Journal of Contemporary Educational Research, 2024, Volume 8, Issue 12
http://ojs.bbwpublisher.com/index.php/JCER
ISSN Online: 2208-8474
ISSN Print: 2208-8466

Science Skill-Based Activities for Senior High School Students

Norman Ruelo Marquez[1,2]*

[1]Senior High School, Bauan Technical High School, Pedro Munoz Street, Bauan, Batangas, Philippines
[2]Kauai High School Lualima St. Lihue, Hawaii 96766, United States

***Corresponding author:** Norman Ruelo Marquez, marquez.norman27@gmail.com

Abstract: Science enables students to seek knowledge and practice relevant scientific processes to provide meaningful solutions or information that can contribute to the development of society. This study aimed to create a science learning activity for senior high school students that integrates learning skills in science such as information retrieval, scientific reading, data representation, scientific writing, and knowledge presentation. The subjects of this study, which was employed through purposive sampling, were Grade 12 STEM students and Science teachers from Batangas' 2nd Congressional District-Area II. Documentary analysis was used to analyze the least mastered competencies in earth science, general biology, general chemistry, and general physics. An interview was also used to reinforce the data collection and analysis. The content's relevancy influences the students' attitudes and interests, the teachers' teaching tactics, and the opportunity to learn collaboratively. The student's learning skills in science were honed by the learning activities provided by their teacher. However, the students' data representation and knowledge presentation skills must be strengthened. Different pedagogical considerations may be emphasized in developing a learning activity to boost student engagement and achieve a better learning experience.

Keywords: Science learning competencies; Attitudes and interest of STEM; Learning skills in science; Pedagogical consideration

Online publication: December 31, 2024

1. Introduction

Education currently faces numerous challenges confronted by circumstances that shocked not only the country but all nations worldwide [1]. As truthfully as it gets, education plays a vital role in every generation, considering the fact that people have various lifestyles, work, principles, and technological inclinations. Targeting holistic development, education should provide platforms and diverse fields where knowledge can be applied in all walks of life, from person to person at varying levels [2,3].

Science is a fundamental body of knowledge that has transformed people's beliefs, practices, way of life, and quality of life dramatically [4–6]. As a learning area, it frames cognitive skills in the open-ended discovery

of facts and the generation of new knowledge. It is intended to educate students for life in a multifaceted world with a relentless quest for scientific and technological advancement.

In the real scenario, there is a necessity to improve the Philippines' science and technology as it is one of the demands of socio-economic growth in the modern world. As reported by the Second International Science Study (SISS) and the 2019 Third International Mathematics and Science Study (TIMSS), they pointed out that there is a remarkable decline in the country's meeting global standards concerning science as an academic discipline. As a result, in the recently concluded assessment initiated by the Programme for International Student Assessment, it is noted that the country is at the tail end among other countries worldwide [1].

In line with this, Learning Skills in Science (LSS) has put teachers and practitioners' positive challenges into modernizing strategies, resulting in new pedagogical perspectives and assessment tasks. These skills are the result of the basic science process skills, which include observing, classifying, predicting, inferring, measuring, and communicating. At present, scientific literacy as mandated by the K-12 Basic Education Program demands the acquisition of relevant skills for critical and creative thinking. Within the spectrum of the program, students are pushed to become problem solvers. Also, LSS such as information retrieval, listening and observing, scientific reading, data representation, scientific writing, and knowledge presentation have emerged and influenced the way science classroom instruction should be delivered.

Under the umbrella of these pedagogical discussions, the development of science skills-based activities is rooted in the observations and experiences of STEM students about science learning activities and instruction. It cannot be denied that there is a demand for greater acquisition of science learning among STEM students, hence higher competencies are expected to be devoted and manifested. Students' learning skills in science are seemingly not in congruence with the competency standards of science literacy as such science skill-based activities are to be developed to remedy these predetermined academic challenges. The developed science skill-based activities will significantly give opportunities for teachers to recalibrate their science instruction while students are engaged in enhancing their science learning skills.

