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Development of Project-Based Assessment Activities in Learning Science

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Abstract

Based on the outcome of the first to fourth quarter assessments, which served as the basis of the developed project-based learning activities, the researchers conducted this study due to the need to objectively evaluate student learning in Science courses. There is a noted deficiency in the scores as seen on the least mastered learning competencies for grade 10 students in Earth Science, Biology, Chemistry, and Physics in the public secondary schools of General M. Natividad. The study's concentration was on the perceived effectiveness of the designed activities in Science courses. It was conducted within the jurisdiction of DepEd General M. Natividad, Division of Nueva Ecija. The respondents were 30 Science teachers of the six public secondary schools in the district, namely: Azarcon Integrated School, Mataas na Kahoy High School, Talabutab Norte National High School, Eduardo L. Joson Memorial High School, Virginia Dulay Integrated School, and General Mamerto National High School. The development of Project-Based Activities was based on the ADDIE model developed by the Center of Educational Technology, which has five steps specifically: Analysis, Design, Development, Implementation, and Evaluation. Based on the findings of this study, the following conclusions were drawn: (1) The developed project-based learning activities in Science were found in 4 stages: Analysis, Design, Development, and Evaluation. (2) The developed project-based learning activities were believed to be effective, as the teachers strongly agreed with the parameters stated for each category. (3) The designed Science project-based learning activities were verified based on the evaluative ideas and recommendations of the validators. Recommendations and suggestions of the validators were incorporated into the development of project-based activities for learning Science.

Keywords: *Developed Project-based activities, assessment of Project-based activities, Science Project-based activities*

INTRODUCTION

When it comes to Science courses, where students need more hands-on experience to comprehend the context of each idea, modules and online instructions alone may not be able to meet their demands. Meanwhile, various approaches are shifting away from conventional teaching methods and toward more creative inquiry that foster students' scientific and critical thinking skills. Teachers and students must cooperate to achieve the same objectives to enhance and promote hands-on education.

According to the K–12 Curriculum Guide Science 2013, the science curriculum is intended to produce scientifically literate citizens who are informed and active members of society, responsible decision-makers, and apply scientific knowledge that will significantly impact society and the environment. The curriculum uses learning strategies, including inquiry-based learning methodologies, to include students in the learning process. Students were instructed in concepts and abilities using a method that successfully supports the development of their cognitive, emotional, and psychomotor domains. The scientific curriculum's main goal is to help students become more proficient in each of the three learning areas. These include, among other things, the capacity to carry out scientific practices and abilities, grasp and apply scientific information, and develop scientific attitudes and values.

Sadly, it has had to deal with the COVID-19 outbreak since the start of 2020, which has wreaked havoc around the globe, particularly in the Philippines, disrupted people's lives and livelihoods, and sparked widespread fear. Due to the restrictions put in place to stop the spread of the novel coronavirus, all enrolled students in the schools, colleges, and universities in the Philippines have been unable to attend their respective institutions for over two years since the middle of March 2020.

Since the pandemic, there have been further problems. Therefore, while teaching science, the instruction should be more inclined toward more innovative instructional strategies like project-based learning (Cardaba, 2020). Students react positively to studying science because they sense more understanding, which increases motivation and learning interests, according to Bhakti et al. (2020). Similarly, project-based learning may help students regulate their learning attitudes and habits and improve their sense of self-efficacy (Tsai-Yun Mou, 2020).

This research concentrated on creating project-based activities and evaluating them in light of the abovementioned awareness. It was evident that project-based teaching and learning worked well in the face-to-face science class. It gave learners in a learning community access to relevant experiences, promoted a culture of creativity, and gave them influence (Pam Grossman, 2019). Thus, it is important to assess the benefits of studying science broadly to meet the expanding demands of our grade 10 students in the K-12 Education Program.

Project-based learning Assessment

Project-based learning (PBL) is a learning technique founded on constructivism (Hmelo-Silver, 2004), which was initially suggested by John Dewey at the end of the 1890s and has been widely used since then (Douglas and Stack, 2010). Dewey's theory was child-centered, and he incorporated real-life circumstances and settings into the classroom environment to help students learn more effectively. Kilpatrick's ideas were further refined in his book *The Project Method*, published in the early 1900s and published in English in 1918. The project-based learning (PBL) model has since been developed in depth and applied to a variety of educational disciplines and learning circumstances. As a result of such real-world applications, our understanding of PBL has been significantly expanded. A recent study by Hovey and Ferguson (2014) has revealed that there are numerous interpretations of problem-based learning with various overlapping terminology, such as problem-based learning, inquiry-based learning, problem-based learning, and the project approach, among others. Furthermore, both activity-based learning and discovery learning share many characteristics in common.

Practice-based learning (PBL) was previously defined by Holm (2011) as "student-centered instruction that occurs over an extended time period during which students select, plan, investigate, and produce a product, presentation, or performance that answers a real-world question or responds to an authentic challenge" (Holm 2011, p. 1). "A systematic teaching style that involves students in gaining information and skills via an extended inquiry process based around challenging, real questions as well as carefully created products and assignments," according to a prior, but more thorough description of PBL (Markham et al. 2003, p. 4). In contrast to the former definition, which places emphasis on student-centered learning processes, the latter definition places equal emphasis on the development of skills in addition to knowledge acquisition, as well as the critical task of planning, which includes task design and the complexity and authenticity of the questions. It is possible to gain insight into some of the challenges underlying current arguments over what constitutes PBL by comparing these two descriptions.

The ability of teachers to put their plans into practice in the classroom determines the effectiveness of project-based learning assessment. The use of project-based assessment activities by teachers has been proven to significantly impact students' knowledge of content and development of skills (Han, Yalvac, Capraro, & Capraro, 2015; Kokotsaki, Menzies, & Wiggins, 2016).

