology 2 lesson.

Likewise, the comparative analysis of the pretest and posttest performance levels in scientific creativity clearly demonstrates that the use of the REACT framework has been effective in increasing Grade 11 STEM students' posttest scores. There was an increase in the number of students achieving proficient and highly proficient levels, alongside a reduction in those categorized as low proficient. This suggests that by contextualizing lessons in General Biology 2 by using available local resources offline and online, encouraging hands-on activities using local materials, promoting application from lesson to real life situations, fostering cooperation during group activities, and enabling knowledge transfer from one activity to another, the REACT framework has contributed meaningfully to enhanced student learning outcomes and the level of scientific creativity.

Table 13. Test of Difference between Pretest and Posttest Scores Performance of the Grade 11 STEM Students Exposed to REACT Framework in to Scientific Creativity.

variable	**Pre**		**Post**		**t**	**df**	**Sig. (2-tailed)**
	Mean	SD	Mean	SD			
Performance	9.67	2.29	15.21	2.38	-40.517	38	0.000

P < .05 - Significant

The Grade 11 STEM learners assessed using a 20-item pretest and posttest, aligned with the content standards and MELC of General Biology 2 Quarter 3 and the guidelines in crafting a test question using PISA framework and HOTS-SOLO and integrated to REACT framework. The tests focused on learners' understanding of taxonomic concepts and their ability to apply these principles in scientific scenarios. The results in Table 13 demonstrate a statistically significant difference in students' performance before and after the exposure to REACT framework. The computed t-value of -40.517 and a p-value of 0.000 ($p < 0.05$) indicates a highly significant improvement in Grade 11 STEM student performance. Based on the findings of this study, the researcher observed that the low pretest scores were due to the students' limited prior knowledge of the lesson on taxonomy and phylogeny, despite having been introduced to these concepts in Grade 8. The 20-item multiple-choice test was based on the Most Essential Learning Competencies (MELC) for Weeks 5–6 under General Biology 2. After two weeks of implementing the contextualized lesson using the REACT framework, the posttest scores of the Grade 11 STEM students showed a significant increase. The same result in a study presented where students pre-test results met low criteria caused by learning habit and post-test results enhanced after the implementation of contextual and authentic learning method [15]. Moreover, previous study showed that there is a substantial difference between the mean pre- and post-assessment scores for students exposed to an integrated teaching technique in terms of their learning and innovation abilities [16].

The findings in Table 13 indicate that the student's exposure to REACT framework had a significant positive impact on students' performance in General Biology 2. The high t-value and very low p-value suggest that the improvement in mean scores was not due to random chance, but rather the result of the teaching intervention using contextualized lesson that includes different set of activities aligned to the lesson objectives of binomial nomenclature system and phylogenetic tree. The experiencing and cooperating components of the REACT framework that is integrated to the lesson exemplar supported the enhancement of student's performances. Integrating technologies like virtual simulations and interactive platforms enables students to visualize and experiment with biological concepts, linking familiar ideas to novel scenarios and enhancing creative abilities [17]. Relating old lessons to new experiences by contextualizing lesson in General Biology 2, especially through inquiry, collaboration, and use of low and high technology like presenting video from YouTube, is a one way to enhance students' scientific creativity.

Likewise, students' interest in biology increases when they participate in hands-on activities, especially when these experiences are of high quality and align with their interests [18]. The quality and design of hands-on experiences are crucial and well-designed activities that are engaging and relevant are more likely to foster both interest and creativity. Moreover, the application of tools like virtual reality, augmented reality, and interactive simulations creates immersive and engaging experiences [17]. These technologies like database from National Library of Medicine and Co's Digital Flora of the Philippines support the application of student's knowledge to develop an understanding of taxonomy by identifying characteristics of specific taxa. This is related to the study where the availability of science materials and hands-on experiences are one of the factors that contribute to the interest and creativity of the students [19].

When collaborative projects are implemented in a science laboratory activity it helps students to learn from a variety of perspectives, hone their interpersonal skills, and combine their abilities to tackle complicated issues more quickly and effectively [20]. Moreover, the supportive learning environment that encourages risk-taking and values creative contributions fosters scientific creativity [21]. The contextualized lessons help students develop coherent mental maps of scientific concepts, making it easier to transfer knowledge to new contexts and problems [22]. This transfer is facilitated when lessons are designed around real-life or socially relevant situations. This suggests meaningful learning is occurring, though further reinforcement may help solidify scientific creativity of the students.

Previous study found that REACT improves learning outcomes, especially for students with strong critical thinking skills, when compared to conventional methods [23]. However, while the REACT framework significantly boosts science achievement, its practical implementation poses certain challenges that must be addressed to maximize effectiveness [11]. Research supports that contextualized lessons tailored to students' needs can enhance scientific creativity in biology, especially when evaluated through pre- and post-tests. The observed gap between pretest and posttest scores confirms that using contextualized content and innovative instructional strategies effectively promotes scientific creativity among Grade 11 STEM students. This aligns with previous study which affirm that localizing and contextualizing lessons and activities significantly contribute to students' learning outcomes and academic development [24, 25].