2. Objectives

This study aimed to develop learning activity sheets for Senior High School students of Batangas' 2nd Congressional District-Area II which integrated the learning skills in science. This study was guided by the following objectives.

1. Determine the least mastered competencies in the following areas: 1.1 earth science, 1.2 general biology, 1.3 general chemistry, and 1.4 general physics.
2. Describe senior high school students in terms of 2.1 attitude and 2.2 interest.
3. Assess the teaching-learning activities in science integrating the following skill areas: 3.1 information retrieval, 3.2 scientific reading, 3.3 data representation, 3.4 scientific writing, and 3.5 knowledge presentation.
4. Compare the assessments of students and teachers on the teaching-learning activities integrating Learning Skills in Science (LSS).
5. Determine the pedagogical considerations in evaluating learning activities.
6. Develop learning activities in science integrating the use of LSS.

3. Materials and methods

The study was conducted at a senior high school in the 2nd District. The respondents are Grade 12 students and teachers who both take the STEM strand (**Table 1**). They were gathered using purposive sampling. The study utilized the descriptive method. Survey questionnaires, interviews, and documentary analysis were used to collect the data. Its statistical treatment was a weighted mean and an independent *t*-test.

Table 1. Distribution of respondents

District	Number of respondents	
	STEM students	STEM teachers
A	41	8
B	89	17
C	35	9
D	20	4
E	67	12
Total	252	50

4. Results and discussion

4.1. Least mastered science competencies in science

4.1.1. Earth science

The least mastered competencies in earth science include explaining how heat from inside the Earth (geothermal) and from flowing water (hydroelectric) is tapped as a source, describing the changes in mineral components and texture of rocks due to changes in pressure and temperature (metamorphism), and describing how rocks behave under different types of stress such as compression, pulling apart, and shearing.

4.1.2. General biology

The least mastered competencies in general biology include describing the patterns of electron flow through light reaction events, describing the significant events of the Calvin Cycle, explaining the major features and sequence of chemical events of cellular respiration, distinguishing major features of glycolysis, the Krebs cycle, electron transport system, and chemiosmosis, and discussing the applications of recombinant DNA.

4.1.3. General chemistry

Explaining the enthalpy of a reaction, writing a thermochemical equation for a chemical reaction, and calculating the change in enthalpy of a given reaction using Hess Law are the least mastered competencies in general chemistry.

4.1.4. General physics

The least mastered competencies in general physics include deducing the consequences of the independence of vertical and horizontal components of projectile motion; calculating range, time of flight, and maximum height of projectiles; determining the potential energy stored inside the capacitor given the geometry and the potential difference across the capacitor; predicting the effects on the final potential difference and change in potential energy of a capacitor when either the geometry or charge is changed.

4.2. Senior high school students

4.2.1. Attitude

STEM student attitudes toward learning science may be extrinsically influenced, and more activities will be provided for learners to demonstrate an engaging attitude toward science learning. This assured that learners will never lose confidence in dealing with other relevant tasks in science class. This goes in parallel with the concept of a study [6]. According to the study, the science teaching and learning process should regard attitude as an important factor for the effective acquisition of learning. On the other hand, another study added that scientific attitudes can be enhanced or developed among learners if there are relevant scientific undertakings in the classroom that are supported by appropriate motivation, such as the result of the activities above, which are made known to students [5].

Students' responses agree that their attitude toward science is much affected by several functions, which include the quality of teaching and learning experiences being provided, the assessment tasks being used, and the kind of environment where science lessons are situated. These factors enable STEM students to develop a positive attitude toward science, resulting in improved performance and achievement. This result is a suggestion of the fact that science teaching should always be geared towards developing students' attitudes, for the students' attitudes have a crucial impact on their performance and mindset about science.