Because students practice and become skilled with twenty-first-century skills such as communication, negotiation, and teamwork, it fosters social learning in the classroom. The ability to make a decision is critical for kids' success. Differentiation enables students to explore their own interests while also pursuing deeper learning opportunities. PBL's active learning method takes into consideration the diverse learning styles and preferences of pupils. When we use PBL to teach children, we are allowing them to discover who they are as learners. It is critical for teachers to meet with students on a frequent basis to ensure that students are on track and that they are fully developing their ideas and abilities. Developing these abilities is essential for future success in both school and life. PBL has been shown to be an effective strategy for engaging students in real-world problems, according to research. Real-world projects allow students to have a deeper understanding of their subjects (Belle 2010).

Similarly, according to Hugerat's (2016) findings, students who learned sciences through project-based teaching strategies perceived their classroom learning climate as significantly more satisfying and enjoyable, with excellent teacher support and teacher-student relationships that were considerably more favorable than those of other students. The variations in views of the science classroom learning atmosphere between the experimental (project-based learning techniques) and control (non-project) groups might be explained by differences in the science teaching and learning strategies used in the two groups. A qualitative study conducted by Grant et al. (2011) revealed that five themes emerged from what influenced participants' projects and what they learned as a result of interviews, observations, and document collection. These themes were: (1) internal influences; (2) external influences; (3) beliefs about projects; (4) tools for technology-rich environments; and (5) learning outcomes and products.

Integration of project-based learning assessment in Science

When it comes to instructional models, project-based learning (PBL) is based on the constructivist approach to learning. This approach entails the construction of knowledge from multiple perspectives within a social activity and allows for self-awareness of learning and knowing while being context-dependent (Duffy & Cunningham, 1996). Thomas (2000) establishes five criteria for project-based learning: projects should be central to the curriculum, focused on problems that cause students to struggle with major concepts, involve students in constructivist investigation, be student-driven, and be realistic in their expectations of students. Furthermore, Grant (2002) describes how PBL implementation is characterized by the following characteristics: an anchor of the activity, a task, an investigation, the supply of resources, scaffolding, cooperation, and chances for reflection and the transfer of knowledge. PBL provides a number of advantages over other instructional models when it comes to the learning process. Teachers, on the other hand, face a number of difficulties. This literature review will focus first on the aims and advantages of PBL for learning and then on the obstacles that teachers face when implementing PBL in the classroom. This study aims to shed light on the issues students face when teachers implement project-based learning assessments in the school, particularly in times of pandemic.

Project-based learning is an educational strategy that has been shown to be effective because it allows students to take an active role in their own learning process. It is becoming increasingly popular. According to the findings of Shin (2018), project-based learning has a beneficial impact on students' motivation and may also help them improve their cooperative skills by encouraging them to work together. Students' impressions of project-based learning are quite favorable, as evidenced by their replies to a survey administered after the project was completed. It is recommended that further study be conducted to determine the benefits of project-based learning on students' motivation and self-efficacy at various levels, grades, and age groups. Although distinct viewpoints may exist in different situations, such as when modalities and teaching methodologies change, it is possible to have more than one perspective.

Science Curriculum in K-12

According to Lynch (2018), when it comes to encouraging deep learning in K–12 classrooms, one of the most common approaches is problem-based learning. As the title suggests, there is an issue right away. In this technique, pupils are given a problem that may be solved in any way they want. Students must search through a range of materials, referred to as trigger material, in order to gain a comprehensive understanding of the topic from all perspectives. Sample learners' performance is a declarative statement that specifies an action, a skill, and a result that students are expected to accomplish and achieve. These will show their comprehension of the subject as well as their ability to apply scientific concepts in a variety of situations. The majority of scientific education is so compartmentalized that students are seldom given the chance to establish connections that would help them get a more comprehensive grasp of the significance and applicability of science and technology in their daily lives. It is important to note that the scientific ideas for each curriculum area contain fundamental concepts in the field that have not changed through time and are comparable to notions present in many nations' basic education science curricula.

The topics taught in these science lessons are fundamental concepts that serve as a basis for students' development of a greater grasp of scientific knowledge as they advance through the curriculum from Grade 1 to Grade 10. The application of information and skills may begin with situations that are known to the learner. It is critical for children to engage in activities and experiences that allow them to make correct and compelling conceptual connections in order to succeed in school. As their inquiry abilities grow and as their capacity to access and apply ideas and information becomes more refined, they will be able to draw connections between these concepts and the applications to which they will be exposed. They begin to describe and explain the links between occurrences and events that seem unrelated at first glance. When students face a new concept or application, it is the science teacher's responsibility to assist them in making connections between what they currently know and the new concept or application. The scientific instructor should also assist students in transferring their knowledge and abilities to novel environments, which may be difficult (SEI-DOST & UP NISMED 2011).

Consequently of the COVID-19 epidemic, the move to distant teaching and learning presented a significant problem for both instructors and students, according to Lapitan et al. (2021). In their study, a blended learning method in the context of teaching and learning was utilized. They proposed an online method that aided in the transition from traditional learning to full-fledged online learning. Students are given the opportunity to study and move through learning at their own pace through the use of asynchronous teaching methods such as the broadcast of pre-recorded lectures from an online platform. The synchronous portion of the training was carried out through the use of video conferencing services such as Zoom or Google Meeting. Prior to implementing the method, the students were informed about it and engaged in discussion about it. Student learning experiences, academic performance, and instructor observations were used to evaluate the overall teaching and learning experience. The results of the research revealed that the technique had a beneficial influence on students as well as instructors. The dependability of the internet connection and the instructor's expertise with readily available internet-based teaching tools, such as video conferencing software, were both cited as obstacles to overcome. It was decided that teachers must generate income so that they can increase interactions with students and sustain student attention and engagement while teaching online. According to the results of the study, the majority of students are happy with the plan. Therefore, the technique is deemed to be a reasonable and successful option that may be modified to include complete online education. Further hybrid teaching in the post-COVID-19 period will benefit from their results and insights, which will provide valuable resources.