Overall, the results indicate that the use of contextualized lessons and exposing students to REACT framework affects the level of scientific creativity among Grade 11 STEM students. This approach also supports improved conceptual understanding and increased student engagement in the lessons and activities of General Biology 2.

Table 14. Test of Relationship Between Students' Exposure and Post-Performance Level

Variables	Post-Performance Level
Relating	-0.031
Experiencing	0.113
Applying	-0.091
Cooperating	0.022
Transferring	-0.195

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

Table 14 presents the correlation coefficients between the five components of the REACT framework, the Relating, Experiencing, Applying, Cooperating, and Transferring and the Grade 11 STEM students' post-performance levels. Although there have been no statistically significant relationships between each of the REACT components and the post-performance of the Grade 11 STEM students, this does not mean that their participation had no significance. Based on the observation, the scientific creativity of Grade 11 STEM students from the 2 weeks implementation of contextualized lesson exemplar improved. However, their level of exposure is not only linked to one part of the REACT framework. Instead, it is affected by several factors such as students' performance and study habits.

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Furthermore, individual Grade 11 STEM student variations that may mediate or moderate the impacts of each component, such as prior knowledge, learning styles, or cognitive performance, may be the cause of the absence of significant correlation between the student's exposure to REACT framework and post-performance level of scientific creativity. It is also possible that Grade 11 STEM students engaged with the five components in various ways or that some phases like transferring need more practice and reinforcement before the outcomes are noticeable in performance evaluations.

Exposure of students towards REACT framework was mentioned in several studies. The relatively weak or neutral relationships may be influenced by the fact that for many of the Grade 11 STEM students' contextualized approaches are already implemented in other subjects or lesson which gives it another interpretation. However, REACT framework expands rather than initiates critical and creative thinking skills. Its systematic course gives students the possibility of associating ideas between them and strengthens what they already know. It serves as a scaffold in this way, assisting students in drawing connections between the material covered in class and real-world situations, a crucial ability for scientific innovation.

In the final analysis, the implications of applying the REACT framework are encouraging even though the data does not reveal statistically significant relationships. The framework provides a multifaceted strategy that stimulates transfer of information, collaboration, and curiosity. Such components are essential for producing scientifically innovative students who can evaluate, synthesize, and apply information to new contexts. As a result, the REACT framework continues to be a useful teaching tool for encouraging student participation and creativity in science education. Overall, while the REACT framework led to an improvement in performance (as seen in previous tables), the absence of significant correlations suggests that the individual components may not independently predict performance gains. This could imply that it is the holistic and integrated nature of the REACT framework, rather than isolated components, that drives student success.

4. CONCLUSIONS AND RECOMMENDATIONS

The conclusions are summarized in this chapter that were reached about the data. Additionally, it provides actionable suggestions that teachers, researchers, and other interested parties may find helpful in enhancing scientific creativity. This chapter's objective is to summarize the knowledge gathered from the study and offer practical suggestions for research studies.

4.1. Conclusions

The study reveals that there is a significant difference in the students pre- and post- performance after their exposure to the REACT framework into their scientific creativity. Thus, the null hypothesis posited in the study is not sustained. As to the test of the significant relationship between students' exposure to the REACT framework and their post-performance level in scientific creativity, the study revealed no significant relationship. Therefore, the null hypothesis between the two is supported.

The conclusion suggests that the REACT framework is effective in enhancing students' scientific creativity, as evidenced by the significant improvement in their post-performance. However, since no significant relationship was found between the level of exposure to the REACT framework and to the students' scientific creativity, this implies that while REACT contributes to learning gains, other factors such as individual learning styles, engagement, or prior knowledge may also play a key role in influencing students' creative performance. This highlights the need for a more holistic approach in designing lesson exemplar.

4.2. Recommendations

Here are the recommendations to guide future researchers in addressing the research gap of this study.

1. Future researchers and teachers should explore the use of differentiated, contextualized lesson plans that accommodate varying levels of prior knowledge and cognitive performance. By placing a strong emphasis on pretests, learning gaps can be found and activities can be modified to help underachievers and enhance the development of scientific creativity in high-achieving students.

2. Future studies are advised to think about creating lessons that purposefully balance tasks requiring both divergent and convergent thinking. Researchers might look into how students' engagement and understanding of difficult biology ideas can be enhanced by combining organized reasoning with creative inquiry.
3. All REACT framework's components should receive equal attention from researchers and teachers, with a special emphasis on experiential, real-world, and collaborative components. Future research could examine whether REACT components improve students' creativity and comprehension the most.
4. The REACT-based contextualized lessons should be expanded and replicated in additional senior high school strands and specialized subjects by future researchers. Longitudinal studies that assess REACT's long-term effects on students' scientific creativity beyond a single academic quarter are also advised.
5. This study should serve as a basis for teachers and researchers to create multimedia-integrated, inquiry-rich lesson exemplars that complement the REACT framework. Future studies can also look at how well individual REACT components work to improve particular creative thinking abilities.
6. Future studies may examine how learner profiles (such as motivation and cognitive styles) affect the effect of REACT framework on scientific creativity. Teachers who use the framework should do so holistically and consistently across topics.

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