4.2.2. Interest

Students agreed that they are satisfied with participating in science class because the teacher uses a variety of teaching methods. The result of the assessments entails the effects of the methods used by the science teachers on the achievements of students in science. In science learning, student's interests can be mainly associated with engaging activities that stimulate their ability and capability to explore, innovate, and test the validity of their ideas and acquired knowledge when applied in real-life situations. This supports another study [2]. The study emphasized that one great factor for improved science learning is the development of an interest in hand in hand with varied strategies employed in the learning environment and context of the learners.

Generally, it can be said that the student's interest in science learning can be ultimately considered as an important tool in providing effective and quality-oriented science learning. The findings imply that student interest in science is at great heights when varied teaching approaches and methodologies are utilized by teachers, and when lessons and discussion are made relevant to the daily life interactions of the students. Also, they become more interested in science when there is fulfillment in everything that they do and when they find each activity and task significant to their desired work in the future.

4.3. Teaching learning activities in science integrating the skill areas

4.3.1. Information retrieval

The teacher respondents strongly agree that they integrate science activities that enable the students to save and find information whenever they work on a science activity. This only reflects that teachers demonstrate resourcefulness and initiative in finding information to support the teaching and learning process. They might find that students are eager to learn more when they see information to increase their knowledge of a specific topic. Also, the results revealed that the students feel more motivated when their teachers exert effort and update information other than what is available or those supplied by books. Significantly, this result reflects the insight of a study [7]. The study accentuated that teaching is a high-information career with rising transparency and success expectations.

The teacher and student respondents strongly agree that the teaching-learning activities in science that

integrate information retrieval as a science learning skill are those that include saving and finding information, finding information in books and other printed materials, choosing the right book or references, and finding answers from relevant websites.

4.3.2. Scientific reading

The teachers strongly agree that a think-pair-share activity may enhance the students' scientific reading skills. This activity may engage STEM students to become more engaged in exploring more learning methods. When the students share ideas and thoughts with other members of the class, they are likely to become interested in validating the ideas and concepts that others have shared through extensive reading. Learning science concepts proceeds in this way, from a collaborative exchange of learning experiences to a firm comprehension of specific areas or disciplines through reading.

This finding also suggests that other elements, such as the excitement that students feel while discussing ideas with others, may have an impact on their scientific reading abilities. This backs up an argument that participatory pedagogic concepts (groups, pairs) promote social connection, togetherness, and action-oriented communication [4].

The teacher and student respondents strongly agree that the teaching-learning activities in science that integrate scientific reading as a learning skill are those that include conducting think-pair-share. However, they both agree that providing materials within the student's level and interest is paramount. Designing games that enhance critical reading skills and vocabulary-building activities are also part of the teaching-learning activities that highlight scientific reading in science lessons.

4.3.3. Data representation

The process of creating graphs gives youngsters a meaningful way to express and explain essential mathematical relationships that are relevant to real-life situations. Students can match, group, and sort the objects, as well as establish connections between them. Students can also explain how items are similar and different. Furthermore, they can produce excellent results.

Furthermore, the result of the survey also gives rise to the significance of making a visual representation. As this is taken crucially, teachers and respondents strongly agreed that the type to be used should apply to the given data and concepts. Proper usage of visual representation is important. Their use in teaching and studying should bear a resemblance to their use in related practical practice, as diagrams are sense-making representations of complex situations. Furthermore, a study stated that science educators should be aware of why data visualization skills are important to their students and that they should provide them with a practical roadmap of how to use these skills effectively [8]. Students of science should have training or experience in data representation because a failure to have such will result in poor communication of scientific information, putting students at a disadvantage in terms of comprehension of important scientific knowledge.

Teacher and student respondents strongly agree that the teaching-learning activities in science which integrate data representation as a science learning skill are those that include utilizing various types of pictures, features, and tables in class presentation, making visual representations based on the concepts and data.

4.3.4. Scientific writing

These abilities are necessary for a career in science and must be honed. Rather than creating courses solely focused on writing, in which students write about their data, during breaks in experimental procedures, students

completed writing exercises and received feedback during the session.