On the other hand, the move from traditional schooling to online learning during the COVID-19 epidemic caused significant disruption to official school instruction. According to Hira (2021), even if students and professors were at home, they maintained teaching and learning in a socially distant manner through the use of internet technology. Teachers and parents have also acknowledged a strong need for assistance in keeping pupils motivated and involved in learning activities throughout the year. As a result of the epidemic, online learning has left instructors and parents in need of assistance in developing learning activities that excite and engage kids in class. Project-based learning is a pedagogical method that is becoming increasingly popular. It involves students working cooperatively on projects as the teacher guides them through the learning activities and development. Project-based learning incorporates a number of variables that have been identified as essential to online learning motivation. When examining students' willingness to learn through online learning experiences, the researchers want to know how to build a strategy that presents itself as a candidate for learning during a pandemic.

Rather than depending exclusively on textbooks, instructors are urged to engage students in hands-on learning activities in order to pique their interest and encourage them to become active participants in their learning. School science should reflect a dedication to the establishment of a scientific-based culture throughout the school community. A culture of science is defined by high standards of performance, honesty, dedication, and discipline. Science education in schools should emphasize the close relationship that exists between science and technology, particularly indigenous technology. Science education in schools should acknowledge that science and technology reflect, influence, and form our cultural values. The scientific curriculum should acknowledge the importance of science and the role it plays in society. The use of technology in ordinary human concerns It is necessary to include science and technology in the process. The civic, personal, social, and economic components of life, as well as the moral and ethical aspects of life, are all covered.

Advantages of project-based learning assessment

Terms such as "authentic learning activity" and "hands-on learning" are widely used to describe constructivist learning, which argues that learning can only be accomplished through rigorous, meaningful, and hands-on practice.

Zhang (2021), When learning and applying knowledge, case studies, business simulations, seminars and lectures, and textbooks relevant to the subject matter are all effective methods of learning and application. In order for students to practice complex real-world project management and deal with genuine obstacles, it is vital that they have access to resources that will assist them. Authentic project-based learning (APBL) is an active educational method that necessitates the provision of genuine solutions by the students. As a real-world educational method, authentic project-based learning (APBL) requires the involvement of real customers, real users, and real projects in the curriculum. Students' participation in problem-solving activities has been shown to improve motivation, student performance, and retention rates at all levels of education, including primary, secondary, and postsecondary levels of instruction. A marketing course was redesigned in response to the COVID-19 pandemic's impact on higher education. The APBL pedagogy and the Project Management Body of Knowledge Guide from the Project Management Institute were used to increase student interest and motivation while also compensating for the lack of direct face-to-face contact. For the purpose of providing an overview of the APBL course, this page describes how it was designed, implemented, and delivered during the fall semester of 2020. It is documented in the article how students utilized integrated brand promotion (IBP) methodologies as well as project management skills to advertise and produce a new ballet performance for audiences, which is also discussed in the report. There have been significant gains in a number of important learning objectives, including the maximization of students' learning, enhanced efficiency, and a significant decrease in the occurrence of "student syndrome" (procrastination). The current project comes to a close with a discussion of future research and teaching opportunities, as well as the limitations of the current effort.

Students in the Philippines did not fully comprehend the spiraling of competencies in science, according to the findings of a study conducted by Montebon (2014), which was administered to 216 students from purposefully selected public schools in Metro Manila. However, their findings suggest that students do not fully comprehend this change, with thirty percent of those who responded giving a neutral response. When students are not aware of this shift, they may be unable to appreciate how the concepts they are studying in scientific courses are related to one another. In terms of skill acquisition, educators should provide more opportunities for students to use indigenous materials or recycle methods in their scientific tasks, as the results of this study revealed that 29 percent of students are unaware of the significance of doing so. Furthermore, it is necessary to instill in pupils an understanding that the topics they are learning in science will be critical in their future careers, which should be considered.

Statement of the Problem

This study sought to develop Project-Based Learning assessment activities in Science classes. Specifically, it aimed to answer the following:

1. How may the development of project based assessment be described in the following stage:
    - 1.1 analysis;
    - 1.2 design;
    - 1.3 development;
    - 1.4 evaluation?
2. How do the science education expert evaluate the project based assessment in terms of:
    - 2.1 objective;
    - 2.2 content;
    - 2.3 graphical;
    - 2.4 evaluation activities; and
    - 2.5 consistency?

3. What are the recommendations and suggestions of the experts in the development of project-based activities?

METHODOLOGY

Research Design

The study used research-based development's educational research and development (R and D) method. R and D bridge the gap between research and practice. It takes the findings generated by basic and applied research to develop products ready for operational use in schools. R and D increase the potential impact of translating them into usable educational products like curriculum, a particular teacher-training program, a textbook, or an audio-visual aid.

The ADDIE-adapted model is utilized. It is one of the models for systematic learning design that was selected after considering that it was created methodically and is based on the theory of learning design. This model is organized and programmed with sequences of systematic activities. There are five steps in the original ADDIE model: (1) analyze; (2) design; (3) development; (4) implementation; and (5) evaluation. In this study, the modified ones were used in the absence of an implementation phase.

Research Locale

The study was conducted in the School District of General M. Natividad, Nueva Ecija. The following were the public secondary schools where the respondents were stationed: Azarcon Integrated School, Talabutab Norte National High School, Mataas Na Kahoy National High School, Eduardo L. Joson Memorial High School, General Mamerto Natividad National High School, and Virginia Dulay Integrated School.

Respondents

Respondents were 30 junior high school science teachers from public secondary schools in the Municipality of Gen. M. Natividad in the school year 2021-2022.

Table 1
The Respondents

Respondent Schools	Number of Respondents
Azarcon Integrated School	1
Mataas Na Kahoy national High School	3
Talabutab Norte National High School	4
Eduardo L. Joson Memorial High School	6
Virginia Dulay Integrated School	2
General Mamerto Natividad National High School	14
Total	**30**

The respondents consisted of 21 female teachers and 9 male teachers. Respondents consist of 8 teachers within the age bracket of 36 to 39 years old; 6 teachers were 28–31, 32–35, and 40–43 years old; and the least comprising 4 are those within 24-27 years old.

Thirteen of the respondents have already earned master's degree units, 11 have graduated with a master's degree; five (5) are bachelor's degree graduates, and one (1) has Phd/EdD units. The respondents are ranked from teacher I up to Head Teacher III. There were ten (10) Teacher I, ten (10) Teacher II, eight (8) Teacher III, one (1) Master Teacher I, and one (1) Head Teacher I.

Sampling Procedure

In total population sampling, a researcher decides to analyze the total population that shares one or more characteristics with them. Self-purposive sampling, also known as selective sampling, is a non-probability sampling approach that is used to pick samples for a specific purpose. Respondents in this study were the Science teachers from the six (6) public junior high schools in the District of General Mamerto Natividad, Nueva Ecija.

Data Gathering Procedure

The researcher developed a rating scale that she gave to each respondent. In gathering the data, the researcher carried out the following procedure:

A request letter was sent to the Schools Division Office of Nueva Ecija to ask permission to conduct the proposed study. Another request letter was sent to the school heads to ask permission to conduct the proposed study. The researcher distributed the questionnaire to the respondents personally with the approval of the school head.

The researcher utilized Google Forms to collect the information she required from respondents who could not come to her office in person. However, for those respondents who lived in close proximity to her, the researcher physically visited them, ensuring that all health and safety regulations were followed.

Validity and Reliability

The content validity of the questionnaire was determined through consultations with the researcher's adviser and her statistician. Likewise, the suggestions of the panel of examiners were considered and incorporated into the final draft of the questionnaire.

Permission was sought from the school division office to administer the instrument to the six (6) schools' 30 Science teachers, who were the identified respondents to the study. The researcher personally handed the respondents the questionnaire and requested that they answer all the items and questions contained therein as truthfully as possible. She likewise assured them that the data to be generated would be for research purposes only and that the utmost confidentiality of their responses would be observed. The assessment of the developed instrument was based on the degree of agreement with the statements describing the components of the instrument given by the Science teachers.

Research Instrument

To determine the behavior of the respondents in using project-based learning methods in the Science subject, the rating scale contained items intended to assess the developed project-based assessment activities. The researcher developed a rating scale, and the tools are divided into two parts. The first part was designed to describe the project-based assessment activities. The second part of the rating scale described the scoring of the project-based learning activities.

Data Management and Analysis

The graduate school dean and the researcher's advisor both signed a request letter that the researcher wrote. The letter is addressed to the School Head of the respondents' school. Upon approval, the researcher retrieved the letter and submitted a request letter to the identified respondents. The researcher personally approached the target respondents and explained the study. The researcher also demonstrated that their cooperation meant a lot for the study's success. The study employed frequency distribution and averages to describe the project-based learning activities.

Specifically, this study utilized the following:

Cronbach's Alpha Measure of Reliability was used to test the instrument's internal consistency for this study.

Percentage and **Frequency Count** were used to describe the respondents in each school.

Weighted Mean was used to describe the frequency of behavior with project-based assessment activities. The collected data were tabulated and processed using Statistical Packages for Social Sciences (SPSS). In order to analyze and interpret the data gathered, the following statistical measures were used:

RESULTS AND DISCUSSION

Development of Project-Based Activities

The development of Project-Based Activities was based on the ADDIE model developed by the Center of Educational Technology, which has five steps specifically: Analysis, Design, Development, Implementation, and Evaluation. Essentially, the study adapted the ADDE model covering Analysis, Design, Development, and Evaluation. These stages were utilized in the process of designing and developing the project-based learning activities. Figure 2 shows the ADDE model framework.

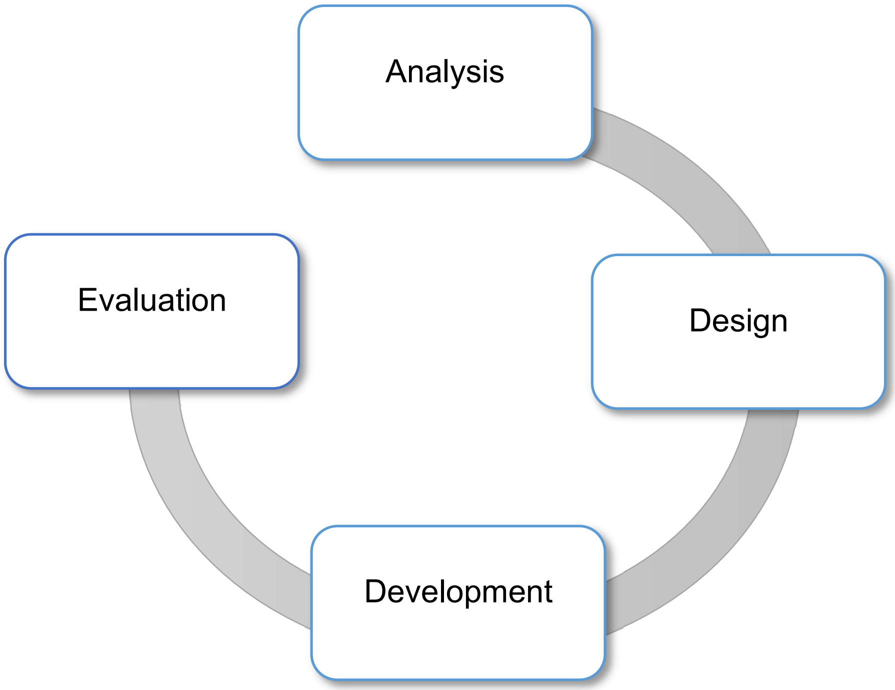

Figure 2. ADDE model

Analysis Stage

In the analysis stage, before the development of the project-based activities, there were steps included in the analysis stage, including the basis of the project-based activities. In this phase, the least learned competencies were identified first by the researcher from the examination taken by the grade 10 junior high school from the respondent schools during the school year 2020-2021 in science in four (4) quarters, whereas the competencies that ranked as the least learned items were determined and listed as the target learning competencies that are included as project-based learning competencies. The table below shows the two (2) least learned competencies in each quarter identified by the researcher, the given content standard, and the performance standard in the science curriculum in grade 10 in four quarters.