The results of the assessments show that teaching students how to produce a practical research paper can help them improve their scientific writing skills, as can be seen in **Table 7**. This result is convincingly true. Making a practical research report can help students improve their reading and writing abilities. When students are taught how to write a research paper effectively, they can choose what things to look for in the document. This is in congruence with the ideas derived from a study that asserts that the research dimension contributes to a more comprehensive teaching environment in which students can investigate and evaluate the outcomes of integrating new thought processes [9]. Students should be taught how to search for facts and critically evaluate whether the information they find is relevant.

The teacher and student respondents agree that the teaching-learning activities in science that integrate scientific writing as a science learning skill are those that include writing a practical research paper, making a detailed scientific report, writing a summary abstract and review article, and making literature reviews.

4.3.5. Knowledge presentation

A presentation should be constructed methodically while maintaining a connection with all the previous stages of learning. In addition, an examination of how an intellectual individual's opinions, desires, and value assumptions can be conveyed in a simple, pictorial format suitable for automated thinking in artificial intelligence.

As the data indicates, one of the most frequently utilized methods of presentation during science activities is PowerPoint. This is demonstrated by the respondents' great agreement. It can be argued that teachers usually utilize PowerPoint due to its features that are quick and uncomplicated. Its features, which include a template, a transition, and an animation, can help make the presentation more compelling and engaging for the students. This is consistent with a study that discusses that PowerPoint presentations enable students to use images, audio, and video to enhance the visual appeal of the presentation [10,11]. This also helps them to present their ideas clearly and comprehensibly.

The teacher and student respondents strongly agree that the teaching-learning activities in science that integrate knowledge presentation as a science learning skills are those that include preparing a short presentation through PowerPoint presentations and making video presentations.

4.4. Difference between the assessments of teachers and students

The results of the test of significant differences between the teachers and students regarding the different teaching and learning activities. The analyses revealed from the table that there were no significant differences were shown for information retrieval, scientific reading, and scientific writing. However, significant differences in the assessments were found in data representation and knowledge presentation as science learning skills.

4.5. Pedagogical considerations in developing learning activities

Teachers play a vital role in students' learning and development. They have a responsibility to accommodate all of their students' differences; otherwise, learning will not take place. Teachers need to consider different pedagogical approaches to fulfill every student's needs. Students should be able to discover and maximize their potential to promote classroom engagement. Therefore, it is crucial to design and implement appropriate tasks for their levels, interests, and abilities. To achieve this, the teacher should give clear instructions to ease the students. It is also noteworthy to consider using a variety of presentations to meet every student's learning style. When a student feel acknowledged by their teachers, their attitude will improve. They will be more likely to

engage in future discussions, which can benefit the students' learning.

The teacher respondents strongly agree that the opportunities for learners to maximize their individual aptitudes, abilities, learning styles, and multiple intelligences. The appropriateness of the tasks given to students, the development of learners' critical and creative thinking skills, the clarity of directions and instruction for each activity, and the presentation of well-conceptualized graphs and other symbols were some of the pedagogical considerations practiced and observed to develop learning activities that nurture the science learning skills.

4.6. Developed learning activity sheets in science

Nowadays, education focuses on developing students' 21st-century competencies. From the foundational prerequisites of civic knowledge and rote learning, 21st-century skills demonstrate sufficiency in encouraging civic engagement. This implies that students are expected to contribute successfully as community members, to think critically, and to be sensitive and aware of the societal challenges they encounter in their everyday interactions. They are shaped to be effective problem solvers of social, political, and environmental concerns to contribute to the country's economic success by utilizing their 21st-century talents.