The Most Essential Learning Competencies (MELCs) were developed by the Department for use by field implementers and private schools throughout the country from School Year 2020-2021. The department will be able to concentrate teaching on the skills that students need to master. It also sheds light on the challenge of transforming learning materials geared for in-person instruction into those that are suitable for distance learning. Additionally, the MELCS needs to help the schools make the most of the few available school days as they use various delivery methods by giving them enough classroom space.

Table 2 shows the Most Essential Learning Competencies (MELCs).

Table 2. *Most Essential Learning Competencies (MELCs)*

Quarter/ Lesson	Content Standard	Performance Standards	Most Essential Learning Competencies
First Quarter/ Earth Science	*The learners demonstrate an understanding of* the relationship among the locations of volcanoes, earthquake epicenters, and mountain ranges	The learners should be able to suggest ways by which he/she can contribute to government efforts to reduce damage due to earthquakes, tsunamis, and volcanic eruptions	Describe and relate the distribution of active volcanoes, earthquake epicentres, and significant mountain belts to Plate Tectonic Theory.**(S10ES-Ia-j-36.1)**
	The learners demonstrate an understanding of the relationship among the locations of volcanoes, earthquake epicenters, and mountain ranges	The learners should be able to suggest ways by which he/she can contribute to government efforts to reduce damage due to earthquakes, tsunamis, and volcanic eruptions	Describe the possible causes of plate movement **(S9E-Ia-j36.6)**
Second Quarter-Physics	The learners demonstrate an understanding of the different regions of the electromagnetic spectrum		Cite examples of practical applications of the different regions of EM waves, such as radio waves in telecommunications. ***(S10FE-IIc-d-48);*** Explain the effects of EM radiation on living things and the environment (S10FE-IIe-f-49)

Third Quarter-Biology	The learners demonstrate an understanding of how changes in a DNA moleculemay cause changes in its product mutations that occur in sex cells as being heritable	The learners should be able to write an essay on the importance of adaptation as a mechanism for the survival of a species	Explain how mutations may cause changes in the structure and function of a protein (S10LT-IIIe-38)
	The learners demonstrate an understanding of how changes in a DNA moleculemay cause changes in its product mutations that occur in sex cells as being heritable	The learners should be able to write an essay on the importance of adaptation as a mechanism for the survival of a species	Explain the occurrence of evolution
Fourth quarter-Chemistry	The learners demonstrate understanding of the structure of biomolecules, which are made up mostly of a limited number of elements, such as carbon, hydrogen, oxygen, and nitrogen	using any form of media, present chemical reactions involved in biological and industrial processes affecting life and the environment	Recognize the significant categories of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids.
	The learners demonstrate understanding of the structure of biomolecules, which are made up mostly of a limited number of elements, such as carbon, hydrogen, oxygen, and nitrogen	using any form of media, present chemical reactions involved in biological and industrial processes affecting life and the environment	Explain how the factors affecting rates of chemical reactions are applied in food preservation and materials production, fire control, pollution, and corrosion

Design

After the analysis stage, activity continued in the design phase, creating an overall blueprint of the project-based activities. In this stage of the development of project-based activities in learning science, the researcher includes an essential question, planning, scheduling, monitoring, assessment, and evaluation. These components must be adaptable to the teacher's specific needs. Specifically, the design of the project-based activities was as follows:

Setting objectives to help teachers guide student inquiry, allow students to practice critical thinking skills as they engage in mental debate, and ensure that students retain key concepts, beliefs, values, and comprehension from a unit they can apply to their study of other subjects.

Understanding the essential questions that guide students through the basic content of the project and the need to answer them at the end of the project output The project-based activities were meticulously designed, with goals and objectives linked to the Department of Education's content standards, performance standards, and most fundamental learning skills. The beginning portion of each exercise centered on a project would provide students with a pointer to the lesson they had previously discussed with their instructor.

The project-based activities have a daily timetable; each day, the students would be tasked with completing one job or a series of tasks that would bring them closer to achieving their ultimate objective. The project-based learning exercises were created with the guidance that students should constantly assess their progress while completing the project. The progress of the students' project will be monitored by checking a copy of the project schedule with the teacher.

Assessment. The project-based activities' assessment would be based on the achieved objectives monitored and observed by the teachers.

Evaluation. There were rubrics to be utilized to assess project-based activities to determine the authenticity and significance of the student's work. Following the assessment session, students will reflect.

Development

In this stage, developing project-based activities in science integrates the essential elements discussed in the design stage, including objectives, content questions, a project timeline, materials needed, assessment, evaluation, and rubrics for scoring. The project-based activities would cover modalities of learning, from the conventional classroom to virtual and blended modalities. The developed project-based learning activities in science were designed to assess skills that could be given prior to the discussion of the lesson or in the middle of the unit to provide ample time to prepare the students and anticipate their needs.

Objectives were identified for every project-based activity based on the given content standard, performance standards, and essential learning competencies discussed in the analysis stage. The first quarter, as identified in the curriculum as a unit for Earth Sciences, comprises two (2) activities entitled "Earthquake: Detection Method and Techniques" (Activity 1) and "Modeling Earth's Movement" (Activity 2). These were The second quarter, which is about Physics has two (2) project-based activities entitled "EM Waves" (Activity 1) and "I am Exposed to EM" (The third quarter about Biology has two (2) developed project-based activities entitled "Mutation Blog" (Activity 1) and "Evolution, how is it". The quarter four of Science project-based activities were about Chemistry entitled "My Diet Plan" (Activity 1) and "Chemical Reaction: How Is That?" The objectives were defined properly and carefully to ensure they aligned with the subject's essential learning competencies, the level of skills of the students, and the other parts of the project-based activities.

Evaluation

In the evaluation stage of the project-based activities, the researcher utilizes a questionnaire sent to teacher respondents. The assessment phase assesses the effectiveness of the project-based activities to gain in-depth knowledge of the project-based activities. Parameters were categorized according to objectives, content, graphical presentation, assessment activities, and consistency.

Evaluation of Project-Based Activities

The 30 teacher-respondents from six (6) public junior high schools in the district of General Natividad evaluated the project-based learning science activities as to objectives, content, graphical presentation, assessment activities, and consistency.

Objectives

Table 3 shows the distribution of the parameters according to the evaluation of project-based learning activities in Science as to Objectives.

The presented data show the evaluation of project-based learning activities in terms of objectives. According to the respondents' evaluations of the objectives presented in each developed activity, Biology Activity No. 2 objective "The project describes how fossil records, comparative anatomy, and genetic information provide evidence for evolution" has the highest mean of 3.87 (SD = 0.35), while three items have ranked second with a mean of 3.80 (SD = 0.41), these are "The activity caters to the quarter's performance standards: demonstrate ways to ensure disaster preparedness during earthquakes, tsunamis, and volcanic eruptions (Earth Science Activity No 1)," "The project investigates the pieces of evidence of the Continental Drift Theory (Earth Science Activity No. 2)", and "Describe a technology or behavior that can be used to protect or decrease exposure to electromagnetic waves (Physics Activity No. 1). The objectives that ranked third were "The project explains the effects of EM radiation on living things and the environment (Physics Activity No. 1),", "The project explains how mutations may cause changes in the structure and function of a protein through research-based materials (Biology Activity No. 1)", and "The project explains how the factors affecting rates of chemical reactions are applied in food preservation and materials production, fire control, pollution, and corrosion (Chemistry Activity No. 1)," both with a mean of 3.77 (SD = 0.43). The objective with the lowest mean was "The project recognizes the vital role of biomolecules in our lives—Chemistry Activity No. 1," with a mean of 3.73 (SD = 0.45). All the objective parameters have a verbal description of strongly agree.

Table 3. *Evaluation of Project-based Learning Activities in Science as to Objectives*

Parameters	Mean	SD	Verbal Description
The activity caters to the quarter's performance standards: demonstrate ways to ensure disaster preparedness during earthquakes, tsunamis, and volcanic eruptions-Earth Science Activity No. 1	3.80	0.41	Strongly Agree
The project investigate the pieces of evidence of the Continental Drift Theory-Earth Science Activity No. 2	3.80	0.41	Strongly Agree
Describe a technology or behavior that can be used to protect or decrease exposure to electromagnetic waves-Physics Activity no 1.	3.80	0.41	Strongly Agree
The project explains the effects of EM radiation on living things and the environment Physics Activity No. 1	3.77	0.43	Strongly Agree
The project explains how mutations may cause changes in the structure and function of a protein through research-based materials. Biology Activity No. 1	3.77	0.43	Strongly Agree
The project describes how fossil records, comparative anatomy, and genetic information provide evidence for evolution Biology Activity No. 2	3.87	0.35	Strongly Agree
The project recognizes the vital role of biomolecules in our life. Chemistry Activity No. 1	3.73	0.45	Strongly Agree
The project explains how the factors affecting rates of chemical reactions are applied in food preservation and materials production, fire control, pollution, and corrosion. Chemistry Activity No. 1	3.77	0.43	Strongly Agree

**Legend: 1.00 – 1.74 Strongly Disagree; 1.75 – 2.49 Disagree; 2.50 – 3.24 Agree; 3.25 – 4.00 Strongly Agree*

The respondents were convinced that the set objectives were appropriate, as they strongly agreed in their assessment. The result indicates that the activity will be highly effective as a project-based learning activity in Grade 10. It would certainly benefit the students due to the constructed objectives based on the most essential learning competencies of the curriculum. The respondents may have modified or revised objectives according to the goal of their planned lesson if needed, but they are nonetheless thoroughly interrelated to the competencies of the lesson. Thus, in the study by Kokotsaki (2016), an active, student-centered education style characterized by students' autonomy, constructive inquiries, goal-setting, cooperation, communication, and reflection while engaged in real-world practices and scenarios reflects the nature of the project-based activity.

Content

Table 4 shows the distribution of the parameters according to the evaluation of project-based learning activities in Science as to Content.

Table 4. *Evaluation of Project-based Learning Activities in Science as to Content*

Parameters	Mean	SD	Verbal Description
The activity demonstrates concepts of the relationship among the locations of volcanoes, earthquake epicentres, and mountain ranges (Earth Science Activity No. 1)	3.63	0.49	Strongly Agree
The activity is related to the distribution of active volcanoes, earthquake epicenters, and significant mountain belts to Plate Tectonic Theory (Earth Science Activity No. 1)	3.80	0.41	Strongly Agree
The project demonstrate the evolution of the oceanic crust through Sea Floor Spreading. (Earth Science Activity No. 2)	3.77	0.43	Strongly Agree
The project describes the possible causes of plate movement (Earth Science Activity No. 2)	3.80	0.41	Strongly Agree
The project explains the effects of electromagnetic radiation on living things and the environment (Physics Activity No. 1)	3.75	0.45	Strongly Agree
The project cited examples of practical applications of the different regions of EM waves, (Physics Activity No. 2)	3.77	0.43	Strongly Agree
The project explains the effects of EM radiation on living things and the environment (Physics Activity No. 2)	3.73	0.45	Strongly Agree
The project explains the relationship between population growth and carrying capacity Biology Activity No. 2	3.87	0.35	Strongly Agree
The project explains the chemical structures of carbohydrates, lipids, protein, and nucleic acid through essential questions. Chemistry Activity No. 1	3.83	0.38	Strongly Agree
The project describes the local uses of chemical reactions (Chemistry Activity No. 1)	3.77	0.43	Strongly Agree