Aside from the activities already provided in the learning activity sheets, teaching-learning activities in science integrate skill areas needed for the students to develop. Subsequently, the learning activity sheets developed focus on strengthening the skills that the respondents find difficult to do. Various activities were designed to encourage students' interest and learning while they improved their science learning skills. Although these activities integrate scientific skills in different ways, they are all linked. Students can thoroughly assimilate the content by exposing them to a range of learning activities, which improves the quality of the learning experience. The objectives of the activities are to help the students acquire and develop science skills, gain an interest in earth science, general biology, general chemistry, and general physics, and foster a feeling of inquiry and responsibility. These activities are composed of different parts that are aligned with the learning skills in science (LSS) as information retrieval, scientific reading, data representation, scientific writing, and knowledge presentation. Teachers, on the other hand, can make modifications to the content of each activity. The learning activity sheets could be put together as part of a learning kit or incorporated into a learning module.

5. Conclusion

Based on the findings, the following conclusions were drawn.

The least mastered competencies in earth science, general biology, general chemistry, and general physics are those that require students to perform critical analysis and have conceptual abstractions.

The quality of the teaching experience, the learning activities used, and the classroom setting where science class discussions and activities are held all have a significant impact on STEM students' attitudes. STEM students are interested in science because of its relevance in the real world and their teacher's teaching strategies.

In science lessons, there are a variety of teaching and learning activities that can integrate the different learning science skills.

Differences in assessments were only observed in the teaching and learning activities that integrated data representation and knowledge presentation as learning skills in science.

Most of the important aspects of pedagogy were considered in evaluating learning activities developed to nurture learning skills in science.

The learning activities feature relevant scientific undertakings intended to develop the learning skills in

science of STEM students.

6. Recommendations

Based on the results of the assessment, the following recommendations are hereby presented.

The produced learning activities may be subjected to extra evaluation and analysis for content validation and reliability, as well as applicability testing before they are used.

The senior high school science curriculum may be incorporated by considering some emerging trends in learning skills in science.

Further research may be conducted focusing on the variables relevant to learning skills in science.

Disclosure statement

The author declares no conflict of interest.

References

[1] Organization for Economic Co-operation and Development (OECD), 2014, Beyond PISA 2015: A Longer-term Strategy of PISA.

[2] Juuti, K, Loukomies A, Lavonen J, 2013, Pupils' Views on Motivating Features of Inquiry Based Teaching, in Inquiry in Science Education and Science Teacher Education. Akademika Forlag, Trondheim.

[3] Krist CR, 2016, Meaningful Engagement in Scientific Practices: How Classroom Communities Develop Authentic Epistemologies for Science, thesis, Northwestern University.

[4] National Research Council, 2012, Division of Behavioral and Social Sciences and Education, Board on Science Conceptual Framework for New K-12 Science Education Standards. National Academies Press, Washington.

[5] Kelly-Jackson C, Jackson TO, 2011, Meeting their Fullest Potential: The Beliefs and Teaching of a Culturally Relevant Science Teacher. Creative Education, 2011(2): 408–413.

[6] Krapp A, Prenzel M, 2011, Research on Interest in Science: Theories, Methods, and Findings. International Journal of Science Education, 33(1): 27–50.

[7] Van Uum MSJ, Verhoeff RP, Peeters M, et al., 2015, Inquiry-based Science Education: Towards a Pedagogical Framework for Primary School Teachers. International Journal of Science Education, 38(3): 450–469.

[8] Diekema A, Olsen M, 2011, Personal Information Management Practices of Teachers. Proceedings of the American Society for Information Science and Technology, 48(1): 1–10.

[9] Hepworth K, Ivey CE, Canon C, 2019, Embedding Online, Design-focused Data Visualization Instruction in an Upper-division Undergraduate Atmospheric Science Course. Journal of Geoscience Education, 68(2): 168–183.

[10] Cleveland University, 2016, The Importance of Research to Students. https://www.cleveland.edu/blog-post/~post/the-importance-of-research-to-students-20160418/

[11] Bell K, 2014, What are Benefits of PowerPoint? http://smallbusiness.chron.com/benefits-powerpoint-55958.html