**Legend: 1.00 – 1.74 Strongly Disagree; 1.75 – 2.49 Disagree; 2.50 – 3.24 Agree; 3.25 – 4.00 Strongly Agree*

The presented data show the evaluation of project-based learning activities as to content. According to the respondents' evaluations of the content presented in each developed activity, the item that has highest mean "The project explains the relationship between population growth and carrying capacity (Biology Activity No. 2)" with mean of 3.87 (SD=0.35), the second highest mean was "The project explains the chemical structures of carbohydrates, lipids, protein, and nucleic acid through essential questions (Chemistry Activity No. 1) with a mean of 3.83 (SD = 0.38), while the items that ranked third were "The activity is related to the distribution of active volcanoes, earthquake epicenters, and significant mountain belts to Plate Tectonic Theory (Earth Science Activity No. 1)", "The project describes the possible causes of plate movement-Earth Science Activity No 2", both content have mean of 3.80 (SD=0.41). Moreover, the parameters that have a mean of 3.77 (SD = 0.43) were "The project demonstrated the evolution of the oceanic crust through sea floor spreading (Earth Science Activity No. 2),", "The project cited examples of practical applications of the different regions of EM waves (Physics Activity No. 2)", and "The project describes the local uses of chemical reactions (Chemistry Activity No. 1)." . The content that has a mean of 3.75 (SD = 0.45) is "The project explains the effects of electromagnetic radiation on living things and the environment (Physics Activity No. 1)," while the parameter "The project explains the effects of EM radiation on living things and the environment (Physics Activity No. 2)" has a mean of 3.73 (SD = 0.45), and the parameter that has the lowest mean among all parameters is "The activity demonstrates concepts of the relationship among the locations of volcanoes, earthquake epicentres, and mountain ranges (Earth Science Activity No. 1)" has a mean of 3.63 (SD = 49).

Respondents highly agreed with the assessment of the content of project-based learning activities; they saw the statements as applicable to the lessons in the developed project-based activities. These materials provide students with a foundation for specific claims and scopes. The contents of the project-based activities would provide an overview of the activity's direction and specifics, in addition to providing information about the project and its scope. The contents of the project-based activities would provide an overview of the activity's specifics and directions, in addition to providing information about the project itself.

According to the results, the item with the highest mean, "The project explains the relationship between population growth and carrying capacity" (Biology Activity No. 2), and the item with the second-highest ranking, "The project explains the chemical structures of carbohydrates, lipids, protein, and nucleic acid through essential questions" (Chemistry Activity No. 1), are perceived to have high potential in Science, possibly due to their clarity and application of the topic.

The result indicates that content that may be utilized as both an integration and skill-based activity is necessary for simulating student comprehension. Identifying the same action that develops students' understanding of empathy in the topic is essential and must be tailored to meet the requirements of each student. It affirmed the study of Ardianto et al. (2016) that guided exploration and problem-based learning content both have the potential to increase students' scientific literacy.

Graphical presentation

Table 5 shows the distribution of the parameters according to the evaluation of project-based learning activities in Science as to graphical presentation.

Based on the presented data, the evaluation of the developed project-based learning activity in Science as to graphical presentation, the item that ranked first was "Classify reactions according to the different types (Chemistry Activity No. 2)," which has the highest mean of 3.87 (SD = 0.35), and the item that has the second highest mean is "The project shows the importance of chemical reactions to industrial applications (Chemistry Activity No. 2)" with a mean of 3.93 (SD = 0.35), and the third highest mean were "The project provided simple activities that helped the student understand the major categories of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids (Chemistry Activity No. 1)" and "The project explains the occurrence of evolution through research-based materials-Biology Activity No. 2" with a mean of 3.77 (SD = 0.43). "The project recognizes the utilization of technology with creativity (Biology Activity No. 1)" and "The project cited examples of practical applications of the different regions of EM waves (Physics Activity No. 1)," which ranked as the fourth highest mean, have 3.73 (SD = 0.47), while "The project compares the relative wavelengths of different forms of electromagnetic waves (Physics Activity No. 1)" and "The project illustrates the way to identify the kinds of chromosomal mutations (Biology Activity No. 1)" have a mean of 3.70 (SD = 0.47) and 3.63 (SD = 0.49), respectively.

Table 5. *Evaluation of Project-based Learning Activities in Science as to Graphical Presentation*

Parameters	Mean	SD	Verbal Description
The project compares the relative wavelengths of different forms of electromagnetic waves ((Physics Activity No. 1)	3.70	0.47	Strongly Agree
The project cited examples of practical applications of the different regions of EM waves. Physics Activity No. 1)	3.73	0.47	Strongly Agree
The project illustrates the way to identify the kinds of chromosomal mutations Biology Activity No. 1	3.63	0.49	Strongly Agree
The project recognizes the utilization of technology with creativity. Biology Activity No. 1	3.73	0.45	Strongly Agree
The project explains the occurrence of evolution through research-based materials Biology Activity No. 2	3.77	0.43	Strongly Agree
The project provided simple activities that helped the student understand the major categories of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids. Chemistry Activity No. 1	3.77	0.43	Strongly Agree
The project shows the importance of chemical reactions to industrial applications. Chemistry Activity No. 2	3.83	0.38	Strongly Agree
Classify reactions according to the different types. Chemistry Activity No. 2	3.87	0.35	Strongly Agree

**Legend: 1.00 – 1.74 Strongly Disagree; 1.75 – 2.49 Disagree; 2.50 – 3.24 Agree; 3.25 – 4.00 Strongly Agree*

The result shows the evaluation of project-based learning activities in Science as to graphical presentation. Teacher-respondents strongly agreed that the parameters have a clear graphical presentation and provide a clear picture of the entire project. The hierarchy of all the work that has to be done is shown in the activities. Project-based learning activities were designed to educate students on how to work creatively and methodically and offer them evaluation. The researcher thought those techniques denoted purpose, facilitating and improving learning, understanding the content, being flexible in nature, and supporting creative, personalized, and more engaging presentations. The actual output of the project-based activities was expected to be in the form of graphics, drawings, tables, and concept maps. It could, however, be related to the price of resources and labor.

Classify reactions according to the various types (Chemistry Activity No. 2) and "The project highlights the relevance of chemical reactions to industrial applications" were the two project-based activities with the highest mean for graphical presentation. "Chemistry Activity No. 2" and "Chemistry Activity No. 2" explain how a project-based activity that produces visuals will have a greater impact on students' and teachers' interest. The value of project-based learning for students' self-development and skill development would be acknowledged. According to Lasauskienea and Rauduvaite (2015), project preparation and presentation are ways that pedagogical technologies are used to move towards interactive learning environments. Hence, the perceived effectiveness of the graphical presentation of project-based learning activities may motivate students to concentrate more on enhancing their knowledge and performance abilities.

Evaluation Activities

Table 6 shows the distribution of the parameters according to the evaluation of project-based learning activities in Science as to evaluation activities.

Table 6 shows the distribution of the respondents according to the assessment of the developed project-based learning activities in Science as to evaluation activities, where the item that has the highest mean was "The project describes the plate movement in a simulated manner" (Earth Science Activity No. 2) with a mean of 3.90 (SD = 0.31), which ranked as strongly agreed among the parameters of evaluation activities. The second highest mean was "The activity suggests ways by which students can contribute to government efforts to reduce damage due to earthquakes, tsunamis, and volcanic eruptions" (Earth Science Activity No. 1), with a mean of 3.83 (SD = 0.38), while the third parameter had a mean of 3.77 (SD = 0.43), "The project was informative in nature that helped students as decision-makers" (Chemistry Activity No. 1). The two parameters with the least mean of 3.73 (SD = 0.45) and 3.72 (SD = 0.45) were "The project determines that chemical reactions are associated with biological and industrial processes affecting life and the environment "(Chemistry Activity No. 2) and "The project explains how species diversity increases the probability of adaptation and survival of organisms in changing environments" (Biology Activity 2).

The two that ranked highest as to the evaluation activities were "The project describes the plate movement in a simulated manner" (Earth Science Activity No. 2) and "The activity suggests ways by which students can contribute to government efforts to reduce damage due to earthquakes, tsunamis, and volcanic eruptions." (Earth Science Activity No. 1) indicates that the teacher-respondents may believe that these evaluation activities have specific activities that may be performed effectively in the classroom or distance learning modality. Students in grade 10, in particular, have the ability to merge their technical talents into the production of innovative and exceptional projects that serve as models for lower grade levels. Sumarni et al. (2016) found that 85 percent of students' mastery of learning is based on concept understanding and psychomotor elements when utilizing project-based approaches.

Table 6. *Evaluation of Project-based Learning Activities in Science as to Activities*

Parameters	Mean	SD	Verbal Description
The activity suggests ways by which students can contribute to government efforts to reduce damage due to earthquakes, tsunamis, and volcanic eruptions Earth Science Activity No. 1	3.83	0.38	Strongly Agree
The project describes the plate movement in simulated manner Earth Science Activity No. 2	3.90	0.31	Strongly Agree
The project explains how species diversity increases the probability of adaptation and survival of organisms in changing environments Biology Activity No. 2	3.72	0.45	Strongly Agree
The project was informative in nature that helped students as decision-makers Chemistry Activity No. 1	3.77	0.43	Strongly Agree
. The project determines that chemical reactions were associated with biological and industrial processes affecting life and the environment Chemistry Activity No. 2	3.73	0.45	Strongly Agree

**Legend: 1.00 – 1.74 Strongly Disagree; 1.75 – 2.49 Disagree; 2.50 – 3.24 Agree; 3.25 – 4.00 Strongly Agree*

Consistency

Table 7 shows the distribution of the parameters according to the evaluation of project-based learning activities in Science as to consistency.

Table 7 shows the distribution of the respondents according to the assessment of the developed project-based learning activities in Science as to consistency, where the parameter with the highest mean of 3.87 (SD = 0.35) was "The project promotes decision-making skills" (Physics Activity No. 2). The second highest, with a mean of 3.83 (SD = 0.38), was "The project promotes technological and environment-friendly activities" (Chemistry Activity No. 1), and the third was "The skills shown in the activity are appropriate for grade 10 learners" (Earth Science Activity No. 1), with a mean of 3.80 (SD = 0.41).

According to the results, the two highest ranks in consistency as perceived by the teachers, "The project promotes decision-making skills" (Physics Activity No. 2) and "The project promotes technological and environment-friendly activities" (Chemistry Activity No. 1), indicate that consistent

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critical thinking and skilled decision-making contribute to the advancement of technology and environmental consciousness.

Table 7. *Evaluation of Project-based Learning Activities in Science as to Concisitency*

Parameters	Mean	SD	Verbal Description
The skills shown in the activity are appropriate for grade 10 learners. Earth Science Activity No	3.80	0.41	Strongly Agree
The project shows the importance of the seafloor spreading process relative to the Continental Drift Theory. Earth Science Activity No 2	3.77	0.43	Strongly Agree
The project promotes decision-making skills (Physics Activity No. 2)	3.87	0.35	Strongly Agree
The project promotes awareness of the environment	3.80	0.41	Strongly Agree
The project describes behavior toward environmental conditions. (Physics Activity No. 2)	3.70	0.47	Strongly Agree
The project value the significant understanding of genetic mutation and how it may affect one's life. Biology Activity no 1	3.70	0.47	Strongly Agree
The project promotes critical thinking Biology Activity no 1	3.73	0.45	Strongly Agree
The project describes an ecosystem as being capable of supporting a limited number of organisms (Biology Activity no 1)	3.67	0.48	Strongly Agree
The project promotes technological and environment-friendly activities Chemistry Activity No 1	3.83	0.38	Strongly Agree

**Legend: 1.00 – 1.74 Strongly Disagree; 1.75 – 2.49 Disagree; 2.50 – 3.24 Agree; 3.25 – 4.00 Strongly Agree*

CONCLUSIONS

Based on the findings of this study, the following conclusions were drawn:

1. The developed project-based learning activities in Science were founded on four stages: Analysis, Design, Development, and Evaluation.

2. The developed project-based learning activities were believed to be effective, as the teachers strongly agreed with the parameters stated for each category.

3. The designed Science project-based learning activities were verified based on the evaluative ideas and recommendations of the validators.

4. The recommendations and suggestions of the validators were incorporated into the development of project-based activities for learning Science.

Conflict of Interest

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